A Brief Glimpse At 2008

January
NTU President Dr Su Guaning and IIT-K Director Professor Sanjay Govind Dhande sign an MOU between NTU and Indian Institute of Technology Kanpur (IIT-K) for joint research and development (R&D) efforts as well as academic exchange of staff and students. IIT-K is one of the seven established Indian Institutes of Technology (IITs) that are internationally recognised for their technological prowess and world-class research.
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February
A high ranking delegation from the National Office for Research and Technology, Hungary (NKTH) visits NTU for a fruitful discussion on potential collaborations on research and development. NKTH plays a key role in the development and implementation of the Hungarian government’s science and technology policies.
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March
A patent titled “Sample Preparation Integrated Chip” was granted to the School of Mechanical and Aerospace Engineering (MAE). This patent is for a biochip platform technology for DNA analysis for applications in molecular diagnostics of diseases. It was developed for efficient consumption of reagents and high throughput diagnostics capability.
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April
A range of Interactive and Digital Media (IDM) efforts and applications being showcased at the inaugural NTU International Workshop on IDM Research. The Institute for Media Innovation (IMI) was also launched during the workshop. IMI is an initiative to take NTU’s efforts in IDM to the next level and serves as a common platform for interdisciplinary research.
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May
Regency Steel Asia Pte Ltd (RSA), one of Asia’s largest steel distributors, launches the RSA Fund at NTU, donating $1.5million to establish the Fund, which will promote the advancement of research and expertise on steel. The RSA Fund will also provide 2 scholarships and 2 bursaries on an annual basis.
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June
Participants at the 11th International Work Conference on Work Values and Behaviour hosted by NTU Nanyang Business School. The conference by the International Society for the Study of Work and Organisational Value (ISSWOOV) was held for the first time in Asia and featured a series of interactive sessions and research papers on management issues.
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July
NTU team wins the eINDIA 2008 award for the ‘Best ICT enabled University of the Year (Digital Learning Category)’ with their project “Digital Repository”. eINDIA 2008 was organised by the Centre for Science, Development and Media studies (CSDMS) and supported and co-organised by the Ministry of Information Communication Technology, Government of India and the United Nations Global Alliance of ICT for Development.
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August
Prints installed on the windows of the Alexandra Hospital Geriatric Ward as part of an art therapy project supervised by the School of Art, Design and Media (ADM) and University of the Arts, London (UAL). The project culminated with an exhibition titled “Creative Synergies” which was opened by the Director of the Design Singapore Council.
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September
Demonstration at the NTU – ST Kinetics Cold Spray Research Centre (CSRC), Southeast Asia’s first R&D facility for cold spray research. Officially opened on 5 September 2008, the CSRC is a state-of-the-art robotic-controlled joint research laboratory that taps the combined strengths of NTU and ST Kinetics to advance the application of leading-edge technology in the cold spray method.
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October
Mr Goh Geok Khim, Chairman of the Temasek Foundation, speaking at the launch of the Temasek Foundation Centre for Trade & Negotiations (TFCTN), S. Rajaratnam School of International Studies (RSIS). TFCTN is dedicated to improving the process of international negotiations, with a particular focus on increasing capabilities and access for developing states.
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November
School of Mechanical and Aerospace Engineering Professor awarded ASAIHL-Scopus Young Scientist Award. The ASAIHL - Scopus Young Scientist Awards are given annually to outstanding young scientists and researchers in Asia-Pacific who have made significant contributions to scholarship and research.
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December
Video Still from “Synchronicity”, one of the innovative outcomes of a project from the School of Art, Design and Media (ADM) that involved groups of people from differing backgrounds. Several pieces were shown at different exhibitions, and “Synchronicity” was selected for the International Santa Fe Film Festival.
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NTU broadens its vision by striking a new path with a multidisciplinary approach and keen focus on promoting pioneering research

NTU is an engineering based university, (indeed, it has one of the world’s largest engineering colleges) with an increasingly strong base in the natural sciences. To this one can add one of the best business schools in the region. It also covers the humanities, arts and social sciences and media/journalism, and so has the base to develop in exciting multi-disciplinary areas. 2008 has been a year of exciting development for the University as we are now becoming even more research-intensive and competitive, winning new sources of government support for two large scale research initiatives. The newly launched Earth Observatory of Singapore (EOS), which was awarded S$150 million by National Research Foundation (NRF) and Ministry of Education (MOE), is the region’s flagship institute for earth sciences research and innovation. We are also leading the field in water technology through the Nanyang Environment and Water Research Institute (NEWRI). Another area that we are focusing on is energy research and we are now moving ahead with our new Energy Research Institute at NTU (ERI@N) which provides a new platform for our research in this increasingly important sector. These initiatives demonstrate NTU’s continuing leadership in technology while transforming itself into a more broad-based academic institution. This Research Report 2008 will reveal more insights on notable research works accomplished throughout the year.

NTU has also attracted a broadening network of academic partnerships, including those with the United States Air Force Academy, Stanford University, and Hungary’s Nemzeti Kutatási és Technológiai Hivatal (NKTH) – the National Office for Research and Technology. Our research reputation has also led to a growing list of industrial collaborations with commercial entities, including EADS, Rolls-Royce, Robert Bosch and STMicro.

The University is recruiting top-notch faculty, both junior and senior, to develop high level research, along with offering high-quality teaching. In July 2008, NTU advertised internationally to recruit young and talented researchers through the Nanyang Assistant Professorship scheme. The University has since received more than 600 applications and has eventually offered assistant professorships with S$1 million grants each to eight excellent researchers. We now have a pool of outstanding faculty and students, working hand-in-hand to bring NTU to further heights. A section of the Research Report has been dedicated to list the outstanding new faculty recruited in 2008.

NTU also launched the Institute of Media Innovation (IMI) together with the inaugural NTU International Workshop on Interactive Digital Media (IDM) Research. The University recognises IDM technology as a strategic area of research and development with a high global market value, and the workshop was an excellent opportunity to showcase the range of IDM efforts and to demonstrate the excitement of multi-disciplinary research combining art, humanities and education content with advanced technological delivery systems.

NTU is moving to a new level of excellence in this beautiful garden campus. We are well known abroad for our excellence, and given the strong technological foundation and growing brilliance of our engineering, science, humanities and business schools, it is not impossible for us to aspire to produce a Nobel Prize winner in the reasonably near future.

Professor Bertil Andersson
Provost
World Class Research at NTU

Research is carried out within and across the University's Colleges and Institutes, including more than 70 research centres, and often through strategic partnership programmes. This section showcases research in various fields of interest undertaken by researchers at the University.

- Aerospace and Mechanical Engineering
- Biological and Life Sciences
- Biomedical Engineering
- Economics and Finance
- Electronics and Photonics
- Health and Society
- Imaging Technology
- Info-Communications Technology
- Interactive and Digital Media
- Management and Organisation
- Mathematical Science and Cryptography
- Nano-Science and Technology
- Teaching and Learning
- Visual Art and Society
- Water and Clean Energy
A Novel Transition Technique for Maneuvre Control of Versatile Micro Air Vehicles (MAV)

Methods to allow transition between hover and cruise manoeuvres for Micro Air Vehicles (MAV) with minimal loss of controls or altitude

The requirement to equip the airborne vehicles with increased versatility has demanded more complex and demanding transition manoeuvres like perching and switching between hover and cruise. The investigation of such constrained complex manoeuvres is led by Assistant Professor Go Tiauw Hiong in collaboration with Assistant Professor Roxana Vasilescu from the School of Mechanical and Aerospace Engineering (MAE). The transition manoeuvres are studied in order to maintain control over the vehicles subjected to operations in close cluttered terrains, urban havoc as well as clandestine systems for military operations. In this project, exploratory research effort will be made to study the transition manoeuvres with increased controllability. A new aerodynamic-assisted transition technique is proposed for the Micro Air Vehicle (MAV) in which the angle of incidence of the wing with respect to the fuselage/ducted fan is a control variable. The optimal dynamic setting of the variable-incidence wing during the transition manoeuvres is the key area of investigation. The technique will be evaluated on several platforms of small Unmanned Air Vehicles (UAVs)/MAVs. The objective is to perform transition manoeuvres in minimum time with minimum variation in altitude and with limited thrust-to-weight ratios. The variable-incidence wing concept will also be studied in other flight conditions such as in a gusty situation during hover. Moreover, during cruise flight, the wings can be trimmed at some optimal performance parameter like maximum lift-to-drag ratio for higher performance targets, subject to the variation in altitude, temperature and wind disturbances. The study will present the trade-off design rationale in aircraft systems utilising this novel concept.

Development of a New Airspeed Sensor for Helicopters

Alternative method of airspeed sensing at low airspeeds suitable for automated take-off and landing

Helicopters are frequently operating at low airspeeds, such as during take-off, landing and hovering. Conventional methods in sensing the airspeed are inaccurate in the low airspeed range. An example would be the Pitot-static tubes that are widely used in fixed-wing aircrafts to measure the stagnation point pressure and relate it to the freestream velocity. However, stagnation point pressure changes little over a large range of low airspeeds and hence, a precise measurement of the airspeed is impossible. This causes problems, especially for automated take-off and landings. In this project by Assistant Professor Jorg Uwe Schluter from the School of Mechanical and Aerospace Engineering (MAE), alternative methods of airspeed sensing are developed with a focus to provide a cost-effective and robust method.
Evaporative Spray Cooling System for Thermal Management of High Power, Temperature Sensitive Electronic and Electro-Optical Devices

Development of a portable evaporative spray cooling system to meet cooling requirements reliably

High power electronic and electro-optical devices have now reached extreme cooling requirements that cannot be met even by enhanced convection cooling technologies. A novel cooling technology that can be considered for such applications is Evaporative Spray Cooling (ESC). ESC uses an array of spray nozzles placed such that they will impinge minute liquid droplets onto a heated surface where a thin liquid film forms removing heat through the combined processes of forced convection, evaporation and nucleate boiling. A team headed by Associate Professor Toh Kok Chuan, including Associate Professor Wong Teck Neng and Assistant Professor Fei Duan from the School of Mechanical and Aerospace Engineering (MAE) in collaboration with Mr Choo Kok Fah, Research Scientist from Temasek Labs@NTU, has been awarded a grant by the Defence Innovative Research Programme (DIRP) to study this technique.

For many military and commercial applications, the ability to be portable, be exposed to harsh environments and yet be able to maintain the equipment at close to or below ambient conditions is desirable. The objective of this project is to study the conditions that will enable a closed-loop ESC system to meet the above requirements. The focus of the research will be to understand the key processes involved, in particular the spray atomisation, droplet evaporation or nucleate boiling and bubble formation behaviour, and surface enhancements to promote higher critical heat fluxes. The goal is to produce an overall system design that has the smallest package form factor to perform the cooling requirements reliably.

How Spray Cooling Works

Sources of Transport
Fracture Capacity  
Investigation of Pipeline Girth Welds during Installation and Operation

Re-examination of the integrity of pipeline girth welds with bi-axial loading

During the installation and operation procedures of pipelines in marine, offshore and onshore structures for pipeline installation with extra large plastic deformation, Engineering Critical Assessments (ECA) are required. However, existing assessment methods applied are in general too simplified and too conservative. For pipelines in operation subjected to bi-axial loading and aging, the current understanding of ductile fracture under bi-axial stress states is rather limited. The need for more accurate assessment procedures is vital as several new developments allow the pipeline to deform plastically during operation. The few results available indicate that the fracture capacity may be significantly reduced due to the bi-axial loading from combining pressure and axial loading.

Hence, a new common practice on how to assess the integrity of pipeline girth welds under operation with bi-axial loading is required. This project by Associate Professor Xiao Zhongmin of the School of Mechanical and Aerospace Engineering (MAE) thus seeks to investigate the fracture capacity of pipeline girth welds subjected to bi-axial loading during installation and operation.
SCART Scavenger Receptors Identify a Novel Subset of Adult γδ T-cells

Characterisation of γδ T-cells with two novel surface receptors

Although there has been great progress in the characterisation of αβ T-cell differentiation, selection, and function, γδ T-cells have remained poorly understood. One of the main reasons for this is the lack of γδ T-cell-specific surface markers other than the T-cell receptor (TCR) chains themselves. In the recent study led by Professor Klaus Erik Karjalainen from the School of Biological Sciences (SBS), the research team describes two novel surface receptors, SCART1 and SCART2. SCARTs are related to CD5, CD6, and CD163 scavenger receptors but, unlike them, are found primarily on developing and mature γδ T-cells. Characterisation of SCART2 positive immature and peripheral γδ T-cells suggests that they undergo lineage specification in the thymus and belong to a new IL-17-producing subset with distinct homing capabilities.

Developing Improved Cancer Therapeutics

A new drug target could lead to more effective anticancer drugs

The general interest of Assistant Professor Curtis Alexander Davey from the School of Biological Sciences (SBS) is the role of deoxyribonucleic acid (DNA) conformation, dynamics and context in gene regulation. His research team’s ultimate goal is to find new drug targets and develop novel cancer therapeutics by studying DNA structure and chemistry within a physiological framework. For instance, they recently conducted an investigation of how some of the most popular platinum-based anticancer drugs (cisplatin and oxaliplatin) interact with their targets, many different sites on the DNA in our cells. Our DNA is not ‘free’ or ‘naked’, rather it is wrapped up by a special type of protein into nucleosomes – these are like wire coiled onto spools. The team found that this packaging into nucleosomes changes how the drugs interact with DNA, which alters their current view of the actual targets of these therapeutic agents. Most importantly, this work has revealed a new drug target within the nucleosome, which may allow the design of much more effective anticancer drugs – that is, with reduced side effects. The team’s present focus is to exploit the complexity of the nucleosome by designing drugs that can hit only a specific site in a particular gene, which happens to be a weak point in cancer cells.

The Role of Polycomb Group Protein Ezh2 in Immune Response of Dendritic Cells

A three-prong approach to determine the role of Ezh2 in immune response of dendritic cells

The dendritic cell (DC), as one of the most efficient, professional antigen-presenting cells, with the potential to either activate or suppress antigen-specific T-cell responses, has recently become a powerful tool for manipulating immune responses and developing therapeutic treatments for many diseases.

The recent finding from the School of Biological Sciences (SBS) Assistant Professor Su I-Hsin and team indicates that a polycomb group protein Ezh2 plays an important role in regulating the physiological function of dendritic cells. Ezh2 has been implicated in the chromatin-mediated control of cell differentiation. However, the team has shown previously that cytosolic Ezh2 methyltransferase complex regulates activation-
dependent actin polymerisation in T-cells. A similar complex may also control specific functions in dendritic cells.

To further substantiate the role of Ezh2 in immune response of dendritic cells, they propose three complementary specific aims, which will make use of conditional Ezh2-deficient mice: an in vitro DC-culture system, in vivo functional studies and biochemical approaches. The first aim of this proposal will address the involvement of Ezh2 in the basic physiological function of DCs. They will test the contribution of Ezh2 to the regulation of endocytosis and motility. The second aim will address the role of Ezh2 in affecting DCs’ ability to regulate T-cell responses in vitro and in vivo. The third aim will focus on the identification of the molecular mechanisms by which Ezh2 regulates physiological function of DCs. The project is funded by Agency for Science, Technology and Research (A*STAR)’s Biomedical Research Council (BMRC) grant.

Manipulation of Immune System via Immortal Bone Marrow Stem Cells

Cells engineered to support self-renewal for unlimited expansion

Extensive amplification of Hematopoietic Stem Cells (HSC) and their primitive progenitors (MPP) in culture would greatly benefit not only clinical transplantation but also would provide a potential tool to manipulate all cellular lineages derived from these cells for gene therapy and experimental purposes. Headed by Associate Professor Christiane Ruedl, the research team from the School of Biological Sciences (SBS) recently demonstrated that mouse bone marrow cultures, containing cells engineered to over express NUP98-HOXB4 fusion protein, support self-renewal of physiologically normal HSC and MPP for several weeks, leading to their practically unlimited expansion. This allows for time consuming and cumulative in vitro experimental manipulations without sacrificing their ability to differentiate in vivo or in vitro to any hematopoietic lineage.

Structural Basis of Signaling Mediated by Sterile Alpha Domain (SAM)

Interfacial residues of Ste11 are involved in its structural stability and binding

The sterile alpha motifs or SAM domains are multi-functional protein-protein interaction modules that are essential in a variety of regulatory processes ranging from cell signalling, transcription repression, synaptic scaffolding to translational control. Structural perturbation in SAM domains in signalling proteins are responsible for a number of human diseases including leukaemia. Recently, the research group headed by Assistant Professor Surajit Bhattacharyya from the School of Biological Sciences (SBS) has demonstrated that the binding activity and stability of the unique dimeric SAM domain from the Ste11 protein from budding yeast is controlled by the interfacial residues.

Designing Peptide-based Antiendotoxin Molecules

Neutralising endotoxin to tackle the cause of septic shock

Lipopolysaccharide (LPS), or endotoxin, is a major constituent of the outer membrane of Gram negative bacteria. LPS can be released into systemic circulation, either due to the invasion of Gram-negative bacteria or as a consequence of intensive antimicrobial chemotherapy of severe microbial infections. The circulating LPS in blood stream is recognised by the phagocytic cells, monocytes and macrophages, of the innate immune system of host, which mount an immune response against invading pathogens by the production of tumour necrosis
factor-α (TNF-α), interleukin-6 (IL-6) and interleukin-1β (IL-1β). However, an uncontrolled and overwhelming production of these cytokines may lead to a constellation of symptoms termed endotoxic shock or septic shock, characterised by endothelial damage, loss of vascular tone, coagulopathy, and multiple organ system failure, frequently resulting in death. Septic shock is the major cause of mortality in the intensive care unit accounting for 200,000 deaths every year in the US alone. A potential strategy to overcome sepsis-mediated lethality would be the discovery and development of compounds that would bind and sequester LPS, thereby blocking its interactions with the serum and cellular receptors. Assistant Professor Surajit Bhattacharyya and his team from the School of Biological Sciences (SBS) are engaged in designing short synthetic peptides that may interact with LPS to fold into specific conformations. Recent work from the laboratory showed a 12-residue de novo designed peptide acquires a folded structure in complex with LPS resulting in endotoxin neutralising activity.

Structural Basis of Integrin Signaling: Interactions and Structures between Cytosolic Domains of Leukocyte Integrins

NMR analysis of the solution conformations and interactions of the αLβ2 cytoplasmic tails

The cell adhesion molecule integrins are bi-directional signal transducers. Devoid of enzymatic activity, integrin cytoplasmic tails serve as a hub for the recruitment of cytosolic proteins – many of these are signalling molecules. The leukocyte-restricted integrin αLβ2 is essential for the adhesion, migration, and proliferation of leukocytes. In the collaboration between Assistant Professor Surajit Bhattacharyya and Assistant Professor Tan Suet Mien, both from School of Biological Sciences (SBS), solution conformations and interactions of the αLβ2 cytoplasmic tails by Nuclear Magnetic Resonance (NMR) analysis are reported. The αL tail is characterised by three helical segments in the order of helix 1, 2, and 3 that are connected by two loops with helix 3 having a number of NOE contacts with helix 1 and helix 2. The conformation of the β2 tail is less defined with only a helical segment restricted at its N-terminus. Acidic residues from the helix 2-loop-helix 3 motif of αL were found to be responsible for its binding to calcium ion. There were detectable interactions between αL and β2 tails, involving helix 1 and helix 3 of the αL tail and the N-terminal helix of the β2 tail. Talin head domains that contain the FERM domain showed binding affinity of Kd ~ 0.5 µM with the β2 tail. The binding affinity of αL and β2 tails is Kd ~ 2.63 µM. These data are in line with the activating property of talin head domain on αLβ2 by which binding of talin head domain to β2 tail disrupts the interface of the αL and β2 tails that constrains αLβ2 in a resting state.
First Comprehensive Study on the Morphology and the Solvation of Proton Methanol

Collaborative effort with experimental teams to bring about comprehensive knowledge on the solvation of proton in methanol

A theoretical team led by Assistant Professor Kuo Jer-Lai from the School of Physical and Mathematical Sciences (SPMS) has performed extensive Density Functional Theory (DFT) calculations to study the structure of $\text{H}^+(\text{MeOH})_{n=2-9}$ (see left-hand panel of the figure below) and analyse the morphological development of the hydrogen bond network in the clusters with increasing cluster size.

The experimental IR (infrared) spectra (see right panel of the figure) above 3000 cm$^{-1}$ were obtained by Professor Fujii’s group at Tohoku University. They were able to analyse the experimental spectra features based on the spectral simulations of the isomers by DFT calculations. It was discovered that the blue-shifting peaks for increasing sizes can be attributed to the dominance of the open structures (that is L, C and Ct). The assignment was validated for IR spectra above 3600 cm$^{-1}$ and the conclusions provided a solid foundation and motivations for greater investigation on motion of the proton.

Using the free electron laser facility in Tokyo University of Sciences, the vibration motion of an excess proton in $\text{H}^+(\text{MeOH})_{n=5-8}$ (900–2300 cm$^{-1}$) was probed for the first time. Its spectra were investigated by the joint theoretical/experimental approach. The excess proton is indicated to be delocalised between two methanol molecules. Mixed vibrations of the shared proton and the two ligands molecules are responsible for spectral features observed in the range of 1400–1800 cm$^{-1}$. At $n = 6–8$, broad spectral features in the region above 1800 cm$^{-1}$ suggest coexistence of isomers in which the excess proton and a methanol molecule are tightly bound to form an ion core, CH$_3$OH$_2^+$. 

\[ \text{ Structures and spectra of the most stable conformation of different } \text{H}^+(\text{MeOH})_{n}. \]
Research Highlights

Biomedical Engineering

EEE’s Biomedical Engineering Group line up host of exciting research

Biomedical Engineering is a widespread and multidisciplinary research field. In line with the nationwide efforts on research into life sciences, the research interest and activities of the School of Electrical and Electronic Engineering (EEE)’s Biomedical Engineering Group cover biomedical system modelling, medical imaging, biomedical signal processing, biomedical instrumentation and their extensions to practical instrumentation and applications in health care services, such as clinical diagnosis, therapy and life support for patients. Some research projects currently carried out in the group are as follows:

Brain-Computer Interface:
Examination and improvement of the post-stroke rehabilitation process of physiotherapy and occupational therapy are investigated using a Brain-Computer Interface (BCI) to control functional electrical stimulation.

Perfusion Imaging:
In collaboration with the National Cancer Center and the National Neuroscience Institute, the group has developed methods and algorithms for perfusion imaging using dynamic contrast-enhanced computed tomography and magnetic resonance imaging, which can be used as biomarkers for assessing the effectiveness of anti-cancer drugs.

Ultrasound Signal Modelling and Processing:
Current medical ultrasound images suffer from low resolution, tissue distortions and grainy type speckles. System modelling and identification methods have been developed to deal with this problem to provide high quality ultrasound imaging.

Recurrent and Spiking Neural Modelling:
Since there is no explicit sensory input present during the delay period in a working memory task, neuronal activity must be a result of the dynamics of relevant recurrent neural actions. The group has conducted neural modelling work to describe the delay-period activity as a reflection of dynamical attractors.
Biodegradable Cardiovascular Implants

**Fully biodegradable implants to avoid possible late stage thrombosis**

This project was awarded with S$10 million grant under the National Research Foundation (NRF)’s Competitive Research Program (CRP) in June 2008. Led by Professor Freddy Boey and Professor Subbu Venkatraman from the School of Materials Science and Engineering (MSE), the project focuses on the development of biodegradable cardiovascular implants. Biomedical implants which deliver drugs/proteins locally form one of the fastest-growing segments in the healthcare industry, accounting for about 50% of this market and, in the last decade, this segment has made the most substantial innovations, driven by the use of novel biomaterials. The single biggest constraint limiting cardiovascular implants is the danger of late stage thrombosis (formation of blood clot long after being implanted, which is usually fatal). The most compelling solution to this constraint is to develop fully biodegradable implants which biodegrade away totally after their therapeutically useful lifetime, thus eliminating any possible thrombosis in the long term.

**Translational Research Innovations in Ocular Surgery (TRIOS)**

**Developing alternatives for ocular drug delivery**

The Singapore Eye Research Institute (SERI) was recently awarded S$25 million grant under the Translational and Clinical Research (TCR) Flagship programme funded by the National Research Foundation (NRF). The TCR programme - also known as Translational Research Innovations in Ocular Surgery (TRIOS) - aims to study the major causes of blindness, develop novel treatments for wound healing and to work on better alternatives on drug approaches. The TRIOS programme consists of six sub-projects. A team led by Professor Freddy Boey and Professor Subbu Venkatraman from the School of Materials Science and Engineering (MSE) will spearhead one of the sub-projects on ocular drug delivery.
**Optimised Communication Protocols and Integration Techniques for a Therapeutic Microcapsule System**

**An ingestible therapeutic capsule**

Assistant Professor Louis Phee from the School of Mechanical and Aerospace Engineering (MAE) is leading an Agency for Science, Technology and Research (A*STAR) programme to develop an ingestible therapeutic capsule. Together with Assistant Professors Wong Kai Juan and Tan Su Lim from the School of Computer Engineering (SCE), this programme also involves six other teams from various A*STAR research institutes. When swallowed, the proposed capsule would travel naturally though the patient’s digestive system, capturing and transmitting endoscopic images along the way. With these images, diagnostic software would be utilised to automatically look out for possible abnormalities. At the push of a button from an external control and monitoring device, the medical doctor could also command the capsule to perform therapeutic procedures like biopsy, localised drug delivery and mechanical tagging of an area of interest for subsequent treatments.

**Double Water Exclusion and Protein Binding Hotspots**

**Hypothesis to investigate spatial adjacency and vicinity of hot residues**

The influential O-Ring theory (Bogan & Thorn, 1988) has revealed that non-evenly distributed hotspots of binding energy are made-up of small fractions of residues in the binding interface. These hotspots are surrounded by an O-Ring, energetically less important residues that likely serve to occlude bulk water molecules from the hot spots. However, the organisational topology of the ring inside (energetically more important hot residues) is uncertain and not specified by this theory. Through their double water exclusion hypothesis and the support garnered from the Ministry of Education (MOE)’s Academic Research Fund (AcRF), Associate Professor Li Jinyan from the School of Computer Engineering (SCE) and his team is actively investigating the spatial adjacency and vicinity of these hot residues, and the discovery of whether protein binding hot spots have a zero-tolerance to water molecules. The project titled “Double Water Exclusion and Protein Binding Hotspots” will employ the following approach: Bipartite graph modelling and subgraphing mining, and SASA calculation and biological significance evaluation.

**Hypothesis: The hotspot itself is water free**

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**Diagram:**

- The O-ring structure
- Hypothesis: The hotspot itself is water free
**Lab-on-a-Chip (LOC) for Detection of Nerve Gas**

**A hand-held portable device to detect nerve gas as well as insecticides**

Associate Professor Nguyen Nam-Trung, Deputy Director of the Thermal and Fluids Engineering Laboratory at the School of Mechanical and Aerospace Engineering (MAE) and the team led by Dr Loke Weng Keong, Head of Medical Countermeasures (Chemical) at DSO National Laboratories (DSO) joined to develop a Lab-on-a-Chip (LOC) device that can easily detect sarin, other potential nerve gases, as well as insecticides.

Sarin is a colourless, odourless and highly toxic phosphonate that acts as a cholinesterase inhibitor and disrupts neuromuscular transmission. Sarin and related phosphonates are chemical warfare agents, and there is a possibility of their application in a military or terrorist attack. The research team developed a LOC device for detecting a trace amount of sarin in a small volume of blood sample. The device allows early detection of sarin exposure during medical triage to differentiate those requiring medical treatment from the mass psychogenic illness cases.

The LOC device is based on continuous-flow microfluidics with sequential stages for lysis of whole blood, regeneration of free nerve agent from its complex with blood cholinesterase, protein precipitation, filtration, enzyme-assisted reaction and optical detection. Whole blood is first mixed with a nerve gas regeneration agent, followed by a protein precipitation step. Subsequently, the lysed product is filtered on the chip in two steps to remove particulates and fluoride ions. The filtered blood sample is then tested for trace levels of regenerated sarin using immobilised cholinesterase on the chip. Activity of immobilised cholinesterase is monitored by enzyme-assisted reaction of a substrate and reaction of the end-product with a chromophore. Resultant changes in chromophore-induced absorbance are recorded on the chip using a Z-shaped optical window. Loss of enzyme activity obtained prior and after passage of the treated blood sample, as shown by a decrease in recorded absorbance values, indicates the presence of either free or regenerated sarin in the blood sample.

The results from the project demonstrate the potential use of a field-deployable hand-held device for point-of-care triage of suspected nerve agent casualties. The device also has other possible commercial applications. For example, it can detect organophosphorus insecticides commonly used in agriculture, offering a low-cost way of monitoring the degree of insecticide contamination in crops and water sources. The device is suitable for tracking the standard of occupational hygiene in agriculture.
Economics and Finance

The Statistical Physics of Financial Markets

Study of macroeconomic phase transitions

Economies are complex systems which can exist in many different macroeconomic phases (or regimes). These macroeconomic phases can be distinguished from each other by the statistical footprints they leave on economic and financial time series. Knowing the characteristics of each of these phases, the phase an economy is currently in, and which phases are likely to follow, is of immediate relevance to economic policy planning at the national and international levels. Together with Mathematical Sciences final year student Wong Jian Cheng, Assistant Professor Cheong Siew Ann from the School of Physical and Mathematical Sciences (SPMS) carried out a systematic statistical segmentation and clustering study on the Dow Jones Industrial Average Index time series, which is a rough performance measure for the New York Stock Exchange, over a 11-year period between January 1997 and March 2007. They found five macroeconomic phases, which are distinguished primarily by their market volatilities. The market spent most of its time in two phases, a low-volatility expansion phase (yellow), and a high-volatility contraction phase (cyan). Both phases are interrupted by a moderate-volatility correction phase (orange), as well as a very-high-volatility crash phase (blue). A very rare very-low-volatility phase (red), whose nature is not yet understood, was also discovered.

Macroeconomic phases in the DJI time series
The Trend of Trade, Foreign Direct Investment and Monetary Lows in East Asia and Its Policy Implications

Study awarded with external grant from ASEAN Secretariat

An economics division team from the School of Humanities and Social Sciences (HSS) consisting of Assistant Professor Yothin Jinjarak, Assistant Professor Chia Wai Mun and Dr Pradumna Rana were awarded an external research grant of JPY 7,000,000 from the ASEAN Secretariat. The team will be studying “The Trend of Trade, Foreign Direct Investment and Monetary Lows in East Asia and Its Policy Implications”. They will be working with a lead institute from Japan (Nomura), and two other institutions from Indonesia and Philippines. There will be two meetings in Japan and the report will be presented to Asian central banks and finance ministers in April 2009. Each year approximately ten or more institutions across Asia bid for this external grant.

Financial Atoms and Molecules

A statistical clustering method to analyse markets

To develop a deeper understanding of how macroeconomic phases and their transitions arise from self-organisation within the complex dynamics of financial markets, Assistant Professor Cheong Siew Ann, with the help of CN Yang Scholars Goo Yik Wen (School of Mechanical and Aerospace Engineering (MAE)), Lian Tong Wei (School of Electrical and Electronic Engineering (EEE)), Ong Wei Guang (School of Physical and Mathematical Science (SPMS)), and Physics and Applied Physics second year student Choi Wen Ting (SPMS), developed a novel two-time-scale statistical clustering method to analyse entire markets, and discover what collective variables are the most important. In all five equity markets (New York Stock Exchange, London Stock Exchange, Tokyo Stock Exchange, Hong Kong Stock Exchange, and Singapore Stock Exchange) studied, very similar high-level self-organisation was found. Depending on how many stocks they are made up of, the collective variables were dubbed financial atoms (< 10 stocks), financial molecules (30-70 stocks) and financial supermolecules (100-200 stocks).
Intra-Group Propping: Evidence from the Stock-Price Effects of Earnings Announcements by Korean Business Groups

Intra-group propping consistent with market’s ex-ante valuation

The research by Professor Kang Jun-Koo, Distinguished Professor of Finance from the Nanyang Business School (NBS), Bae Gil Soo from Korea University and Cheon Youngsoo Susan from Chung-Ang University studied propping within Korean chaebols, which are a South Korean form of business conglomerate. Results show that announcement of earnings by a chaebol-affiliated firm has a corresponding effect on the market value of other non-announcing affiliates, consistent with the market’s ex-ante valuation of intra-group propping.

Target Behaviour and Financing: How Conclusive is the Evidence

A number of existing tests of target behaviour have no power to reject alternatives

The research by Assistant Professor Xin Chang from the Nanyang Business School (NBS) and Associate Professor Sudipto Dasgta from the Hong Kong University of Science and Technology looked at evidence to prove that firms which have a debt ratio target is a primary determinant of financing behaviour. Samples were generated where financing is unrelated to a firm’s current debt ratio or a target. The study finds that much of the available evidence in favour of target behaviour based on leverage ratio changes can be reproduced for these samples. Taken together, the findings suggest that a number of existing tests of target behaviour have no power to reject alternatives.

The Geography of Block Acquisitions

Study finds that geographic proximity affects partial block acquisitions

Professor Kang Jun-Koo, Distinguished Professor of Finance from the Nanyang Business School (NBS) and Assistant Professor Kim Jin-Mo from Rutgers, The State University of New Jersey, studied the importance of geographic proximity in corporate governance and target returns by examining a large sample of partial block acquisitions in the US. It was found that block acquirers have a strong preference for geographically proximate targets and acquirers that purchase block shares in such targets are more likely to engage in post-acquisition target governance activities than are remote block acquirers. Moreover, the targets of these acquirers realize higher abnormal announcement returns and better post-acquisition operating performance than do targets of other types of acquirers. Results suggest that information asymmetries or monitoring costs associated with geographic proximity are an important source of gains in partial block acquisitions.
Corporate Governance and Merger and Acquisition (M&A) Foreign Direct Investment (FDI)

Firm-level evidence from Japanese FDI into the US indicate that increased corporate governance has a negative effect on M&A FDI activities.

In the research by Associate Professor Joseph Dennis Alba from the School of Humanities and Social Sciences (HSS), Park Donghyun, Senior Economist from the Asian Development Bank and Associate Professor Wang Peiming from Auckland University of Technology, it is posited that an improvement in overall corporate governance may have a negative effect on M&A activity, and also affect M&A FDI since it is a cross-border variant of M&A.

Firm-level evidence from Japanese FDI into the US was used to investigate the effect of US corporate governance on Japanese M&A FDI. Results indicate that two landmark corporate governance regulations by the US Securities and Exchange Commission (SEC) in 1992 contributed significantly to the decline in Japanese M&A FDI in the US during the 1990s. The evidence lends some support to the notion that corporate governance may affect not only domestic M&A activity but also cross-border M&A activity. This study also sheds light on the puzzle of why Japanese FDI into the US fell during the 1990s despite the depreciation of the US dollar.

The Long-Run Benefits of Chaos to Oligopolistic Firms

Study finds that chaos is beneficial to oligopolistic firms and economy

Associate Professor Huang Weihong from the School of Humanities and Social Sciences (HSS) challenges conventional economic beliefs on ‘equilibrium’ and ‘stability’ with a heterogeneous oligopolistic model that consists of a naive firm and a group of sophisticated firms. Results indicate that when the market equilibrium is unstable, the naive firm (using a simple Cobweb strategy) is able to turn an explosively diverging market into a bounded but chaotic one by adopting simultaneously a cautious adjustment strategy. There exists an upper-bound such that as long as the growth rate does not exceed this bound, the average profits made by all oligopolistic firms are higher than their respective equilibrium profits. Moreover, the average economic surplus can also be higher than the equilibrium surplus. In this sense, chaos is beneficial not only to all oligopolistic firms but also to the economy as a whole.
Artificial Mesoscopic Structures for Next Generation Electronic and Photonic Technology

Design and fabrication of a class of artificial mesoscopic structures of materials and devices that give rise to fundamentally new electrical and optical properties

Using an artificial mesoscopic structure, one can manipulate light and design new components not previously realised, such as a “perfect lens”, permitting arbitrarily high resolution for writing, reading or imaging. In information technology, this will improve the density of data storage enormously. A breakthrough in biotechnology may also take place such that it brings a chance for human beings to see viruses optically. As electronic devices shrink and integration density increases, optical interfacing between the chip and the world becomes increasingly essential to break the electronic communication bottleneck. The Defense Advanced Research Projects Agency (DARPA)’s recent call for proposals to develop nanophotonic architecture to interface with the underlying CMOS (complementary metal oxide semiconductor) electronics testifies to the importance of harnessing photonics to solve critical bottlenecks in integrated electronics. The vision for such a nanophotonic layer can only be realised with the development of mesoscopic structures for routing and processing light that can be integrated with active devices such as lasers and detectors in a very compact form factor. Integration of active devices such as sources into these photonic platforms will be the next major thrust area for all-optical signal processing, which the team led by Associate Professor Mei Ting from the School of Electrical and Electronic Engineering (EEE) is well positioned to address.

Integration technology increases the functionality while reducing the cost per unit chip area. The project, which was awarded with S$10 million funding by National Research Foundation (NRF) in November 2007, aims to investigate the artificial mesoscopic structures for foundations of next generation engineered artificial media which can be manufactured and integrated into functional photonic systems on a chip for applications in biotechnology and communications.

Research focused on micro-ring resonators proves interesting properties of a simple two-coupled-ring structure as either a sharp resonance with enhanced finesse, which is ideal for bi-stability switching, or a broader resonance giving larger delay-bandwidth product than other ring-based buffers for storing optical bits (led by the late Associate Professor Chin Mee Koy). Comprehensive understanding has been well achieved on ICP (inductively coupled plasma) -enhanced QWI (quantum well intermixing) as a technique enabling integration of active photonic devices, as demonstrated by the integrated two-section super luminescent light emitting device with broadened spectrum shown in Figure 1 (led by Associate Professor Mei Ting). With quantum well absorber incorporated in a Bragg mirror and carefully designed structures, high power self-started passive mode-locking has been achieved on the erbium-doped fiber lasers, the diode-pumped Nd:YAG (5.5W, 23 ps) and Nd:LuVO₄ lasers (8.3 W, 20 ps), which is the best mode-locked result so far (led by Associate Professor Tang Dingyuan).

A structure with subwavelength size grating array embedded into a gold film converts normal incident free-space light into SPP (surface Plasmon polariton) waves, forming a subwavelength-sized SPP dot arrays which can be utilised as the virtual probing mechanism to excite the fluorophores near the metal surface to get fluorescent images with sub-diffraction-limited resolution (led by Associate Professor Yuan Xiaocong). Negative permeability in visible frequency range is obtained...
in a two-layer planar metamaterial aiming for “super-lens” application, and it is found that the frequency at which the negative permeability appears is closely related to the structure dimension (led by Associate Professor Zhang Dao Hua). Zinc Oxide (ZnO) quantum dots with ultra-small average size of ~2.5nm have been synthesised in by solvothermal synthesis method, showing an obvious blue-shifted photoluminescence peak in the UV wavelength range as shown in Figure 3 (led by Professor Hu Xiao and Associate Professor Mei Ting). Room-temperature visible electroluminescence (EL) from CMOS-compatible Al/Al₃Nₓ/p-Si MIS diode structures on Si wafers (as shown in Figure 4) has been demonstrated. Aluminum nanocrystals distributed in the aluminum nitride matrix is found to be responsible for the EL (led by Associate Professor Chen Tupei).
Ultra-Fast Technologies Based on New Bandgap-Engineered Nitride-Based III-V Compound Semiconductors

For near-infrared operation that potentially covers the entire optical communication range from 1.3-1.55µm

The Compound Semiconductor and Quantum Information Group led by Professor Yoon Soon Fatt in the School of Electrical and Electronic Engineering (EEE) recently announced the first ever demonstration of ultra-fast phenomena in devices fabricated using novel bandgap-engineered nitride-based III-V compound semiconductors grown by molecular beam epitaxy. Because of bandgap limitations of the conventional AlGaAs and InGaAs semiconductor technologies, it had not been ideal to fabricate ultra-fast photoreceivers on GaAs substrates for operation at 1.3µm wavelength, which is one of the most technologically important near-infrared wavelengths for optical communication applications. Currently, those near-infrared photoreceivers are fabricated using more expensive InP-based material systems. The breakthrough research, which was financially supported by the European Commission under the 6th Framework ISIS program, THALES@NTU and the MERLION program, and carried out in partnership with University of Duisburg-Essen Germany, IEMN France, Paris VI University and THALES Research and Technology France, has successfully developed and optimised a new GaAs-based material system in conjunction with a nitride-based photon-absorption layer. The new III-V compound semiconductor is suitable for near-infrared operation that potentially covers the entire optical communication range from 1.3-1.55µm. By using this new material system in conjunction with an ultra-fast photoreceiver device design, the international team has successfully demonstrated multi-gigabit (5Gb/sec) operation at 1.3µm near-infrared wavelength with bit error rate of 10^-7 in real-time digital transmission trials. Furthermore, recent experiments have shown that the new material system can exhibit ultra-fast microwave photoconductive switching mechanism with 30ps response time up to 1.6µm wavelength at 15GHz. The results have clearly demonstrated the viability of this new III-V nitride-based compound semiconductor for radio-frequency (RF)-photonics platforms with strong potential for industry and perhaps defence applications.

Figure 1: Scanning electron micrograph of ultra-fast photoreceiver fabricated from new nitride-based III-V compound semiconductors (Research partner: University of Duisburg-Essen Germany)

Figure 2: Carrier-mounted ultra-fast microwave photoconductive switch fabricated from new nitride-based III-V compound semiconductors (Research partners: Paris VI University, IEMN France, THALES@NTU and THALES Research and Technology France)
Advanced Metal Bonding through Self Assembled Monolayers (SAMs)

SAMs-mediated bonding for Au and Cu surfaces

This research project funded by the Agency for Science, Technology and Research (A*STAR) describes an innovative approach to achieve a metal-to-metal thermo-compression bond at low temperatures and pressures, without involving high vacuum. Such metallurgical bonds are ubiquitous in the making of all electronic/photonic systems where heterogeneous integration of disparate devices and materials are required. The approach in this project uses a single monolayer of Self Assembled Molecules (SAMs) as an intermediate temporary interface between the 2 metal surfaces about to be mated. The pioneering work on this was done at Associate Professor Wong Chee Cheong’s group from the School of Materials Science and Engineering (MSE), where it was demonstrated that a SAMs-mediated interface could lower bonding temperature through a mechanism involving surface passivation, without compromising electrical performance. Unlike other bonding research, where the intermediate layer serves as a “glue” which stays at the interface, the SAMs in this work are meant to activate metal bonding, but not participate in the final bonded interface. The target bonds are true metallurgical bonds which approach the cohesive strength of metals, not adhesive joints. This work proposes to investigate SAMs-mediated bonding for Au and Cu surfaces, the two metal finishes most common for integrated circuits (ICs). Surface characterisation using XPS (X-ray photoelectron spectroscopy) and SPR (surface plasmon resonance) would be used to elucidate the mechanisms involved, so that both SAMs functionalisation and surface preparation could be optimised.

Synthesis and Characterisation of Inverse Opal Photonic Crystals and Nanophosphors Coupled Materials for Solar Cell Application

Study on the use of nanophotonic crystals in solar cell applications

This project aims to study the coupling of rare earth-doped nanophosphors and photonic crystals to maximise the energy redistribution at specific wavelength for the excitation of solar cell. A high quality nanophotonic crystal (PC) requires a long range periodic ordered structure and engineered dielectric environment. This project also focuses on the application of solar cell which is one of the key research initiatives in Singapore. This project, funded by the Ministry of Education (MOE)’s Academic Research Fund (AcRF), is led by Assistant Professor Alfred Tok from the School of Materials Science and Engineering (MSE) in collaboration with Assistant Professor Zhao Yang (MSE) and Assistant Professor Sum Tze Chien from the School of Physical and Mathematical Sciences (SPMS).
Controlling Magnetism with an Electric Field

Multiferroic materials may have potential applications in nanoelectronics

Multiferroics, defined as materials that possess at least two of the ferroic (electric, magnetic and elastic) properties simultaneously, have attracted tremendous attention recently. Among them, materials that show both ferroelectricity and ferromagnetism are especially attractive. Both ferroelectricity and magnetism have led to some of the most important technological advances to date. Their coexistence in multiferroics opens a whole new area of research.

Assistant Professor Wang Junling from the School of Materials Science and Engineering (MSE) in collaboration with Assistant Professor Chen Lang (MSE) and Assistant Professor Wu Tao from the School of Physical and Mathematical Sciences (SPMS) are actively participating in this fascinating area, with the financial support from Ministry of Education (MOE)’s Academic Research Fund (AcRF). The goal here is to investigate the coupling between electric and magnetic order parameters in multiferroic materials with the aim of controlling magnetism through an electric field. The main objectives are to understand the physics of magnetoelectric coupling and to control the phenomenon in multiferroics and, to create devices with much lower power consumption and novel functionalities for potential applications in next generation nanoelectronics.

![Figure 1: High resolution TEM image of the BiFeO$_3$/SrRuO$_3$ interface](image1)

![Figure 2: P-E hysteresis loops of multiferroic BiFeO$_3$ thin films](image2)

![Figure 3: Ferroelectric domain images of multiferroic BiFeO$_3$ thin films](image3)
Solid Immersion Nanolithography for Sub-60nm Multi-Dimensional Patterning

Multiple beam lithography to achieve sub-60nm feature fabrication

A novel concept for 3D sub-60nm feature fabrication using a multiple beam lithography approach is one of the recent research endeavours being undertaken by Associate Professor Murukeshan Vadakke, School of Mechanical and Aerospace Engineering (MAE), Division of Manufacturing Engineering. Optical lithography possesses great potential for micro and nanofabrication, from lab to industry implementation. However, it has become technically and financially challenging to achieve higher resolution by employing exposure sources with deep ultraviolet wavelengths. This project, in this context investigates novel concepts in the near field optical lithography to achieve nanoscale patterning. It employs the interference of multiple counter-propagating evanescent waves. This project will also explore the physics and characteristics of the induced polarisation evanescent reflection with respect to different SIL (Solid Immersion Lithography) materials, substrate materials. It is found that either periodic nanopillars or nanowells and nano gratings can be realized, as shown in Figure 1. Each nanopillar has a theoretical height of 225nm and diameter of 28nm (0.08λ) with height-to-width ratio of almost 10.

These proposed novel concepts can find tremendous applications in semiconductor industry and for biomedical applications. This project is financially supported by Ministry of Education (MOE)’s Academic Research Fund (AcRF) and Chartered Semiconductor Private Limited has shown great interest by way of collaborative research programmes in this. The main vision of this project is working towards achieving a high speed, large area one-step whole field litho system with high spatial and depth resolution for the technology nodes forecasted for 2025 and beyond.
**Probabilistic Complementary Metal Oxide Semiconductor Chips**

**Low cost energy saving microchip could significantly boost battery lives**

The Probabilistic Complementary Metal Oxide Semiconductor (PCMOS) is a microchip intentionally designed to run at a lower operating voltage by trading off a small degree of accuracy in computation for significant energy savings. This could potentially boost battery life in mobile devices such as mobile phones and reduce development costs for chip manufacturers.

At the NTU Institute for Sustainable Nanoelectronics (ISNE), the research team led by Professor Krishna Palen, who is also the founding director, focuses on research in sustainable nanoelectronics. The team’s work derives from the PCMOS technology and seeks to develop low cost embedded Integrated Circuit (IC) chips that require over 100 times less energy, which would attract the interest of international semiconductor and IC design companies.

PCMOS chips can be used in applications where the need for precision is not crucial enough to affect the user’s experience, such as in video streaming in a cell phone. Previous research conducted has shown that viewers are unable to tell the difference between video processed on regular microchips and PCMOS chips due to the limits of human perception.

**The Origin Room Temperature Ferromagnetism of Transition Metal Doped Oxide**

**Unveiling of the concept of intrinsic origin of ferromagnetism**

Dilute magnetic semiconductors are considered to be very important materials in future semiconductor spintronics applications. Mn-doped GaAs has been proven to have intrinsic ferromagnetism, which can be tuned by charge carrier and gate voltage. However, the application of Mn-doped GaAS is limited due to the low Curie temperature (< 200 K). Dilute oxide systems have obtained dramatic attention in recent years following the theoretical prediction of room temperature ferromagnetism. However, the intrinsic origin of ferromagnetism in these materials remains controversial. Recently, Assistant Professor Wang Lan’s research group from the School of Physical and Mathematical Sciences (SPMS) proposed the concept of intrinsic ferromagnetic phase separation based on their experimental research on transition doped Indium oxide and Indium Tin oxide. They also found the surface spin polarisation and ferromagnetism in the system. The work is supported by the Agency for Science, Technology and Research (A*STAR)’s Science and Engineering Research Council (SERC) grant.
Research Highlights

Electrically Pumped UV Laser Diodes

First ZnO-based laser diodes

Associate Professor Yu Siu Fung and his team members in the School of Electrical and Electronic Engineering (EEE) have developed electrically pumped UV laser diodes. Based on the knowledge gained in transport characteristics of photons and carriers, the team has designed and fabricated a laser diode structure using p-SiC as a hole injection layer and Al-doped ZnO as an electron injection layer. A nanocomposite layer, which consists of SiO₂ matrix and ZnO nanoparticles, is sandwiched between the two injection layers. The special arrangement of nanoparticles provides strong optical feedback which led to the realisation of ultraviolet lasing emission under external electrical excitation. Despite the world-wide intense study in ZnO research, the NTU team is the first research group able to demonstrate ZnO-based laser diodes.

Figure 1: Schematic diagram of the laser diode with ZnO nano-structure.

Figure 2: Photo of the surface of the laser diode. The entire structure lights up with violet-blue emission and the white sparks are the surface ultraviolet emission arisen from the nano-particles.

Diode Pumped Yb:Y₂O₃ Ceramic Lasers

Research into next generation of lasers

Development of ceramic lasers is a new trend of laser research worldwide and much progress has been made in the area in the School of Electrical and Electronic Engineering (EEE). In 2003, in collaboration with Japanese scientists, a research team led by Associate Professor Tang Dingyuan demonstrated the world-first diode-pumped Yb:Y₂O₃ ceramic laser. The first emission of the laser had an output power of 750 mW at 1078nm and a slope efficiency of 12.6%. As this was the first Yb-doped ceramic laser, the result attracted great attention and was reported by several international magazines, including Photonics Spectra, Optics & Laser Europe and Stp-gateway. By 2007, the team had managed to increase the slope efficiency of the laser to 82%. This was the highest efficiency ever achieved by the solid-state lasers. In mid 2007, the team also demonstrated a high power self-started mode-locking of the laser, and achieved mode-locked operation with 1.1ps mode locked pulse width and 2.7W average output power. This work has been well publicised in several journals and magazines.

Ceramic laser setup
Case Study Research Project on the Social Service Sector in Singapore

Managerial and Organisational Issues in the Social Service Sector

Associate Professor Wee Beng Geok from Nanyang Business School (NBS) will develop a collection of case studies on managerial and organisational issues/topics relating to the social service sector in Singapore over a period of 3 years. Funded by the Singapore Totalisator Board, this is the first such project undertaken by Asian Business Case Centre (ABCC) to research, write and publish a case collection on the social service sector in Singapore.

The social service sector provides services to a wide array of the population and the efficient and effective management of all resources made available to this sector is critical. More new services are being set-up to meet emerging needs, and more demands continue to be made on funds and human services from clients, donors, government agencies, volunteers and other stakeholders. Thus with intensifying building of essential competencies and the professionalism of the social sector human capital pool, the need for critical thinking skills and the ability to adapt and apply classroom lessons in the field are essential. The case study method can help meet these needs, through its efficacy as a teaching tool to develop critical thinking skills and its usefulness as a vehicle for the transfer of tacit knowledge and experiences.

Singapore Mental Health Study (SMHS)

Mental Health Disorders and its impact in Singapore

The Singapore Mental Health Study (SMHS) is a comprehensive national collaborative research project led by Associate Professor Chong Siow Ann from Institute of Mental Health (IMH), together with team members Associate Professor Kwok Kian Woon Anthony from the School of Humanities and Social Sciences (HSS), Associate Professor Mabel Yap from the Ministry of Health (MOH), Singapore and Dr Lim Yee Wee from RAND Health, US. Over a 3-year span, the project will assess the prevalence of mental disorders in Singapore, identify barriers to mental health care, investigate the social, cultural and economic impact of major mental disorders, and develop and validate a tool to assess positive mental health in the Singapore population.

A Duopoly Location Toolkit: Consumer Densities Which Yield Unique Spatial Duopoly Equilibria

An extension of known distributions used in density choice

Anderson, Goeree and Ramer (1997) observe that although the uniform consumer density is almost universally assumed in Hotelling style location games, it is more realistic to assume non-uniform distributions. Using Anderson et al.’s (1997) sufficient conditions for the existence of a unique pure strategy equilibrium, Assistant Professor Ernie Teo Gin Swee from the School of Humanities and Social Sciences (HSS), Associate Professor Kieron Meagher from the University of New South Wales and Wen Wang from the Australian School of Business, University of New South Wales extend the list of known distributions with characterised equilibria from two (uniform and triangular) to seven. The extension includes the normal and logistic distributions which are commonly used in empirical research. The effects of density choice on equilibrium outcomes were also analysed. It was found that the uniform distribution inflates differentiation effects when the mean and dispersion of consumer tastes were held constant.
An Assessment of Four Popular Auction Mechanisms in the Sitting of Not-In-My-Backyard (NIMBY) Facilities: Some Experimental Evidence

Evidence contrary to previous research observed in study

Facilities such as landfills and power stations are commonly known as Not-In-My-Backyard (NIMBY) facilities as residents in the vicinity tend to oppose strongly to their sitting in the community. Compensation auctions are one mechanism for the decision making involved in the sitting of such facilities. The research conducted by Professor Euston Quah from the School of Humanities and Social Sciences (HSS) and Dr Yong Jong-Say, Senior Research Fellow from the Melbourne Institute of Applied Economic and Social Research, University of Melbourne, attempted to evaluate the performance of four popular auction formats using laboratory experiments. The auction formats – all-pay first-, and second-price sealed-bid auctions – correspond to the compensation auctions with penalty payments proposed by Kunreuther and Kleindorfer (1986), and Quah and Tan (1998), who claimed that these auctions are more efficient as they restrain strategic (or over) bidding. Research results however contradict the claim by showing that that the first-and second-price auctions without penalty payments are in fact more efficient, in that they tend to minimise social costs, and truthful bidding is more likely.

Promoting Exercise and Healthy Food Consumption: A Study on Senior Citizen’s Acceptance and Adoption of Digitally Mediated Fitness Games

Assessing the Nintendo Wii Fit for senior citizens

The world population is greying rapidly. Worldwide, governments in countries realise that for senior citizens to remain an active part of society, efforts have to be undertaken to ensure active ageing. It is recognised that active ageing leading to social integration and healthy living among senior citizens is dependent on two major health behaviours: regular exercise and healthy consumption. Associate Professor Theng Yin Leng and Associate Professor May O’Lwin from the Wee Kim Wee School of Communication and Information (WKWSCI) received a research grant of S$9,800 from Mitsui Sumitomo Insurance Welfare Foundation to investigate possible approaches offered by the interactive digital technology linking exercise to healthy food consumption. Specifically, the project will focus on assessing the efficacy of digital fit program utilising the newly launched Nintendo Wii Fit, popular in the US and Japan, in promoting regular exercise and healthy food consumption among senior citizens in Singapore (aged 65 years and above). This one-year project is targeted at fulfilling three major research aims:

- To establish baseline information on senior citizens with regard to lifestyle patterns, Interactive Digital Media usage, exercise and food consumption.

- To examine senior citizens’ pre-adoption attitudes in predicting behaviour intentions in using Nintendo Wii, and post-adoption cognitive beliefs and factors influencing intention to continue using (continuance) Nintendo Wii.

- To assess the feasibility of utilising the Nintendo Wii to address the dual strategies of active ageing in promoting regular exercise and healthy food consumption among senior citizens.
Magnetic Resonance Imaging (MRI) Techniques

An innovative imaging technique to address distortion-free magnetic resonance imaging near metallic implants

Assistant Professor Lu Wenmiao from the School of Electrical and Electronic Engineering (EEE) has been researching in novel Magnetic Resonance Imaging (MRI) techniques, and their clinical applications including abdominal, breast and musculoskeletal imaging. He has developed a highly efficient imaging sequence and reconstruction algorithms that provides diagnostically useful image contrast. For example, this work enabled highly SNR-efficient (signal-to-noise ratio-efficient) flow-independent angiography. For this work, Wenmiao was the recipient of the Second Best Poster Award in the category of Pulse Sequence, Image Reconstruction and Analysis at International Symposium on Magnetic Resonance in Medicine (ISMRM) 2007. Recently, he proposed an innovative imaging technique that addresses distortion-free MR imaging near metallic implants. As compared to the state-of-the-art imaging techniques, the proposed technique achieves perfect correction of metal-induced distortions. This technique addresses an unmet need in evaluating patients with metallic implants and is ready for large-scale clinical trials.

Figure 1: Sagittal and coronal flow-independent angiography images of a lower-leg study with excellent depiction of arterial structure. (The bright region is a cyst noted by arrows.)

Figure 2a: Due to severe metal-induced distortions, the MR image obtained from the current technique cannot be used for diagnosis purposes.

Figure 2b: With the proposed technique, the metal-induced distortions are perfectly corrected and the entire spine can be seen.
New Synthesis Algorithm Developments and Hardware Implementations for Image Processing Applied to Medical Diagnostic and Communication Systems

Design and implementation of 2D systems

Associate Professor Anamitra Makur from the School of Electrical and Electronic Engineering (EEE) is leading an NTU team in a joint research project between NTU and Koszalin University of Technology, Poland. Funded by Agency for Science, Technology and Research (A*STAR) Singapore and Polish Ministry of Science and Higher Education, the project aims to investigate design and implementation of two-dimensional (2-D) systems having desirable properties such as low sensitivity, stability, linear phase, and losslessness, which are among other considerations for such 2-D systems. 2-D filters and filter banks are used for various image processing and communication applications.

Surface Construction, Compression and Encoding

Research into surface processing for more efficient 3D imaging

This century has witnessed a “big bang” (an explosion) of digital data. Indeed, information is being created at an exponential rate. Therefore, extraction of relevant information from a huge amount of data is critical to make them useful. Visualisation allows people to comprehend data much more rapidly and economically, and it also can exploit the high bandwidth channel of human visual perception. Surface processing is a key element of visualisation, which needs efficient methods to deal with the surfaces in 3D data sets. For example, in order to visualise the motion of a human body and objects around it from different angles in virtual games, we need fast and accurate tools to process the surfaces of 3D objects. In computer animations, motion of an object can be easily done through the motion and interaction of its surfaces. Therefore, manipulating surface data efficiently is important for many modern digital media applications. The project led by Associate Professor Tai Xue-Cheng in collaboration with Assistant Professors Chen Xin, Wang Desheng and Wang Li-Lian from the School of Physical and Mathematical Sciences (SPMS), will develop new methods for tackling various fundamental problems in surface processing:

- Firstly, the research team shall try to develop innovative methods to construct surfaces accurately and efficiently. Novel ideas and powerful tools from applied mathematics and computer visualisation will be developed for such purposes.
- Secondly, based on some mathematical and computational geometry ideas, the team finds ways to represent the surface for easy control and develop innovative approaches to manipulate and process the surface in an interactive way.
In addition, modern digital applications often require storage of huge surface data in limited disk spaces, and to remotely visualise them through the internet. Thus, the team will explore new ways to “encode” the surface data using as little space as possible, while transmitting them over internet as fast as possible. Encoding here refers to methods that represent the data in a clever way which uses much less storage space to save the same or similar amount of information.

This project concentrates on fundamental researches related to many technologies in Interactive and Digital Media (IDM). The applications of these researches include video games, virtual surgery, e-commerce, medical imaging and visualisation of large scale scientific computing. Surface processing is a key element of these applications.
Info-Communications Technology

Single-Chip Radio

To develop single-chip radio based on advanced silicon and ceramic technologies for low-cost, high-speed, and short-range wireless communications

The Micro Radio Group in the School of Electrical and Electronic Engineering (EEE) is developing a single-chip radio using Complementary Metal Oxide Semiconductor (CMOS) and Low-Temperature Co-Fired Ceramic (LTCC) process.

The first focus of the research is on the radio architecture design. A novel full differential architecture has been proposed for the single-chip radio. The architecture avoids using bulky off-chip or lossy on-chip baluns. The research is pioneering the development of Antenna-in-Package (AiP) technology in LTCC process. A heat spreader inside an IC (integrated circuit) package has been used as an antenna. The antenna has two feeds which can be easily configured for operations of either single-ended or differential signals. This breakthrough in antenna technology received coverage on the front page of the industry’s leading magazine, Antenna Systems and Technology.

The research group is also working on the design of Radio Frequency Integrated Circuits (RFICs) in silicon technology for the single-chip radio. The world’s first differential transmit/receive switch in CMOS has been successfully developed. It is a key building block for the ultimate realisation of the single-chip radio.

The NTU research work on single-chip radio, in particular the differential AiP, has attracted much interest from industry. It has been recognized as the most elegant antenna solution for single-chip radios. In October 2008, NTU and SIMTech jointly announced the successful development of the first antenna-in-package solution in LTCC technology for single-chip 60-GHz radio, a big step forward toward enabling government and commercial organisations to utilise the unlicensed 57-64 GHz band for application development.

The project team, comprising Associate Professor Zhang Yue Ping, Dr Sun Mei of NTU, and Mr Chua Kai Meng, and Ms Wai Lai Lai of SIMTech, was awarded the Best Paper Prize at the IEEE International Workshop on Antenna Technology 2007 held in Cambridge University, UK.
Low Complexity Dynamically Reconfigurable Signal Processing for Cognitive Radios

Potential of providing higher bandwidth wireless services through increased spectrum efficiency

Proliferation of wireless standards and mobile multimedia communication devices have been a catalyst for the research undertaken by Assistant Professor Vinod Achutavarrier from the School of Computer Engineering (SCE) and his fellow colleagues with funding from the Ministry of Education (MOE)’s Academic Research Fund (AcRF). The project titled “Low Complexity Dynamically Reconfigurable Signal Processing for Cognitive Radios” seeks to address the bottleneck issue of the wireless industry, namely spectrum scarcity - a rampant problem that has minimised the ability to include new services. Investigations of spectrum utilisation indicate that not all the spectrum is used in space (geographic location) or time as shown in the figure below. A digital radio can therefore sense and understand its local radio spectrum environment to identify temporarily vacant spectrum for use. This indicates the potential of providing higher bandwidth services, increase spectrum efficiency and minimising the need for centralised spectrum management. Such a radio is termed ‘Cognitive Radio’ (CR). Real-time sensing of wideband spectrum with low power consumption is a crucial task in realising cognitive radio. The outcome of this project will bridge the gap between the algorithm level innovations in spectrum sensing, and their efficient architectural translations by means of novel, low complexity reconfigurable computing techniques. The research will place computationally intensive spectrum sensing and reconfigurable channel adaptation functionalities - to move closer to practical CR terminal implementations which in turn will have significant impact on the multi-billion dollar wireless communications industry. The findings of the research can potentially be applied to spectrum sensing systems in emerging wireless systems.
Collaboration on the Go

A creative environment for mobile knowledge workers

Collaboration on the Go (nomadic collaboration) is an active research area that is currently being pursued by Assistant Professor Anwitaman Datta and Professor Chengzheng Sun from the School of Computer Engineering (SCE). Funded by Agency for Science Technology and Research (A*STAR), this project titled “A Creative Environment for Mobile Knowledge Workers”, has provided both professors with the opportunity to form a research alliance with Assistant Professor Adam Wierzbicki, from the Polish Japanese Institute of Information Technology in Warsaw, Poland. Nicknamed the ‘mTeam’, the goal of this project is to provide innovative support for the creative work of mobile knowledge workers, giving them the freedom to work in an ‘anyone, anywhere, anytime and anyway’ manner. The researchers are looking into a full-spectrum of research topics and technologies that enable nomadic collaboration. This would include algorithmic foundations and basic research on Networked Distributed Systems which will support upper layer functionalities and ubiquity, independent of device (anyway) and location (anywhere); Social Networking to facilitate new collaboration opportunities (anyone suitable) and finally the Collaboration Tools themselves, to carry out the tasks of managing such co-operations.

Tentative mTeam architecture
Information Communication Technology for Health and Society

ICT improves maternal and infant mortality in Aceh Besar, Indonesia

Associate Professor May O’Lwin and Assistant Professor Arul Chib from the Wee Kim Wee School of Communication and Information (WKWSCI) received funding of S$81,000 for a research project on “Information Communication Technology for Health and Society” from the Ministry of Education (MOE)’s Academic Research Fund (AcRF) and World Vision. An article jointly published by Assistant Professors May O’Lwin and Arul Chib entitled, “Midwives and Mobiles: Using ICTs to Improve Healthcare in Aceh Besar”, has been accepted for publication in the Asian Journal of Communication. The project aims to improve maternal and infant mortality in the tsunami-ravaged regions of Banda Aceh, Indonesia. It studies the measures for rural midwives to link up to hospital-based doctors to aid complicated pregnancies, receive training and support from coordinators at health centers, and instantaneously deliver medical indicators via Short Message Services (SMS) to a central database. This project, divided into test and control groups, has multiple data-collection points extending over eighteen months. Traditional survey methodologies and social network analysis are triangulated with qualitative interviews, healthcare statistics and telecommunication data.

Framework for Visual Information Retrieval and Building Content-based Visual Search Engines

Constructing an innovative technique of indexing and annotating database images

Visual Information Retrieval (VIR) is currently an area of active research, investigated from various perspectives and assumptions. Led by Associate Professor Andrzej Sluzek, this project sees researchers from the School of Computer Engineering (SCE) collaborating with both industry and academia in the attempt of combining previous results on machine vision in robotics together with the physiology of human vision to design a novel framework. Together with Institute for Infocomm Research (I2R) and researchers from Wroclaw University of Technology, headed by Professor Halina Kwasnicka, the team is set to construct a new category of local features that correspond to the expected contents of images (‘try to see what you believe you should see’ paradigm) and is able to detect features at the lowest level of image analysis. The method can prospectively be developed into a revolutionary technique of indexing and annotating database images - resulting in a powerful tool for content-based search engines for visual information retrieval. This framework particularly simplifies the quick selection of images, potentially containing data similar to visually presented queries. This project is part of the Singapore-Poland research collaboration program, jointly financed by the Agency for Science Technology and Research (A*STAR)’s Science and Engineering Research Council (SERC) and the Polish Ministry of Science and Higher Education.
Protecting Children’s Privacy Online: How Parental Mediation Strategies Affect Website Safeguard Effectiveness

Type of parental mediation and age group examined

Associate Professor May O’Lwin from the Wee Kim Wee School of Communication and Information (WKWSCI) has a paper published in the Journal of Retailing titled “Protecting Children’s Privacy Online: How Parental Mediation Strategies Affect Website Safeguard Effectiveness”. The paper is co-authored with Dr Andrea J.S. Stanaland from Department of Marketing, College of Business and Economics, Radford University, US, and Dr Anthony D. Miyazaki from Department of Marketing, College of Business Administration, Florida International University, US. The paper is in relation to a research cluster project conducted by Associate Professor May O’Lwin, Professor Ang Peng Hwa and Associate Professor Theng Yin Leng from WKWSCI.

The research by Associate Professor O’Lwin is on children’s safety in an online environment which has resulted in demands for safeguards to protect their online privacy when involved with a wide variety of commercial websites. Unfortunately, little academic research has examined how effective safeguards are in limiting children’s disclosure of information. This void was filled by examining how proposed safeguards may interact with various types of parental involvement in limiting children’s willingness to disclose information online. The results of two studies involving preteen, young teen, and older teen children show that safeguard effectiveness depends on both the type of parental mediation and the particular age group. Implications were presented for retailers, educators, and parents.
Interactive Digital Media

The research thrust in the School of Electrical and Electronic Engineering (EEE) on interactive digital media is focused on the challenges and opportunities associated with the creation, processing, transmission, storage, and application of digital media, such as graphics, animation, sound, speech, image, and video. For example, several faculties from the School have recently secured significant research funding of some $2.9 million under the Agency for Science, Technology and Research (A*STAR)’s Mobile Media Thematic Strategic Research Programme. Their research spans applications, security, retrieval, and content analysis of mobile media. They plan to realise the potential of mobile devices, to study and pioneer the growing trend of users, and to develop mobile media applications that are useful and convenient for the users to adopt in daily life.

Another research effort aims to develop directional sound beam with bass enhancement and beam-steering to support newer forms of interactive digital media applications. One recent research project is on the “Next Generation of Directional Sound Beam with Bass Enhancement and Beamsteering” to support new interactive digital media applications. The Principal Investigator (PI) of this project is Associate Professor Gan Woon Seng. This project has been awarded the first Interactive and Digital Media (IDM) R&D Programme Grant from the National Research Foundation (NRF).

Also another research team, under the guidance of Assistant Professor Andy Khong and Associate Professor Gan Woon Seng, has secured a grant of about S$1.5 million from the NRF-IDM. The title of their research work is “Speech Touch and Acoustic Tangible Interfaces for Next-Generation Applications”.

Other notable areas where active research is being carried out are digital media processing, including compression, analysis and processing, and content-based indexing and retrieval of digital media.

Visual Event Recognition in News Video

Investigating cutting-edge techniques to match escalating interest in online news video search and indexing

Together with School of Computer Engineering (SCE) counterpart, collaborators from Institute of Infocomm Research (I2R) and Columbia University, Assistant Professor Xu Dong is working on a revolutionary project funded by Agency for Science, Technology and Research (A*STAR) entitled “Visual Event Recognition in News Video”. This project is set to tackle the intricacies of event recognition in broadcast news videos, to meet the escalating interest in online news video search and indexing. Together with his team, Xu Dong is set to investigate cutting-edge techniques for this new application, focusing on two research directions: The first is the pursuit of an efficient
similarity measurement between video clips such that the existing learning algorithms (e.g. classical SVM (support vector machine)) can be used directly for classification. The second is to develop new learning technologies to enhance performance. In addition, they are investigating several fundamental problems relevant to new learning technologies, and to new applications of proposed techniques (e.g. near duplicate detection and event recognition in the diverse consumer videos). Through this project, the team aims to develop efficient and effective algorithms for real applications.

Video Categorisation and Representation for Next Generation Compression

Designing solutions to improve compression ratio in video coding

Two scholarships and funding received from the Ministry of Education (MOE)’s Academic Research Fund (AcRF) has enabled Associate Professor Lin Weisi together with peers from the School of Computer Engineering (SCE) to research for a new video coding methodology which is required to address the current major difficulties in improving the compression ratio in video coding, capable of matching the requirements for ubiquity and affordability of multimedia signal representation and communication. The project titled “Video Categorisation and Representation for Next Generation Compression” attempts to find solutions for two underlying problems in prevalent technology; the utilisation of a single codec for video from all sources and the limited consideration of Human Visual System (HVS) properties. Emphasis is given to investigate the characteristics of video and coders with different sources and requirements which will then provide necessary insight for the second phase of the project whereby a new methodology of video coding is to be devised – one which adopts a multi-coder structure, content-based categorisation/adaptation and perceptual representation for next generation video coding. The project also looks to build a perceptual model that supports relevant psychophysical findings. This novel technology could include the following functions: spatiotemporal contrast sensitivity, luminance adaptation, visual attention, etc. The resultant model will be used as an integrated control for the new video coding scheme, complementing the needs of the end-user.

Emerging Mobile TV Industry in Singapore: A Six Forces Model Analysis

Factors that affect the emerging mobile TV industry

Assistant Professor Trisha Lin from the Wee Kim Wee School of Communication and Information (WKWSCI) researches in the development of mobile TV, especially in content creation and business models/strategies. This exploratory research has resulted in two papers presented in international conferences in 2009 in this research area on mobile TV. The papers titled “Emerging Mobile TV Industry in Singapore: A Six Forces Model Analysis” and “Comparison of Mobile TV in Singapore and Taiwan: A Social-Technical System Approach” show that competition (rivalry, new entrant), complementors, and government support, are the forces that favour the rollout of mobile TV in Singapore; however, insufficient made-for-mobile TV content and services, nebulous user demands, and substitutes are likely to inhibit the mobile TV uptake. This project has been carried out in collaboration with Dr Liu Yu-Li, a professor in the Radio and TV Department, National Chengchi University, Taiwan.
“Don’t Do That, Do This”
Exploring real time authoring toolsets and addressing social issues in the medium of digital animation

In this Ministry of Education (MOE) Academic Research Fund (AcRF)’s funded project, Assistant Professor Mark Joseph Chavez from the School of Art, Design and Media (ADM), explores the use of digital animation and innovations inherent to development of content therein as a framework to investigate culturally relevant issues in the current social climate of Singapore and Southeast Asia. This research will result in the formation insights in regards to creating parody with the technical ability to make finely crafted digital animation.

Using Embedded Technology Support for Children’s Concept Development through Play

Innovative play-oriented early childhood pedagogies using i-Cube

The National Research Foundation (NRF) R&D programme on Interactive and Digital Media (IDM) in Education has awarded a grant to a multidisciplinary team of faculty members from the School of Computer Engineering (SCE) and the National Institute of Education (NIE), to explore the use of embedded technology support for children’s concept and social development through responsive play. Led by Associate Professor Goh Wooi Boon from the School of Computer Engineering (SCE) the research titled “Using Embedded Technology Support for Children’s Concept Development through Play” looks to develop and evaluate innovative play-oriented early childhood pedagogies using an interactive audio-visual, kinesthetic and tactile educational tool called i-Cube. i-Cube is an innovative tool; embedded with smart sensors, wireless communication and audio-visual output capabilities that enables tangible user interaction with a computer, through the physical manipulation of block-like objects. Pedagogical research will be conducted to apply and evaluate the efficacy of the i-Cube system for teaching children and children with autism spectrum disorder.
Cinematics and Narratives: Creating Stories within Real-Time Visual Toolsets

Collaboration between NTU and Dreamworks feature animation and the Walt Disney studios

This research funded by a National Research Foundation/ Media Development Authority (NRF/MDA) grant, and led by Assistant Professor Mark Joseph Chavez from the School of Art, Design and Media (ADM), comprised of three inter-related objectives.

The first objective focuses on developing and exploiting real-time animation technology and content within the context of a visual and narrative design repository of animation primitives; the second explores the dynamics of content, exposition and expression, remixing our existing animation primitives into a new form via cinematic narrative. The third objective involves interfacing with an audience in such a way as to enable the system to learn from audience interaction, automatically refining the design. The resulting movie system will create animated experiences that reform content to suit the audience, creating a one of a kind, cinematic experience.

Serious Immersion and Embodied Learning

Traces of dinosaurs in earth system science

In a collaboration with the Learning Sciences Lab, National Institute of Education (NIE), College of Engineering’s School of Computer Engineering (SCE) and School of Electrical and Electronic Engineering (EEE), the School of Art, Design and Media (ADM)’s Assistant Professor Mark Joseph Chavez is a Co-Principal Investigator in this R&D program for an immersive Interactive and Digital Media (IDM) to support learning of Earth system science for Singapore’s secondary level Geography content. This project has received National Research Foundation/ Ministry of Education (NRF/MOE) funding under the MOE R&D Programme on IDM in Education.

Intelligent Agent-Augmented Multi-User Virtual Environments: Research into Designs for Learning Environments of the Future

Enhancing learning experiences through interactive virtual worlds and intelligent agents

The National Research Foundation (NRF) and Ministry of Education (MOE) have awarded the research team steered by Assistant Professor Miao Chun Yan with funding for the research project, “Intelligent Agent-Augmented Multi-User Virtual Environments: Research into Designs for Learning Environments of the Future”. This project fuses talents from different disciplines at NTU namely; the School of Computer Engineering (SCE), School of Electrical and Electronic Engineering (EEE), School of Art, Design and Media (ADM) and the National Institute of Education (NIE). The objective of this research is to develop future learning environments; an agent augmented virtual world that involves intelligent educational Interactive Digital Media (IDM) - integrating intelligent agents with 3D Multi-User Virtual Environment (MUVE). In this research, life-like avatars that simulate real world experience in virtual worlds will be explored to create new, engaging learning environments able to engage and aid students in active learning.
Mobile Alternate Reality Gaming Engine (MARGE): Layering Gaming Interactions in Mobile Content Sharing Environments

Introducing multiplayer role-playing elements for mobile games

An innovative twist to the creation, seeking and sharing of content by introducing passive multiplayer role-playing pervasive gaming elements into mobile content sharing activities is a research project in which Associate Professor Dion Goh, Assistant Professor Alton Chua, Assistant Professor Lee Chei Sian from the Wee Kim Wee School of Communication and Information (WKWSCI) and Associate Professor Rebecca Ang, from the School of Humanities and Social Sciences (HSS) are venturing into, with a grant of $0.8 million from the National Research Foundation (NRF). In this project, play is intertwined unobtrusively with the collaborative creation, seeking and sharing of information such that these activities become the mechanics of gameplay. A persistent layer of alternate reality over digital information associated with the real world by weaving a storyline into mobile content sharing is being created. To achieve this goal, a multidisciplinary approach to address four objectives will be undertaken: construct a framework for mobile content sharing through gameplay, design our proposed gameplay for mobile content sharing using the framework, implement a system (Mobile Alternate Reality Gaming Engine (MARGE)) that realises our vision of mobile content sharing through gameplay, and evaluate MARGE and examine its social implications of use. The deliverables of the research are expected to find wide applicability in a variety of contexts and industries including telecommunications service providers, tourism, culture and heritage, education and training, and advertising and marketing.
**Handbook of Cultural Intelligence: Theory, Measurement, and Applications**

An invaluable resource for future research and application in cultural intelligence

Cultural Intelligence, or Cultural Quotient, is a measure of an individual’s ability to function effectively in an environment or social setting as influenced by the individual’s background. The “Handbook of Cultural Intelligence: Theory, Measurement and Applications” edited by Professor Ang Soon, Executive Director for the Center for Leadership and Cultural Intelligence, Nanyang Business School (NBS), and Professor Linn Van Dyne from Michigan State University, consists of chapters contributed by renowned scholars from around the world. The handbook is a well-informed summary of the body of knowledge about cultural intelligence and is particularly relevant in today’s global and diverse work environment.

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**From Experience to Experiential Learning: Cultural Intelligence as a Learning Capability for Global Leader Development**

Cultural intelligence helps global leaders learn from international assignments

The research conducted by Associate Professor Ng Kok Yee, Professor Ang Soon, both from the Center for Leadership and Cultural Intelligence, Nanyang Business School (NBS), and Professor Linn Van Dyne from Michigan State University, on cultural intelligence and experiential learning focused on learning outcomes gained from international assignments. The project posits that cultural intelligence acts as a moderator in a process model that explains how global leaders convert international work assignments into learning experiences that result in developmental outcomes. This has major implications for the organisations in the selection and training of individuals for international job assignments.

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**Personality and Leader Effectiveness: A Moderated Mediated Model of Leadership Self-Efficacy, Job Demands and Job Autonomy**

Associate Professor Ng Kok Yee, Professor Ang Soon and Associate Professor Chan Kim Yin from the Center for Leadership and Cultural Intelligence, Nanyang Business School (NBS), in the collaborative project with SAFTI Military Institute, investigated how Leadership Self-Efficacy (LSE) influences the traits: neuroticism, extraversion, and conscientiousness with leader effectiveness, given differing job demands and job autonomy. Results showed that LSE mediates the relationships for all three personality variables only for leaders with low job demands, neuroticism and conscientiousness only for leaders with high job autonomy, and extraversion regardless of level of job autonomy.
Managerial Risk-Taking Behaviour and Equity-Based Compensation

The research by Assistant Professor Angie Low from the Nanyang Business School (NBS) looked at the effect on equity-based compensation on manager’s risk-taking behavior, which impacts shareholder wealth. The study shows that managers lower firm risk when faced with an increase in takeover protection. This risk reduction is concentrated among firms with low managerial equity-based incentives, in particular firms with low CEO portfolio sensitivity to stock return volatility. Firms in turn respond by providing managers greater incentives to increase risk-taking.

Survey of Best Practices of the Lodging Industry in Asia

Case studies of hotel facilities in Asia to highlight best practices in the industry

Associate Professor Wee Beng Geok from the Nanyang Business School (NBS) identified numerous case studies of a broad spectrum of hotel facilities in Asia to highlight innovative best practices of the industry. The goal of the study was to facilitate the advancement of the hotel industry at large and focused on the areas of human resource management, training and development, general management, operations, corporate social responsibility, environmental issues, and information technology.

Task Knowledge Overlap and Knowledge Variety: The Role of Advice Network Structures and Impact on Group Effectiveness

Study examines relationship between group effectiveness and influencing factors

Drawing from the structural perspective of social capital theory, this research by Assistant Professor Wong Sze Sze from the Nanyang Business School (NBS) investigates how internal and external advice network structures influence knowledge overlap and variety and, how these knowledge dimensions in turn influence group effectiveness. Findings from two studies on knowledge-intensive groups indicate that different advice network structures are associated with knowledge overlap and knowledge variety, and only knowledge variety was significantly associated with group effectiveness. In addition, despite implicit understanding that advice networks aid performance through enhancing knowledge outcomes, only knowledge variety was found to mediate the relationship between external network and group effectiveness. Implications for theory and practice are discussed in the study.

Business Journey to the East

A look at realities of doing business in Asia

In the book “Business Journey to the East”, Professor Wee Chow Hou from the Nanyang Business School (NBS) explores with co-author Fred Combe, founder and Managing Director of NATUS Private Limited, a Singapore-based corporate management consultancy, the various challenges that companies, leaders, and individuals face while doing business in Asia. This book deals with the practical, cultural and historical realities of doing business in Asia and encourages Westerners to adopt a new openness and fresh attitude with their Asia business counterparts.
Mathematical Science and Cryptography

Theory and Practice of Coding and Cryptography

Research in Cryptography for potential future applications

A team from the School of Physical and Mathematical Sciences (SPMS), comprising Professor Ling San, Associate Professor Chee Yeow Meng, Assistant Professor Frederique Oggier, Associate Professor Wang Huaxiong and Professor Xing Chaoping, together with two overseas co-investigators, won a Singapore National Research Foundation (NRF) Competitive Research Program (CRP) award, worth nearly S$10 million, to conduct research in coding and cryptography. The purpose of the project is to develop new theories and techniques in areas such as: constructions and new applications of block codes, quantum coding, space-time coding, public key cryptosystems, private key cryptographic primitives, hash functions and secure multiparty computations, through the use of diverse mathematical and algorithmic tools. Potential applications in various contexts will be explored in tandem.

Cryptographic Techniques for Secure and Fault-Tolerant Distributed Computations

Applying mathematics and coding theory to tackle fundamental cryptographic issues

The rapid growth of the Internet has created tremendous opportunities for cooperative computation, where people are cooperating with each other to conduct computation tasks based on the inputs they each supply. These computations could occur between trusted parties, between partial trusted parties, or even between competitors, where privacy and reliability are the major primary concern.

The project, funded by the Ministry of Education (MOE) Academic Research Fund (AcRF), is led by Associate Professor Wang Huaxiong, Professor Ling San and Associate Professor Chee Yeow Meng from the School of Physical and Mathematical Sciences (SPMS). The project aims to develop theories, techniques and tools for secure distributed computation with a wide range of computation domains, as well as to design efficient and practical cryptographic protocols with real-life applications. The research is to apply sophisticated mathematical tools of algebra, combinatorics and coding theory for tackling several fundamental cryptographic problems.

The outcomes of this project are set to enhance information protection, which is crucial for rapidly growing e-commerce services, and to strengthen national safeguard capability of digital systems and infrastructure. It will contribute to enhancing Singapore’s leading position in the telecommunication and information industries. It will also contribute to our society by protecting individual’s privacy and providing security for sensitive data.
Algebraic Curves over Finite Fields and their Applications

An example of applications of pure mathematics

For a long time, the study of algebraic curves over finite fields belongs to the realm of pure mathematicians. After a series of three papers in the period 1977-1982, Goppa found fascinating applications of algebraic curves over finite fields, and especially of those with many rational points, to coding theory. This created a much stronger interest in the area and attracted new groups of researchers such as coding theorists and algorithmically inclined mathematicians. Several other incentives were provided by the invention of elliptic-curve cryptosystems and factorisation of large integers in 1983-1986 and construction of low-discrepancy sequences in 1995-1997. Algebraic geometry over finite fields is a flourishing subject nowadays which produces exciting research and is immensely relevant for applications.

The research led by Professors Xing Chaoping and Ling San from the School of Physical and Mathematical Sciences (SPMS) is to develop some new theory and techniques through the study of algebraic curves with many rational points and various applications of algebraic curves over finite fields and algebraic number fields. In particular, they expect to develop some new and systematic constructions of algebraic curves over finite fields with many rational points, block codes, lattices, sequences in cryptography etc. The other aim is to provide the theoretical foundation for software implementation of their low-discrepancy sequences. Furthermore, the team plans to provide some interrelation between block codes and algebraic curves.
**Research Highlights**

**Self-Assembled Growth of Silicide Nanostructures: The Gold Touch**

Methods to synthesise copper silicide nanomaterials with good shape and orientation control

Controlling the shape, size and orientation of nanostructures is a difficult task, but it is an essential step for their applications in nanoscale devices. Of particular interest are silicide nanostructures, that is, alloys of silicon with other metals, which could provide active components for state-of-art electronics. Assistant Professor Tom Wu, in collaboration with Assistant Professor Chen Hongyu, from the School of Physical and Mathematical Sciences (SPMS), is exploring novel routes to produce silicide nanostructures, with the financial support from the university’s Start-Up Research Fund (SUG). Taking a different approach from previous efforts, gold nanoparticles were dispersed on the silicon substrates and vapour transport growth was conducted in a tube furnace under a controlled environment. Interestingly, according to the particular substrate orientation, nanotriangles, nanosquares or nanowires were formed, with one thing in common: their sides were all oriented along the same direction. Gold nanoparticles not only initiate the copper-silicon reaction, but also control the final size of the nanostructures. Since silicon and various metals are very common in today’s electronics, this project has important applications and other functional silicides will be investigated.


**Novel Individual Carbon Nanotube Electronic Devices**

A unique single-walled carbon nanotube (SWNT) diode with no p-n junction

Associate Professor Zhang Qing and his team members in the School of Electrical and Electronic Engineering (EEE) have fabricated a type of unique Single-Walled Carbon Nanotube (SWNT) diode which has no p-n junction. The devices have a structure of SWNT field-effect transistors, in which the SWNT channel length is only 90 nm. Aluminum and gold are used as their drain and source electrodes, respectively. At room temperature, the devices show diode-like characteristics with a maximum current rectification ratio of \(-10^4\). The channel conductance oscillations caused by single-electron tunneling through the asymmetric barriers at the drain and source contacts are observed up to 100° K. The results have been published in Nano Lett. 8, 64 (2008).
Teaching and Learning

Teaching and Learning in Physical Education: Promoting Pupils’ Participation in Lifelong Physical Activity

The status of teaching and learning in Physical Education (PE)

In 2006, National Institute of Education (NIE) embarked on a Ministry of Education (MOE) Educational Research Funding (EdRF) Project entitled, “Teaching and Learning in Physical Education: Promoting Pupils’ Participation in Lifelong Physical Activity”. This project was to be completed in 2008 with the funding of S$432,050 from MOE. The Principal Investigators (PIs) of this project are Associate Professors John Wang, Michael McNeill, Michael Chia, Steven Tan and Assistant Professor Chow Jia Yi from the Physical Education and Sports Science (PESS) academic group of National Institute of Education (NIE). This project is a joint effort between MOE and NIE to examine the current status of teaching and learning in Physical Education (PE), and is valuable as a better understanding of what is currently happening to help to inform policy-makers, administrators, and educators on what can be changed or improved in order to promote pupils’ participation in lifelong physical activity.

Since the project’s inception, many interesting things have taken place and more exciting findings are expected as the project goes into its final lap. To date, reports have been sent to 28 schools, helping them to better understand the motivational profiles of their pupils and formulate more effective actions in the teaching and learning in PE. An inspirational DVD exemplifying best practices in PE has also been produced. Plans are underway to share these best practices with all schools in Singapore, and also to help them in making positive changes in teaching and learning in PE.
Enhancing Education in Environmental Awareness: A Game-Based Approach to Ambient Learning

Assessing the effectiveness of educational games

This project, led by Assistant Professor Vivian Chen from the Wee Kim Wee School of Communication and Information (WKWSCI) in collaboration with Assistant Professor Duh Been-Iirn from the National University of Singapore (NUS), Assistant Professor Tzuo Pei Wen from the National Institute of Education (NIE), Associate Professor Chen I-Ming and Dr Lim Hock Beng from the Intelligent Systems Centre, aims to develop educational games to enhance students’ learning of weather and environmental issues in Singapore. The project has been given an award of S$1.6 million by the National Research Foundation (NRF). The project, based on pedagogical objectives, allows students to gain access to real time weather and environmental information obtained through real data from weather stations at individual schools (as part of the National Weather Study Project). The interface of the game utilises usability and interaction design principles to make sure students have good user experiences with the mobile device and the web interface. Based on education theories, good classroom climate and collaborative learning, the project enhances better learning outcomes, and through game playing, it allows students to have frequent interaction with their peers and teachers, hence creating a more intimate learning environment. It also promotes learning together with others via discussions. The project also assesses the effectiveness of the new learning device and platform. It includes the evaluation of the accessibility of the games, the effectiveness of using games as a teaching tool, the impact of game playing on relationship building among students and teachers, and the consequential effects on learning.
Visual Art and Society

Multimedia Exhibition of Cultural and Heritage Research

Global Positioning System (GPS), video and photography used to research and document two of the five sacred Taoist mountain temples of China and translated into a multimedia exhibition

Assistant Professor Astrid Al Mkhlaafy from the School of Art, Design and Media (ADM) will explore and research on the pilgrimages to Mount Tai Shan and Mount Hua Shan, which are two of the five sacred Taoist mountain temples in China. As a part of this exploration, which is funded by the Ministry of Education (MOE)’s Academic Research Fund (AcRF) grant she will visit, climb, document and finally exhibit her findings of the pilgrimages using Global Positioning System (GPS), video and photography. She will record, coordinate, and fuse local research with the onsite video and sound of the footage of the actual treks. This work intends to document and record historically significant locations and processionals with the newest technology to help preserve and record them for future generations.

She is bringing the GPS technology into her classroom to enhance her conceptual understanding of the technology for practical usages in new realms.

Hero and Idols in Contemporary Singaporean Society

Portraiture using painting and video technologies

Matt Ridley’s book, “Origins of Virtue: Human Instincts and the Evolution of Cooperation”, speaks of the innate desire for humans to cooperate. According to Reynolds, the “hero” in Singapore’s culture is the concept of cooperation. The rapid development of Singapore’s infrastructure in an incredibly short amount of time would not be possible without the cooperative actions of differing cultures and differing classes working together. Granted, the status and hierarchy of the workforce sometimes creates social conflict, however, the need to survive ultimately prevails and results in cooperative action amongst groups of people dependent on each other in a complex system.

To illustrate this case, Assistant Professor Eileen Anastasia Reynolds (Principal Investigator) together with Assistant Professor Joan Marie Kelly (Co-Principal Investigator), both from the School of Art, Design and Media (ADM), developed a portable digital capturing system and have created innovative animations with groups of people from differing backgrounds, which test their ability to cooperate to reach a shared goal. This project funded by the university’s Start-Up Research Fund (SUG) involved 33 students from the School of Electrical and Electronic Engineering (EEE) to work on this project within the NTU campus and in Little India.

Using digital cameras, photo manipulation, in-camera editing techniques, and stop-motion pixilation she created distinct and innovative video portraits of each group, which collaborated with her. So far, collaborative video portraits have been made of student engineers from EEE, migrant workers in Little India, and media students at the University of Malaysia. These videos have been shown at several recent exhibitions, in Singapore and in Malaysia and one video piece, “Synchronicity” was recently selected for the International Santa Fe Film Festival (3 to 6 December 2008).

Video Still – Synchronicity Series
Shoes and Social Fabrics: Exploring the Journeys and Life-Worlds of a Pair of Flip-Flops

Exploring the symbiotic relation between visual arts and sociology

This project was a collaborative experimental research by Assistant Professor Michael Tan (Principal Investigator) from the School of Art, Design and Media (ADM), and Dr Caroline Knowles, Professor of Sociology from Goldsmiths College, University of London. They proposed a pilot-study to test the feasibility of a visual ethnography of a single pair of flip-flops – from raw material to disposal stage – documenting in parallel the individual lives, families and communities that intersect with it. This project involved mapping the life of the slippers and the human life that it parallels in two cities; Fuzhou, China and Addis Ababa, Ethiopia; through photographic essay and writings.

Product chains are rarely conceptualised as biographies, or as human chains, imaginatively connecting diverse lives across continents. Globalisation, too, is rarely conceptualised in these terms around ordinary humble objects and lives. Through this collaborative research work, Assistant Professor Tan and Dr Knowles sought to highlight the possible social inequalities as a consequence of globalisation and secondly, to devise a research approach by conceptualising the use of an everyday object – the flip-flops – to reveal human biographies. This collaborative project was a reflexive exercise to explore the possibilities beyond their respective area of practice, namely Visual Arts and Sociology; to examine the synergistic attribute of multidisciplinary work approaches. This research served as an opportunity to imagine the possibilities in knowledge production and dissemination. It exemplified the symbiotic benefits of knowledge sharing between disciplines.

This research was funded under the Ministry of Education (MOE)’s Academic Research Fund (AcRF) and The British Academy Small Research Grant.
Window Therapy

An art therapy project that brings a glimpse of the outside world into the wards and the waiting area of the geriatric ward in a hospital

Assistant Professor Karen Hong from the School of Art, Design and Media (ADM) is part of this project which also involves the Alexandra Hospital in Singapore, University of the Arts, London (UAL) and Tanglin Trust School Singapore.

The project involved a group of 20 students aged between 13 and 16 years of age, whom Assistant Professor Karen Hong mentored together with another alumnus of the University of the Arts, London.

The initial stage of the project started with a guided tour of the Geriatric Ward of Alexandra Hospital. The Geriatric Ward consists of a Day Care Centre for the elderly, a Clinical Ward, a Geriatric Rehabilitation Centre and a Multi Purpose Hall. The mentors were given the challenge to bring art and design and to create a more natural and tranquil environment, bringing a glimpse of the outside world into the wards and waiting areas to the elderly in the ward.

Beyond Typography

Experiments in form to investigate how far the qualities of typography can be pushed and still retain its meaning

This project, funded by the Ministry of Education (MOE)’s Academic Research Fund (AcRF) is led by Assistant Professor Jesvin Yeo from the School of Art, Design and Media (ADM). The project’s challenge is to explore and investigate visual based learning and development through experimenting form in the area of typography. The research is divided into two main components;

i. Concerning visual perception, and

ii. Information explication. All areas will be subjected to experimental studies and result in actual output of digital or prints form.
For 2 months, the mentors worked with the students by conducting workshops on fundamental principles of creative thinking and idea development and personally demonstrated a variety of experimentations with different mixed-media and techniques. It was decided that the windows of the ward would provide the canvas for the artworks. This proved a fantastic opportunity to create a stunning environment for the patients, with art that connected the inside with the outside. The final presentation to the hospital was a range of prints, designed by students together with the mentors. The resulting imagery represented the luscious and diverse floras and faunas of Singapore, which were printed on transparent vinyl and installed on 16 windows of the Geriatric Ward.

The project culminated with an exhibition titled “CREATIVE SYNERGIES” which was opened by Dr Milton Tan, Director of Design Singapore Council on 2 September 2008.

The main sponsor printing of the final artwork is Overseas Academic Link Private Limited (OAL), the Singapore representative of UAL.

Photos of the windows – before

(a) to (e) are photos of the windows - after

Left to Right : Anthony Tan, Alumni of UAL; Serene Yong, Local representative of UAL; Colin Kerrigan, Deputy Director of UAL; Assistant Professor Karen Hong of the School of Art, Design and Media (ADM) and Alumni of UAL; Robert Le-Grice, Head of Art Tanglin Trust; Bob Masterton, Director of UAL and Steven Andrews, CEO Tanglin Trust School
Digital Imaging in Singapore

The integration of digital imagery with traditional art media and techniques for site specific architectural, urban and landscape settings of Singapore

Innovative approaches toward image creation methodologies, integration of emotive and subjective abstract imagery in digital, traditional and non-traditional forms – are currently areas of active research in which Assistant Professor Ina Conradi Chavez from the School of Art, Design and Media (ADM) is delving into, with the financial support from the Ministry of Education (MOE)’s Academic Research Fund (AcRF).

Implementing the latest technologies in image creation, this research project attempts to document emotive spaces and impressions of Singapore to build illusions of three-dimensional creative vision; then moves forward to using this imagery as a resource for more creative work that will comprise of an exploration of manipulated surfaces and mixed media structures in site specific settings. The project’s aim is to explore abstract imagery in the Singaporean context, using techniques commonly used in the feature film visual effects industry and advertising, e.g. high quality large-sale image creation for banners, posters and projection.

There are four basic problems that Assistant Professor Ina is currently exploring in this research project: oversized image creation using algorithmic paint strokes, high resolution computer rendering techniques, over-painting techniques and reactive painted surfaces and imagery integrating animation and physical motion.

With a focus on exploring techniques for integrated image generation, painting with digital technologies and integrating traditional art and materials, the emphasis is on exploring the limitations of the digital medium, painting and reactive imagery and then pushing to achieve greater creative levels. This research is looking into how the image combined with digital and traditional painted and drawn mediums, affect the significance of the surface. In part, by exploring commercial and custom-coated substrates and an assortment of special surfaces such as metal, plastic laminates in a digital printmaking approach as well as an interactive prototype depicting the illusion of surface.

Implemented methods and art work developed will be exhibited in several galleries and site specific locations such as Post Museum, Esplanade Concourse, NTU’s ADM Gallery, ION Orchard, Krannert Art Museum University of Illinois, Los Angeles Center for Digital, Ljubljana Municipal Gallery and Slovenia Europe; and screened at animation festivals.

The figure above is an oversized image creation using algorithmic paint strokes and utilising high resolution computer rendering techniques. When digital images are combined with outsized and multidimensional surfaces, the creative possibilities are vast, and continue to expand as the new technologies emerge.
EEE Gearing Up for Clean Energy Initiatives and Challenges

The landmark announcement from the Prime Minister’s Office that Clean Energy shall be a major pillar of the country’s economy, was followed by a slew of funding initiatives from public agencies to promote research, education and enterprise in energy technologies. Many global companies in solar photovoltaic, wind, tidal, bio-fuels, fuel cells, hybrid automotive parts, energy storage and other energy-related areas have begun setting up research and development (R&D) centres and manufacturing plants in Singapore. In order to re-position NTU to meet the new challenges and opportunities, the School of Electrical and Electronic Engineering (EEE) has revamped its former Centre for Advanced Power Electronics to the new Centre for Smart Energy Systems (CSES). Its Division of Power Engineering has also been working with the Economic Development Board (EDB) to set up a new Specialist Manpower Program in Clean Energy, with support from the Division of Microelectronics, School of Mechanical and Aerospace Engineering (MAE), and School of Materials Science and Engineering (MSE). EEE is expected to receive over S$20 million in funds over the next few years for research and education in energy-related fields. In February 2008, five projects from the Division of Power Engineering were awarded a combined grant of S$3.48 million from the Agency for Science, Technology and Research (A*STAR) under the theme of Intelligent Energy Distribution Systems (IEDS). Just recently, two projects from the Division of Microelectronics were awarded a combined grant of about S$2.7 million under the EDB Clean Energy Research Programme (CERP). The projects are pertaining to the study of high efficiency solar cells.
Combined-Cycle Solar Energy Self-Sustaining Membrane Distillation and Membrane Distillation Bioreactor (MDBR) Water Production and Recycling System

A 'zero-energy' water production and recycling system

Due to the recent economic growth, especially in the developing countries, carbon emissions have been a major concern as it leads to global warming and climate change. In addition to this, there is also shortage of water in most of the major cities around the world. Water scarcity and availability of electrical power is also major concern in rural areas whereby water and electrical energy are not easily available.

Currently, in order to overcome the shortage of water around the world, reverse osmosis processes and other conventional water purification methods have been implemented. However, currently used purification processes require enormous energy.

This research programme led by Associate Professor Choo Fook Hoong of the School of Electrical and Electronic Engineering (EEE) aims at the desalination of seawater as well as recycling of sewage water using solar energy, a resource which is abundant around the world. This will ultimately resolve the issues in rural areas whereby water scarcity and energy scarcity are common.

The programme was awarded with S$10 million funding by National Research Foundation (NRF)'s Competitive Research Programme (CRP), and its objective is to use the natural phenomenon and resources of the solar system to clean up waste-water generated and contaminated by humans into drinkable water, without adding further damage to the environment. In the natural world, dirty water on land is naturally cleaned by plants and micro-organisms. The same idea is to be applied to the Membrane Distillation Bioreactor (MDBR) system. Through the use of solar energy, a 'zero-energy' water production and recycling system will be built and it will have a tremendous impact on water production and recycling.

The Research Program comprises six major components, namely:

1. Solar Thermal Collection System Research by Associate Professor Choo Fook Hoong and Associate Professor Tan Fock Lai

2. Solar Thermal Energy Storage Research by Associate Professor Choo Fook Hoong and Associate Professor Tan Fock Lai

3. Energy, Temperature and Control System Research by Associate Professor Choo Fook Hoong and Associate Professor Ling Keck Voon

4. Optimisation of Membrane Distillation and Membrane Distillation Bioreactor Wastewater Reclamation by Professor Anthony Gordon Fane, Dr Wong Fook-Sin and Mr Maung Nyunt Wai

5. Data Logging, Acquisition and Analysis by Associate Professor Choo Fook Hoong and Associate Professor Chan Chee Keong

6. Solar Photovoltaic Electric Energy, Storage and Conversion System Research by Associate Professor Choo Fook Hoong, Associate Professor Wang Peng and Assistant Professor Loh Poh Chiang
Schematic of Solar-Powered Membrane Distillation Pilot Plant

Schematic of Solar-Powered Membrane Distillation Bio-reactor Pilot Plant
Solar Thermal Energy Storage

Cost effective solar thermal storage integration, operation and maintenance

The need for solar thermal storage arises due to the mismatch between the availability of solar energy and the demand needs of the processes or applications during the night or due to unpredictable weather conditions. The Thermal Energy Storage (TES) acts as a buffer between the solar collectors and the processes or applications that require solar heat. There are basically three types of thermal energy storage systems – sensible heat storage, latent heat storage and thermochemical heat storage. TES is needed in the research project to supply solar thermal heat to drive the Membrane Distillation (MD) and Membrane Distillation Bioreactor (MDBR) plants in the production of water from seawater and wastewater respectively, and continuously in the 24-hour period.

The objectives of the project are to conduct research into more efficient thermal energy harnessing and storage of thermal energy collected from the solar collectors, to develop cost effective solar thermal storage solutions and to develop engineering strategies for efficient solar thermal storage integration, operation and maintenance. This project is undertaken by Associate Professor Tan Fock Lai from the School of Mechanical and Aerospace Engineering (MAE) in collaboration with other team members namely Associate Professor Choo Fook Hoong, Associate Professor Wang Peng, Associate Professor Chan Chee Keong, Associate Professor Ling Keck Voon and Assistant Professor Andrew Loh Poh Chiang from School of Electrical and Electronic Engineering (EEE), Nanyang Professor Anthony Fane from the School of Civil and Environmental Engineering (CEE), and Dr Wong Fook-Sin and Mr Nyunt Wai from the Institute of Environmental Science and Engineering (iESE).
Research Highlights

Distribution of N-TiO$_2$ nanoparticles over the microscale powdered activated carbon particles for 17% (w/w) N-TiO$_2$/AC composite

Incommensuration in Oxide Crystal Structures: Impact on Photocatalysis and Ion Conduction

Determination of oxide crystal structure to guide chemical tuning and property optimisation

Crystal structures are generally assumed to be periodic in three dimensions. However, as the ability to probe materials more deeply using electrons, neutrons and synchrotron X-rays have developed, it has become clear this simple notion is often incomplete. In fact, many technological materials can only be described in higher dimensions. This project extends the collaboration between teams from the School of Materials Science and Engineering (MSE) led by Associate Professor Tim White and the University of Surrey, who are designing, synthesising and characterising fresnoite and apatite ceramics as photocatalysts and solid oxide fuel cell electrolytes.

This research funded by the Ministry of Education (MOE)’s Academic Research Fund (AcRF), will focus on single crystal determinations to completely describe incommensurate structures that will guide chemical tuning and property optimisation.

Nitrogen-Doped TiO$_2$/AC Composite for Adsorptive-Photocatalytic Oxidation-Reduction of Refractory Organic Substances under Solar Irradiation in Water Purification

To develop solar photocatalytic redox processes for water and used water treatment

Funded by National Research Foundation (NRF), the project led by Associate Professor Lim Teik Thye from the School of Civil and Environmental Engineering (CEE) integrates the skill sets of environmental process engineering, materials engineering and advanced materials characterisation to demonstrate a new generation of adsorptive-photocatalysts, a composite of nitrogen-doped TiO$_2$ supported on powdered activated carbon (N-TiO$_2$/AC), which are photoactive under UV/vis-light for the photodegradation of emerging contaminants. Success of the project will enable a large-scale, economical, clean, and safe application of photocatalytic redox processes in water treatment for potable water reuse.
Development of Inorganic Proton Exchange Membrane for High Temperature PEM Fuel Cells

Heteropoly Acid (HPA) embedded silica mesoporous nanocomposite has the potential to act as inorganic Proton Exchange Membrane (PEM) at high temperatures

High temperature Proton Exchange Membrane Fuel Cells (HT-PEMFCs) have significant advantages over the current PEMFC technology operating at temperatures below 100°C. Direct methanol and ethanol fuel cells benefit greatly from improved oxidation kinetics at elevated temperatures. The critical challenge in HT-PEMFCs is the development of a proton exchange membrane which can operate at temperatures from 200°C to 300°C. The fuel cell group led by Associate Professor Jiang San Ping from the School of Mechanical and Aerospace Engineering (MAE) discovered that Heteropoly Acid (HPA) embedded silica mesoporous nanocomposite synthesised by a novel self-assembly process is highly proton conductive and preliminary results demonstrate that proton conductivity of HPA/silica mesoporous nanocomposite is as high as 0.05 S/cm at 350°C, showing the significant potential in the development of practical, compact and liquid-fuel based portable power sources based on these inorganic proton exchange membranes.
Integration of Novel Forward Osmosis Membranes and Optimised Bioprocess for Water Reclamation

Potential lower energy requirement and high quality purified water from reclamation

The integration of the Forward Osmosis (FO) membrane and the activated sludge bioprocess is a new variant of the Membrane Bioreactor (MBR) technology known as the Forward Osmotic Membrane Bioreactor (FOMBR). By using dense FO membranes, the FOMBR offers potential advantages such as lower energy requirement and high quality purified water for water reclamation, because the dense FO membrane retains recalcitrant organics and increases their biodegradation. However, a number of technical barriers impede FOMBR industrial applications. Two major challenges are the lack of an ideal membrane that can produce a high water flux and poor optimisation of bioprocess performance in the bioreactor.

With financial support from the Environmental and Water Industry Development Council (EWI) of Singapore, Professor Antony Gordon Fane from Singapore Membrane Technology Centre (SMTC) and his team are developing novel FO membranes suitable for use in the FOMBR systems for water reclamation. The membranes will be integrated with a biological process enhanced by system optimisation. The multidisciplinary team includes Associate Professor Wang Rong, Assistant Professor Tang Chuyang and Associate Professor Liu Yu from the School of Civil and Environmental Engineering (CEE), and collaborators from Centre for Advance Water Technology (CAWT), DHI-NTU centre and Imperial College; with expertise encompassing membrane making and characterisation, membrane separation and fouling, biological reaction, modelling, and operational experience.

The aim of the project is to develop further the FOMBR technology and translate it from bench scale to practical application. It will have direct benefits for the water industry in terms of better water quality and lower production cost as well as more options for various types of used water treatment. It will also provide strategic benefits for Singapore by meeting the national goals in sustainability through water reclamation.
Apatite-based Electrolyte for Low to Intermediate Temperature Solid Oxide Fuel Cells

Study may lead to use of apatite-based oxides as electrolytes in low to intermediate temperature solid oxide fuel cells

Apatite-based oxides are potential candidates as electrolytes, for low to intermediate temperature solid oxide fuel cells. Indeed oxide ions located in large conducting channels of the apatite structure suggests that this material should be appropriate for such an application. The key challenges in the apatite system are the fundamental understanding of ionic conduction mechanism and kinetics, and the high phase formation and densification temperatures (~1700°C). A research team led by Associate Professor Jiang San Ping from the School of Mechanical and Aerospace Engineering (MAE), in collaboration with Assistant Professor Su Haibin from the School of Materials Science and Engineering (MSE) and Dr Wu Ping from the Institute of High Performance Computing (IHPC) will combine the advanced computational modelling and systematic experimental approaches to address the fundamental issues associated with the ionic conduction, sintering and densification, with the financial support from the Ministry of Education (MOE)’s Academic Research Fund (AcRF). This fundamental project will have significant and long lasting impact on the solid oxide fuel cells development and will further enhance the status of Singapore as one of the key clean energy R&D centres in the region.
To enhance our research prowess, the University actively pursues strategic alliances with top institutions, organisations and leading industry players around the world, forging strong partnerships and collaborations. Leveraging on our partners’ strength and resources, we bolster our research capabilities and capacity, while at the same time remaining relevant to industrial and economic development needs.
Collaborations and Partnerships

NTU and Chartered setup Joint Lab for Advanced Research in Silicon Nanoelectronics

31 August 2007 marked a significant milestone in the long-standing collaboration between NTU and Chartered Semiconductor Manufacturing Ltd. – the inauguration of the Chartered@NTU laboratory. Chartered@NTU is a 100 square-meter joint laboratory set up by the two organisations to promote technology exchange and collaboration for joint research and development projects. The focus of the research area is cutting-edge nano-scale complementary metal oxide semiconductor (CMOS) process technology and reliability.

The establishment of a physical laboratory in the School of Electrical & Electronic Engineering (EEE) brings researchers from both organisations a big step closer, significantly enhancing the good long-standing relationship between the two parties. Since 1996, both parties have collaborated on numerous research projects in the field of advanced CMOS process and device technology. At that time, a Memorandum of Understanding (MOU) was sealed to facilitate the exchange of intellectual ideas between both parties in their scientific pursuit. Since then, the research programme has successfully trained a large pool of highly skilled semiconductor specialists to support the research and development (R&D) and operational needs of Chartered.

Chartered@NTU leverages on the strengths of both organisations. NTU provides the research talent and expertise while Chartered provides industry and manufacturing knowledge. The joint lab provides practical training and industrial exposure opportunities for NTU's postgraduate students to work on real-world projects with engineers from Chartered. The lab is equipped with state-of-the-art equipment such as 12-inch wafer probers and ultra-fast transient measurement systems, which allow high-precision CMOS transistor characterisation. They are particularly critical in improving the performance and reliability of the microchips fabricated using 65 nm CMOS technology, which is being widely adopted for microprocessor chips used in high-performance desktop and laptop computers, network workstations as well as game consoles.

NTU’s graduate students and researchers have started working on projects in the joint lab with Chartered’s research scientists and engineers. Fully operational since August 2007, the lab houses 20 graduate students from NTU and adjunct staff from Chartered. Graduate students on the research programme receive attractive scholarship grants and are guaranteed a head-start in a high-tech career with Chartered after graduation.
Collaborations and Partnerships

Microelectronics Failure Analysis Laboratory set up in partnership with DSTA, DSO and TL@NTU

The School of Materials Science and Engineering (MSE) has set up the Microelectronics Failure Analysis (MFA) Laboratory in partnership with the Defence Science and Technology Agency (DSTA), DSO National Laboratories (DSO) and Temasek Laboratories@ NTU (TL@NTU). The MFA Laboratory, located within MSE, complements the materials failure analysis capability of MSE, especially in the area of microelectronics devices.

Equipped with state-of-the-art failure analysis tools, such as a reactive ion etcher, decapsulator, grinder/polisher, high magnification optical microscope and chemical fumehood, the MFA Laboratory will be further expanded to include equipment like the Focused Ion Beam (FIB) system and X-ray imaging system for advanced failure analysis work. The objective of the MFA Laboratory is to develop advanced failure analysis capabilities for sub-micron microelectronics devices, with the focus on understanding materials failure. The research program under MFA Laboratory not only taps on the expertise and infrastructure available in MSE but also involves the collaboration with researchers and engineers from DSO, the microelectronics industry and research institutions.

Rolls-Royce Launches State-of-the-Art Facility at NTU’s Yunnan Garden Campus

The opening of the Rolls-Royce Fuel Cell Systems (RRFCS) Process Engineering and Verification Facility at NTU on 18 February 2008 will add to NTU’s ever expanding range of collaborative initiatives.

The launch was attended by key representatives from NTU, the Agency for Science, Technology & Research (A*STAR), the Economic Development Board (EDB) and Temasek Holdings. The new facility extends the partnership between NTU and Rolls-Royce, which already sponsors scholarships for students of NTU’s School of Mechanical and Aerospace Engineering (MAE). Rolls-Royce is a leading provider of power systems and services for civil and defence aerospace, marine and energy applications.
New Virtual Lab on Computational Nanoelectronics and Plasmonics between NTU and IHPC

NTU has signed a research treaty with the Institute of High Performance Computing (IHPC), paving the way for next-generation nanoelectronics and plasmonics.

The research agreement was formalised on 5 February 2008 by Professor Kam Chan Hin, the Chair of the NTU’s School of Electrical & Electronic Engineering (EEE) and Dr Raj Thampuran, the Executive Director of IHPC. The virtual lab will investigate topics in computational nanoelectronics and plasmonics, which exploit the quantum behaviours of electron transport and light interactions in nanometre-scale devices. The joint research lab will take off with eight professors from NTU and eight research scientists from IHPC working synergistically on fundamental topics such as quantum theory of nanoelectronics and plasmonics for applications in future-generation quantum-based devices. Drawing on the mutual strengths of NTU and IHPC, the new virtual lab looks set to be a catalyst and incubator for new scientific thought and innovation.

MOU between School of Computer Engineering and IHPC establishes Joint (Virtual) Research Facility

On 19 March 2008, the School of Computer Engineering (SCE) signed a Memorandum of Understanding (MOU) with the Institute of High Performance Computing (IHPC) to establish a joint (virtual) research facility that encourages active interdisciplinary cooperation between the two institutions in the frontier research of high performance computing.

IHPC is a Research Institute under the Agency for Science, Technology and Research (A*STAR). It promotes and spearheads scientific advances and technological innovations through computational modelling, simulation and visualisation methodologies and tools. In collaboration with IHPC, SCE now offers high performance computing research opportunities to both students and staff.

Model union: EEE Chair Professor Kam Chan Hin and IHPC Executive Director Dr Raj Thampuran formalising the research agreement
The School of Materials Science and Engineering (MSE) signed a research collaboration agreement with Robert Bosch GmbH in April 2008. This collaboration will include participation of up to 10 research staff from Bosch, 8 jointly-supervised PhD students, and over 25 undergraduate students over a five year period. This collaboration aims to study bulk heterojunction solar cells, dye sensitised solar cells, development of new organic-inorganic hybrid systems, tandem cells, large-area process technologies and understanding of the basic device physics that impact solar-cell efficiencies and reliabilities.

As part of this collaboration, NTU and Bosch set up a state-of-the-art joint research laboratory in Photovoltaics in September 2008. This research collaboration will focus on use-inspired research that will accomplish manpower training, knowledge-creation and also creation of intellectual property with commercialisation potential. The inaugural project on Organic Photovoltaics (OPV) aims to develop organic solar cells that provide a cheaper alternative to generating electricity from light. The project led by Associate Professor Subodh Mhaisalkar, Head of Materials Technology at MSE, is the first of its kind on OPV at Bosch’s regional headquarters for research and advanced engineering in Singapore. The groundbreaking research aims to develop solar cells based on organic semi-conductive materials, which are less energy-intensive to produce as their excellent light absorption qualities allow them to be deposited in ultra-thin layers by vapour deposition or by printing. As a result, the solar cells can be manufactured more cost-effectively and with less impact on the environment. Current samples of organic solar cells, however, convert only five percent of the available solar radiation into electrical energy. The research team plans to improve this energy-conversion efficiency to ten percent or more within the next three years.
NTU Partners Temasek Foundation to Bring Earthquake-resistance Technology to West Sumatra

NTU and Temasek Foundation (TF) have joined hands to bring earthquake-resistance technology to West Sumatra, Indonesia, an area prone to earthquakes. The project was a joint endeavour between NTU’s Lien Institute for the Environment (LIFE) and Indonesia’s Universitas Andalas Padang (UNAND). The project, costing about S$313,000, is co-funded by LIFE and Temasek Foundation. The project took place at Lasi Polyclinic in the Candung Sub-District of Agam District of West Sumatra, and consisted of three parts – strengthening Lasi’s main polyclinic to improve the building’s earthquake resistance, improving sanitation and clean water supply, and training the locals in good construction practices. The training facility will be used as a model building to showcase good construction practices for other local masons in West Sumatra and beyond. The six-month training programme began in March 2008 with a group of 20 faculty members from UNAND’s Department of Civil Engineering who were selected to form a core group of master trainers. To further transfer this knowledge to the local community, 45 local masons were also trained with proper construction techniques and canvas strengthening techniques.

Southeast Asia’s First Cold Spray Research Centre

NTU and Singapore Technologies Kinetics Ltd’s (ST Kinetics) joint venture company, Advanced Technology Research Centre (ATREC), have unveiled Southeast Asia’s first R&D facility for cold spray research. Officially opened on 5 September 2008 by NTU Provost Professor Bertil Andersson, the NTU-ST Kinetics Cold Spray Research Centre (CSRC) is a state-of-the-art robotic-controlled joint research laboratory that taps the combined strengths of NTU and ST Kinetics to advance application of the leading-edge technology. Both organisations have committed half a million dollars in equipment and infrastructure development to the project over three years.

One of the key objectives of the CSRC, which has been in operation since July 2007, is to spin off niche industry applications for Singapore. These include new bio-nano-technologies for the defence sector and biomedical applications such as anti-microbial coatings and smart devices. Other sectors that could benefit from the cold spray method are the aerospace, oil and gas, and automotive and chemical industries.

Unlike conventional coating processes that require spray materials to be preheated, cold spray processes are typically carried out at ambient room temperatures and use high-speed spray to achieve metallurgical bonding. This eliminates the undesirable effects of chemical changes caused by conventional techniques. Cold-sprayed materials also display higher densities and thermal and electrical conductivities that are preferred.
UCLA & 12 Collaborating Institutions with MSE as the Only University in Asia, Establish New Center on Environmental Effects of Nanotechnology

The NTU’s School of Materials Science and Engineering (MSE) is one of 12 collaborating institutions with UCLA to establish the University of California Center for Environmental Implications of Nanotechnology (UC CEIN), funded by the National Science Foundation (NSF) and the US Environmental Protection Agency (EPA). This mega-scale international research is worth US$24M and aims to further research on environmental, health and safety implications of nanomaterials.

UC CEIN is located at the California NanoSystems Institute (CNSI) on the UCLA campus and will bring together a multidisciplinary team to address issues of the impact of nanomaterials on the environment and on its interaction with living systems.

MSE’s expertise in materials science – nano-synthesis and nano-characterisation, is a critical component in this research. Some of the pre-determined nanomaterials will be carefully synthesised in MSE through controlled experimental design and those that are synthesised to precision will be used to establish a library of reference nanomaterials. Fundamental toxicity studies on these nanomaterials will be conducted in MSE. Results arising from these toxicity tests will ultimately be used to develop a predictive scientific model to study the impact of nanotechnology on health and the environment.
EEE’s Partnerships with Industry

Joint Industrial Postgraduate (JIP) Programme

The Microelectronics Division, School of Electrical & Electronic Engineering (EEE), has several tripartite agreements with the Singapore’s Economic Development Board (EDB) and leading wafer fabrication companies for joint manpower training and research programme in state-of-the-art silicon transistor technology. The students enrolled in this programme will have the opportunity to research and develop innovative solutions both in the front- and back-end arena for advancing the development of aggressively scaled silicon transistor technology with minimum dimension smaller than 32 nanometres. The students will receive either the MEng or PhD degree upon completion of the research projects. The JIP programme stems from the ever increasing specialist manpower demand of the high-tech wafer fabrication industry.

i. UMC-EDB-NTU JIP Programme

The agreement with United Microelectronics Corporation (UMC), the world’s leading wafer fabrication foundry, was signed in November 2007. The UMC programme promises a projected S$1.7 million scholarship funding for students who will be working towards the MEng degree offered by EEE. Currently, four students have been offered places to work on research projects ranging from device reliability, transistor process optimisation and Cu interconnect reliability and process characterisation.

ii. Chartered-EDB-NTU JIP Programme

A similar programme sponsored by Chartered Semiconductor Manufacturing and EDB was formulated in July 2007. The programme was designed to perform postgraduate PhD research in the area of Si nanotechnology for future complementary metal oxide semiconductor (CMOS) and more-than-Moore technologies. Chartered Semiconductor Manufacturing has committed up to ten PhD scholarships per year up to 2010.

iii. SSMC-EDB-NTU JIP Programme

The joint industrial postgraduate programme with Systems on Silicon Manufacturing (SSMC) and EDB was officially launched in Q3 of 2007. In this programme, SSMC is committed to offering two MEng research scholarships per year for the next 3 years. The focus of the research is on advanced Si CMOS processes and device reliability.

The Division of Circuits & Systems of EEE also offers Joint Industrial Postgraduate (JIP) programme in collaboration with EDB and participating companies. Similarly, the students would receive either the MEng or PhD degree upon completion of the research projects. The main objective of this JIP programme is to supply skilled manpower to meet the demand of the Singapore IC (integrated circuit) industry. Since its implementation, 7 PhD and 17 MEng scholarships had been awarded by Panasonic, MediaTek and Infineon.

iv. Panasonic-EDB-NTU JIP Programme

A tripartite agreement with Panasonic Semiconductor and Singapore’s Economic Development Board (EDB) will see 12 research scholarships – nine Masters, three PhDs - being made available to NTU students interested in IC design.
Collaborations and Partnerships

MOU between the School of Electrical and Electronic Engineering and Panasonic Semiconductor Asia

The Memorandum of Understanding (MOU) between NTU School of Electrical & Electronic Engineering (EEE) and Panasonic Semiconductor Asia Pte Ltd will see $2.3million pledged to sponsor scholarships for EEE students and provide postgraduate training. NTU faculty and graduate students will also work with engineers from Panasonic Semiconductor to research on projects relevant to the industry.

A partnership between NTU and Panasonic Semiconductor already exists in digital audio amplifier research, and this MOU will expand it to include research on integrated chip (IC) design for power management, audio and video applications.

Staff of NTU, Panasonic Semiconductor Asia and EDB commemorating the tie-up

EEE Chair Professor Kam Chan Him (right) exchanging the MOU and JIP Agreement with Mr Akinobu Minagawa, Managing Director of Panasonic Semiconductor Asia
ASEAN-EU University Network Programme (AUNP)

Associate Professor See Kye Yak of Division of Circuits and Systems, School of Electrical & Electronic Engineering (EEE), collaborated with Professors Flavio Canavero of the Polytechnic of Turin (Italy), Hartmut Grabinski of University of Hannover (Germany), Christos Christopoulos of University of Nottingham (UK) and Associate Professor Werachet Khan-Ngern of King Mongut’s Institute of Technology Ladkrabang (Thailand) under the ASEAN-EU University Network Programme (AUNP). The collaboration was fully funded by the European Commission with a total funding of €180,000. A total of 40 projects were submitted to the European Commission but only 10 projects were finally selected for funding, and Associate Professor See’s project was one of them. The project entitled “Joint development of teaching materials to improve electromagnetic compatibility skills of academic staff and post-graduate electronic designers,” aims to develop an innovative university course for training and preparing future electronic designers to design high-speed electronic systems to meet the challenges imposed by the worldwide electromagnetic interference (EMI) regulatory requirements. The new course will be developed by means of sharing research results, seminars, experience, and the fabrication of a demonstrator to be used for teaching. In any field of science, university course curricula must be kept up-to-date in order to prepare future engineers and researchers for the actual problems they will face when they graduate. An exchange of experience and a long-term collaboration between various universities is one of the most effective ways of achieving this goal. The project team feels that the various cultural and socio-economic backgrounds of the partners in this project will facilitate greater understanding of today’s technological challenges by viewing them from various perspectives.
**R&D Project on Leadership Development and Multisource Feedback**

**Nanyang Business School (NBS)** collaborates with SAFTI Military Institute to develop a multisource leadership feedback system for leadership development in the Singapore Armed Forces (SAF). This will assist the SAF in identifying important leadership behaviours for a 3rd generation SAF, and in enhancing leaders’ self-awareness and leadership development. To date, the research team has completed 5 technical reports for the project.

**Strengthening ICT4D Research Capacity in Asia (SIRCA) Programme**

Professor Ang Peng Hwa, Director of the Singapore Internet Research Centre (SIRC), received funding for the Strengthening ICT4D Research Capacity in Asia (SIRCA) programme from the International Development Research Centre (IDRC), Canada. Administered by the SIRC at the **Wee Kim Wee School of Communication and Information (WKWSCI)**, the SIRCA programme seeks to identify future research leaders and to facilitate their development through the support of research grants. The awards are intended to ensure capacities to conduct research in the area of Information and Communications Technology for Development (ICT4D or ICTD) in Asia. This applies particularly to emerging researchers based in Asia who are relatively new to ICTD research and interested in undertaking theoretically-based and methodologically rigorous research. Additionally, these applicants would benefit from concerted capacity building exercises including a mentorship arrangement. In particular, the programme promotes broad-based high-quality multi-disciplinary research in ICT development, e-services, new media use and social impact, and policy for the benefit and advancement of individuals, organisations, nation and society.

**NTU’s Wee Kim Wee School of Communication and Information Collaborates with University of Southern California, Michigan State University, and the University of Jankoping**

The **Wee Kim Wee School of Communication and Information (WKWSCI)** has a collaborative research project “Modelling the IDM Marketplace – business models, pricing strategies & policy scenarios” with the Center for Telecommunications Management at the University of Southern California, USA, the Quello Center for Telecommunication Management and Law of Michigan State University, USA, and the Media Management and Transformation Centre of the University of Jankoping, Sweden. The project is currently led by **Associate Professor Ravi Sharma**, **Associate Professor Margaret Tan**, and **Dr Miguel Morales-Arroyo** from the **Wee Kim Wee School of Communication and Information (WKWSCI)**, and **Associate Professor Sunanda Sangwan** from **Nanyang Business School (NBS)**. The project aims to understand the emerging business-ecosystem for Interactive Digital Media (IDM), to construct valid models and pricing tools for the intermediaries, and to develop a scenario planning framework for policy makers. The project undertakes to investigate business models that may be applied to the IDM marketplace and their policy implications for regulators.
MOU between NTU and Indian Institute of Technology Kanpur (IIT-K)

On 14 January 2008, Nanyang Technological University (NTU), signed a Memorandum of Understanding (MOU) with the Indian Institute of Technology Kanpur (IIT-K) to advance research and development through joint research and development (R&D) efforts as well academic exchange of staff and students. Both parties will also consider administering a joint-degree programme.

IIT-K, in Uttar Pradesh, India, is one of the seven established Indian Institutes of Technology (IITs) that are internationally recognised for their technological prowess and world-class research. The MOU specifically targets the School of Mechanical and Aerospace Engineering (MAE) at NTU and the Departments of Mechanical Engineering, Aerospace Engineering and Industrial and Management Engineering at IIT-K. Some areas of common interest include Computational Mechanics, Microfluidics, Flight Mechanics and Supply Chain Management.

As part of this effort, both parties have co-organised workshops and hosted an exchange of delegations. More exchanges are expected in future.

MOU between NTU School of Biological Sciences and Karolinska Institutet

A Memorandum of Understanding (MOU) was signed between the School of Biological Sciences (SBS), NTU and the Karolinska Institutet (KI) Biomedicine Program, on 17 January 2008 during the first NTU-KI joint symposium on Biomedical Structural Biology, which saw participants exchanging ideas on how to prevent malaria, dengue and cancer at the molecular level. Details of the exchange agreement include hosting exchange visits for undergraduate, graduate and staff of both parties for the purposes of study and research.

Karolinska Institutet is Sweden’s only university specialising in medicine, and among the largest universities in Europe, well known for its medical training and academic research. KI also appoints the laureates for the Nobel Prize in Physiology and Medicine through a committee named the Karolinska Institutet Nobel Assembly.

New partners: NTU President Dr Su Guaning and IIT-K Director Professor Sanjay Govind Dhande inking the MOU in Mumbai on 14 January 2008
Collaborations and Partnerships

MOUs between NTU and three Hungarian Universities

NTU’s President Dr Su Guaning has signed MOUs with three Hungarian universities, namely Semmelweis University (SOTE), Eotvos Lorand University (ELTE) and Budapest University of Technology and Economics (BME). The MOUs were signed following a visit by a delegation from Hungary. The party included Dr Ferenc Pártos, President of the National Office for Research and Technology, Hungary (NKTH), Mr Attila Várkonyi, Chairman of the Research and Technological Innovation Council in NKTH, and other senior university officials, who visited on 29 January 2008 for a fruitful discussion on potential collaborations on research and development. This meeting was initiated by Singapore’s Agency for Science, Technology and Research (A*STAR) as part of A*STAR’s and NKTH’s joint efforts to promote collaborative research in the science, engineering and biomedical fields.

NKTH plays a key role in the development and implementation of the Hungarian government’s science and technology policies. NKTH supports and promotes research and development in Hungary by financial and institutional means.

MOU between School of Computer Engineering and Wroclaw University

A Memorandum of Understanding (MOU) was signed between Wroclaw University of Technology and the School of Computer Engineering (SCE) in February 2008, to strengthen and explore collaborative efforts between the two institutions, with particular focus in the area of research and postgraduate studies. The two institutions also look forward to organising and promoting joint conferences.
MOU with the European Aeronautic Defence and Space Company

The Memorandum of Understanding (MOU) between EADS and NTU signed on 18 February 2008 laid the foundation for joint aerospace projects, such as a helicopter airspeed sensor that NTU’s School of Mechanical & Aerospace Engineering (MAE) is developing for Eurocopter, an EADS company.

At the same time, EADS also gave away six EADS TechMasters Scholarship valued at $5,000 each to MAE final year aerospace engineering students. The EADS TechMasters Scholarship is given to students who not only excelled in their academic performance and co-curricular activities, but also demonstrate strong commitment to a career in the aerospace or defence industry.

Partnership with US Air Force Academy (USAFA)

26 February 2008 marked the start of an exciting partnership between NTU and the US Air Force Academy (USAFA) when representatives from both sides met to sign a Cooperative Research and Development Agreement (CRADA). This CRADA represents the first agreement of its kind for USAFA with a non-American university. USAFA offers excellent science and engineering undergraduate programmes for members of the US Air Force, with world-class faculty, state-of-the-art facilities and extensive curriculum.

Both the School of Mechanical & Aerospace Engineering (MAE) and the School of Electrical and Electronic Engineering (EEE) will be involved in collaboration efforts.

For the School of Mechanical & Aerospace Engineering (MAE), the two key areas of collaboration are mechanics and structural integrity, and computational modelling and aerodynamics. Collaborative activities in these areas will include staff and student exchange, short-term visits and joint research projects. MAE also plans to invite the USAFA faculty to teach various courses from the Aerospace Engineering programme as well as to provide inputs on how to refine the existing curriculum.
Faculty members of the School of Electrical and Electronic Engineering (EEE) are involved in collaboration in the fields of space physics and satellite systems, and laser and optics research. Exchange of students and faculty staff members between the two institutions to undertake joint research in these two areas have been planned. For the first research area on space physics and satellite system, joint projects in relation to a new satellite mission are being defined. For the second research area on laser and optics research, four projects on defective optics, fiber lasers, ceramic lasers and biosensors have been identified and funding is being sought.

**MOU between the School of Computer Engineering and Osaka University**

A Memorandum of Understanding (MOU) was signed on 28 March 2008 between Osaka University and the School of Computer Engineering (SCE) to promote student and staff exchange. Osaka University is a renowned institution acknowledged internationally for its outstanding achievements in various scientific research fields. This initiative between the stellar institutions paves the way for even more collaborations between SCE and Osaka University, specifically with the Graduate School of Information Science and Technology and Cybermedia Centre. This alliance will promote more visits, joint studies and research opportunities to students and staff of both institutions.

**School of Mechanical and Aerospace Engineering Partners Stuart Wright Pte Ltd**

Stuart Wright is a company set up in the Republic of Singapore with its principal business in well design consultancy and related services and focusing on the oil and gas industries. Its major clients include Shell, Talisman, BP and many other multinational corporations. The School of Mechanical & Aerospace Engineering (MAE) signed an MOU with Stuart Wright on 2 June 2008 and both parties wish to collaborate to provide a mechanical drillstring or drilling rig related component failure investigation service for Stuart Wright’s clients in the oil and gas industry in the Australasia region.
NTU’s Breakdancing Robots

The inaugural project of dancing humanoid robots is a joint collaboration between NTU’s School of Electrical & Electronic Engineering (EEE) and the Singapore Discovery Centre to showcase recent projects done in the field of entertainment humanoid robots at NTU. The breakdancing robots can slip and slide and execute handstands, delivering a perfectly synchronised performance with the music. This trio of robots is the handiwork of students from EEE.

Using Robonova-1 (RN1) humanoids, each about 30cm tall, the team of 12 NTU students, working under the supervision of Associate Professor Er Meng Joo, modified the robotic trio to include Bluetooth communication capability, essentially allowing the robots to ‘talk’ among themselves via wireless communication over Bluetooth and an external computer to result in flawless coordination amongst them.

The robots have also been programmed to interact and play in a life-like manner. Audiences at the Young Talents Showcase were thrilled when they were allowed to command the robots via remote control to perform various interesting moves such as cartwheels, somersaults and one-hand push-ups. Like the ever-popular Transformers, the robots could niftily transform into wheeled robots at the press of a button. It was no wonder that the NTU segment, “Dance with Robots”, initially scheduled to run from 14 March to 6 April 2008, was extended until 31 May due to popular demand for repeat performances.
The Regency Steel Asia Pte Ltd (RSA) Fund Supports NTU’s Efforts to Advance Structural Steel Research

Regency Steel Asia Pte Ltd (RSA), one of Asia’s largest steel distributors, broke new ground with the launch of the Regency Steel Asia Pte Ltd Fund at NTU on 14 May 2008. The Fund, first of its kind established in the university, would chart new strategic directions in structural steel research and expertise development. RSA donated S$1.5 million to establish the Fund and it was matched by one-to-one government funding, creating a $3 million reserve enabling the advancement of research and expertise on steel. The first major initiative under RSA’s Corporate Social Responsibility (CSR) Programme, the RSA fund will also provide for two scholarships of $8,000 each and two bursaries of $4,000 each annually for outstanding and needy students from NTU’s School of Civil & Environmental Engineering (CEE) and Nanyang Business School (NBS).

The first research project to come under the Fund is led by Associate Professor Chiew Sing-Ping from the NTU’s School of Civil and Environmental Engineering (CEE). This three-year research project aims to advance the understanding and application of high strength steel in our building and construction industry. It focuses on steel bridging structures fabricated from high strength steel plates. High (460–690 N/mm²) and ultra-high (≥ 690 N/mm²) strength steel are high performance fine-grained steel with enhanced chemical compositions and improved mechanical properties in terms of ductility, toughness and weldability. It is currently available in the form of steel plates and its current usage is largely confined to the marine, ship-building and offshore industries. The intent is to promote the use of this steel material in the building and construction industry.

This research project is timely and relevant as our engineers and builders are facing the challenge of building higher, longer and optimising the use of space in land-scarce Singapore. High strength steel is lighter, and easier to fabricate and erect. Using high strength steel plates, to form bridging structures over existing infrastructure, will enable us to span over longer distances and make more productive and flexible use of our valuable land space.
NTU – TUM- GiST Partnership

NTU’s School of Mechanical & Aerospace Engineering (MAE), Technische Universität München (TUM) and German Institute of Science and Technology Pte Ltd (GiST) signed a Letter of Intent on 3 September 2008 for the purpose of continuing a long term mutually beneficial collaboration among all parties. The parties agreed to work towards a collaboration of a joint PhD programme to be managed and operated by GiST.

Residency at Ksatria Gameworks

As part of the gaming residency Assistant Professor Martin Constable of the School of Art, Design and Media (ADM), (as the artist Jack Youngblood) worked with the Singapore gaming company Ksatria Gameworks as an artist in residence. Together they worked on a set of images that addressed current aesthetic memes within the gaming world. High end imaging technologies and methodologies were employed to produce these images that received national coverage in the press and on TV. The work was also featured as a peripheral event in the Singapore Biennale October 2008. This exhibition was called “Excelsior Mortis!” and was held at the Post Museum in Singapore.

NTU-Tsinghua University MOU

The Memorandum of Understanding (MOU) between Tsinghua University and NTU was signed on 28 November 2008. This is a good initiative and a strategic partnership with the top Chinese engineering University, laying the foundation for future collaboration and deepening current ties between the two universities.

The research in mechanics and aerospace engineering of the School of Aerospace, Tsinghua University is highly recognised internationally. It also has important and wide influences on the academic field in the world and on the engineering field in China. It is relevant and beneficial for NTU to collaborate and promote joint research and development activities of mutual interest with Tsinghua University in the areas of Aerospace Engineering, Bioengineering, Computational Engineering as well as Micro & Nano- Technology and Systems. In addition, both parties will promote academic co-operation and student exchange.

Documentary Film Expedition to Western China

Co-sponsored by Canon Singapore, The China Exploration and Research Society, and Wildlife Asia, six Digital Filmmaking Students from the School of Art, Design and Media (ADM) joined Assistant Professor Scott Hessels on a documentary filmmaking expedition to remote Western China to create short films on two endangered species, highlighting the efforts of noted Chinese explorer and environmentalist Wong How Man. Two short films were created, titled “Sacred Crane, Mortal Birds” (Short Film, 2008) and “The Tibetan Mastiff” (Short Film, 2008). The project received favourable press and media attention both nationally and regionally in several newspapers, magazines and broadcast news reports with dedicated features on Channel News Asia and The Straits Times in Singapore.
Conferences, Events and Symposia

The University is proud to have organised and participated in international and local conferences, events and symposia. These events serve as a platform for the University to showcase our research and gain international exposure, while top researchers around the world interact and share the latest technological breakthroughs. Joint workshops also advance ties and facilitate communication with our partners in academia and industry.
Conferences, Events and Symposia

International Water Association (IWA) Biofilm Technologies Conference 2008

The International Water Association (IWA), in cooperation with the IWA Biofilm Group, NTU and National University of Singapore (NUS), supported by Public Utilities Board (PUB), Singapore, organised the “Biofilm Technologies” conference from 8 to 10 January 2008, Singapore. This conference is of the IWA Biofilm Conference Series and serves to discuss scientific and practical aspects of cell aggregation and the processes, where aggregated microbial cells play a major role. This covers biofilm–based technologies and reactors, biofilm processes, biofilm microbiology, biofouling and biocorrosion. Microbial attached or suspended aggregates, biofilms and granules, are successful alternatives to conventional suspended microbial cells of flocs. Discussion about novel developments of aggregated microorganisms, reactors, processes and their models, together with experience of industrial applications should promote further progress of biotechnologies based on biofilms and technologies preventing formation of unwanted biofilms.

Joint Workshop with Tsinghua University

Following the inaugural joint workshop held at Tsinghua University and the visit by a team from the School of Mechanical and Aerospace Engineering (MAE) to Tsinghua University in January 2008, MAE was pleased to hold the 2nd Joint Workshop with Tsinghua University in NTU, from 15 to 16 May 2008.

The key objectives of the workshop were to advance existing collaborative ties with Tsinghua University and to foster research collaboration between academic staff members and students from both Universities in areas of mutual interest. The workshop featured presentations from faculty members and students in the areas of multi-scale computational modelling, micro sensors and actuators, functional design in Micro-Electro-Mechanical Systems (MEMS), fluid dynamics, fluid mechanics, fluid micro-system, biomaterials and tissue engineering and biomechanics.

Associate Professor Ong gave a presentation on MAE’s research focus and achievement.
Joint Workshop by NTU’s School of Mechanical and Aerospace Engineering (MAE) and Carnegie Mellon University (CMU)

Following a workshop held at Carnegie Mellon University (CMU) in February 2007, a team of six faculty members and researchers from the CMU Department of Mechanical Engineering and the Pittsburgh Centre for Super Computing travelled to Singapore to participate in the joint workshop with the NTU’s School of Mechanical and Aerospace Engineering (MAE) held in NTU on 22 and 23 January 2008.

A total of twelve research presentations in the areas of robotics, manufacturing, computational engineering, microfluidics and design were made by faculty members of both universities on the first day of the workshop. The visitors toured some of the MAE research and teaching facilities after the presentations.

On the afternoon of 23rd January, an additional presentation was made to MAE final year students interested in pursuing a PhD programme at CMU. This was well received. The MAE team and CMU team also met to discuss collaboration opportunities, student exchange and PhD programmes.
Aerospace Seminar: Space... Is the Limit

Aerospace experts from the European Aeronautic Defence and Space Company (EADS), Shanghai Jiaotong University (SJTU) and Alpha Aviation Group (AAG) shared the latest updates on space travel, moon exploration and the novel Pilot Training Standard at the Aerospace Seminar held in NTU on 19 February 2008.

- Mr Hugues Laporte Weywada, Deputy Chief Technical Officer EADS and Chief Designer/ Arianne Programme Director, spoke on the company’s plan to develop a “SpaceBus” for space travel.

- Professor Zhao Wan-Sheng, Head of Department of Aerospace Engineering in SJTU, gave the audience an insight into the China lunar exploration programme named “Chang’e Project”, which comprises three stages through 2017.

- Mr Robert C.M. Hayter, General Manager of Alpha Aviation Academy Europe, gave an overview of their ICAO (International Civil Aviation Organisation) -approved Multicrew Pilot License (MPL) training programme. Under this programme, trainees are trained to be airline pilots in a multi-crew airline operating environment in just twelve months. This is half the duration of typical pilot training programmes.

- The Q&A session with the experts, chaired by Professor Lennie Lim, Associate Chair (Curriculum and Graduate Studies), School of Mechanical and Aerospace Engineering (MAE), and Mr Marvyn Lim, Senior Advisor Vice-President of Defence System and CTO Innovation Works, EADS Group, Asia Pacific, was met with great enthusiasm from the audience.
Asia-Europe Foundation (ASEF) Workshop: Gatekeepers in a Digital Asian-European Media Landscape: The Rising Structural Power of Internet Search Engines

Professor Ang Peng Hwa, Director of the Singapore Internet Research Centre (SiRC) at the Wee Kim Wee School of Communication and Information (WKWSCI) co-organised the ASEF Workshop on Gatekeepers in a Digital Asian-European Media Landscape “The Rising Structural Power of Internet Search Engines” with Professor Marcel Marchill, Chair of Journalism, at the University of Leipzig, Germany, the Asia-Europe Foundation (ASEF), and the Asia Alliance. This workshop was held in NTU from 28 February to 1 March 2008. SiRC received S$30,000 to run the workshop, which was attended by thirteen international presenters as well as two observers. With an interdisciplinary and Asian-European approach, this workshop’s objective was to develop a theoretical ground for a better understanding of the digitisation process and the growing together of communication and computer science, practical knowledge about the functioning of gatekeepers and their limits, and recommendations for decision makers in policy, business and media.
Symposium on Health Economics and Health Management

A symposium on Health Economics and Health Management was held at the Nanyang Executive Centre on 5 March 2008. It was organised by Professor David Reisman from the School of Humanities and Social Sciences (HSS) on behalf of the Division of Economics and Centre for Liberal Arts and Social Sciences (CLASS). The symposium is interdisciplinary in nature and provided a platform for international speakers to share their wide range of expertise in Health Economics.

Seminars on Economics and Public Policy for Junior College Teachers and Students

In 2008, NTU’s School of Humanities and Social Sciences (HSS) organised two seminars on Economics and Public Policy, one for the Junior College students on 8 March 2008 and another seminar on 10 March 2008 for the Junior College Economics teachers. The seminars were well received by students and teachers alike.

On 8 March 2008, about 1000 students participated in the seminar, which was held at the Lee Kong Chien Lecture Theatre in NTU. The speakers for the seminar were Professor Lim Chong Yah, Ambassador Lam Chuan Leong, Assistant Professor Yothin Jinjarak, Professor Chew Soon Beng, Assistant Professor Ho Kong Weng, Professor David Reisman and Dr Ho Woon Yee. They spoke on a variety of topics, including economic growth, equity markets, the Singapore economy, economics of love and health, review of the Singapore Central Provident Fund (CPF) and foreign direct investments. The students were very attentive throughout the seminar as the topics were very relevant and they showcased many facets of applied and policy economics.

The seminar for the Junior College teachers was held on 10 March 2008 at the Ministry of Education (MOE) Edutorium. Professor Lim Chong Yah, Dr Sng Hui Ying, Dr John Lane, Assistant Professor Shubhasree Seshanna, Dr Peter Wilson, Dr Pradumna Rana, and Assistant Professor Chia Wai Mun spoke to the teachers on the Asian financial crisis and the sub-prime mortgage crisis, capital accumulation and total factor productivity in Singapore, uncertainty in the economics of medical decision, globalisation and the rise of “New Challenges”, monetary policy in Singapore, the role of Singapore in Asian monetary integration, Asia’s role in the global economy and the international financial system. The Junior College teachers expressed their interest in attending future such seminars to update themselves on current topics and issues in economics.
The Association of Business Communication (ABC) 8th Asia-Pacific regional conference hosted by Nanyang Business School (NBS) and the Business Communication Group was held in Nanyang Executive Centre, NTU from 27 to 28 March 2008. The annual convention is an important event on the ABC calendar, as it provides an opportunity for business practitioners and the association’s international members to share research, participate in workshops and network.

ABC is an international organisation committed to fostering excellence in business communication scholarship, research, education, and practice. It has a strong membership base in North America, Europe, and Asia and the Pacific. ABC members come from diverse fields, including management, marketing, languages, speech communication, linguistics, and information systems, to name a few.

The 2008 conference continued discussions of previous ABC Asia-Pacific conferences documenting and studying in great detail the dynamism, complexity and richness of communication activity in and relating to business and organisations of many kinds in Asia (and in relation to the Asian context). The theme question was: "Have Business Communication researchers been registering how communication in Asian enterprise is changing people’s perception and understanding of business communication at the global level?"

Perhaps the study of Business Communication is a factor in the shifting and balancing of perceptions about how communication issues affect enterprise globally. All papers addressed this theme in some way. During the conference, sessions were held to discuss and set the future strategy for the ABC.

This was a small and highly focused conference, which gave NBS good international exposure, and generated international relationships and research collaborations for SMO Business Communication faculty. Chaired by Dr Michael Connor and Dr Manique Gunasekera, Assistant Professor and Senior Fellow at the Division of Strategy, Management and Organisation at NBS respectively, the event saw participants from Australia, Belgium, Hong Kong, India, Japan, Malaysia, New Zealand, Norway, Singapore, United Arab Emirates and the US presenting their papers and sharing their findings in robust discussions.
The NTU International Workshop on IDM Research Provided the Perfect Setting for the Launch of the University’s Latest Interactive and Digital Media (IDM) initiative – the Institute for Media Innovation (IMI).

The inaugural NTU International Workshop on IDM Research, held from 29 to 30 April 2008, highlighted the central role of Interactive and Digital Media (IDM) in improving the way we live, and its growing importance as a subject of academic research.

The workshop’s four panel sessions were centred on the themes of ‘Virtual Human 3.0’, ‘Art[tech]’, ‘Futuretech’ and ‘Media Convergence’, and allowed the assembly of international artists, researchers and programmers to share their experiences working on IDM’s distant frontiers. The workshop was also the perfect platform for NTU to launch the Institute for Media Innovation (IMI), an initiative to take the university’s IDM efforts to the next level. The IMI will build on NTU’s strengths in engineering, science, business, the arts and education, providing a common platform for interdisciplinary research groups at NTU to come together and make new discoveries. It will also serve as a conduit for the world to access the university’s range of IDM offerings.

The IMI will be supported by 100 researchers drawn from NTU’s schools, and will boast an academic programme that accommodates 10 PhD students and a visiting professorship. In addition to NTU Provost, Professor Bertil Andersson and Senior Science Officer, Mr Tony Mayer, the IMI’s efforts will be driven by a team of talents that includes Professor Reiser; Professor Shaw; Associate Professor Russell Pensyl of NTU’s Interaction and Entertainment Research Centre (IERC); and Professor Seah Hock Soon of School of Computer Engineering (SCE).

As with all things becoming digital, plans for the IMI are moving forward quickly, guided by the institute’s focus on innovations in entertainment, education, health and medicine, lifestyle, and business. The IMI team’s immediate objectives are to review key IDM projects and pockets of research across NTU, and organising an upcoming workshop on IDM and education.

With more initiatives to come by year’s end, IMI looks set to catch the digital wave that continues to change our lives in fundamental ways.

Symposium on “Empirical Advances in Expanding the Cultural Intelligence Nomological Network” at the 23rd Annual Society of Industrial and Organisational Psychology (SIOP) Conference

NTU’s Nanyang Business School (NBS) Professor Ang Soon, who is also Executive Director of Centre for Leadership and Cultural Intelligence (CLCI) and Professor Linn Van Dyne (Michigan State University), co-chaired the symposium in the 23rd Annual Conference for the Society of Industrial and Organisational Psychology (SIOP) at San Francisco in April 2008. The symposium featured four papers on cultural intelligence from researchers from various universities, including University of Maryland, University of Pennsylvania, Texas A&M, Technion University (Israel), and NTU.
Joint Workshops with Industrial and Management Engineering, Indian Institute of Technology Kanpur, India

The inaugural joint workshop between the NTU’s School of Mechanical and Aerospace Engineering (MAE) and the IIT-K’s Departments of Mechanical, Aerospace and Industrial and Management Engineering was held at NTU on 10 July 2007. The primary aim of this workshop was to foster research collaboration between the faculties of both universities, including academic staff and student exchanges and a possible joint graduate degree programme in engineering. The partnership was sealed with the signing of a Memorandum of Understanding between the two universities on 14 January 2008.

Following this, a second joint workshop, hosted by IIT-K, was held on 5 and 6 April 2008. A team of six MAE professors travelled to India to attend the workshop. Besides giving technical presentations, the NTU team also held discussions with their IIT-K counterparts on research collaborations and the implementation plan.

7th International Federation for Information Processing (IFIP) Networking 2008

Participants from around the globe received a roaring welcome from NTU at the 7th International Federation for Information Processing (IFIP) Networking 2008 conference. Held for the first time in Asia, this event took place over five days from 5 to 9 May 2008 at the Nanyang Executive Centre.

The conference organised by the School of Computer Engineering (SCE), saw the attendance of active and proficient members of the networking community from both academia and industry engaged in discussions on recent advancements in the broad field of telecommunications where key-issues were highlighted, trends identified and visions refreshed. Chaired by Associate Professor Francis Lee, Associate Chair (Research) from the SCE, and Professor Lawrence Wong from the National University of Singapore (NUS) the conference was a stellar success. It received a total submission of 249 papers from 41 countries; 47% of the submissions came from Europe and the Middle East, 38.3% from the Asia Pacific, 11.3% from the United States, 2.8% from Canada and 0.4% from Latin America. Present at the event was Guest-of-Honour Dr Tan Geok Leng, Chief Technology Officer, Infocomm Development Authority (IDA) Singapore who delivered the first keynote speech that discussed the development and trends of broadband in Singapore.
Fifth International Conference Structures in Fire (SiF) 2008

The Structures in Fire (SiF) conference organised by NTU’s School of Civil and Environmental Engineering (CEE) was held in Nanyang Executive Centre, Singapore, 28 to 30 May 2008. It provided a forum for experts in the fire engineering research field from around the world to meet and exchange views on their research. It was also an opportunity for professionals to keep abreast with research and development works. The conference, first created in 2000, was held in Copenhagen, Denmark. It was subsequently rotated to Christchurch, New Zealand in 2002, Ottawa, Canada in 2004 and Averio, Portugal in 2006. Singapore is the first Asian country to host this event.

Singapore International Water Week (SIWW) Symposium for Young Water Talents 2008

The Symposium for Young Water Talents is a symposium targeted at graduate students in water science and technology and was held on 23 June 2008 at Suntec City, Singapore. The one-day symposium organised by NTU, supported by International Water Association (IWA) and Public Utilities Board (PUB) Singapore, formed part of the activities at the Singapore International Water Week (SIWW) and is to encourage scientific enquiry and interaction amongst young, budding scientists and engineers in the water industry. By linking the symposium to the main SIWW conference, graduate students can benefit from exposure to renowned international researchers and key industrial water players. At the same time, the industry had the opportunity to scout for talent and recruit skilled manpower.

11th International Conference on Work Values and Behaviour: “Work Values and Social Responsibilities in a Changing World: From Being Good to Doing Good”

The International Society for the Study of Work and Organisational Value (ISSWOV) conferences never aim to be too big, in order to encourage good dialogue and networking among those present. However, the conferences attract widespread attention from a worldwide audience that accesses the ISSWOV website and many who discuss the conference proceedings in universities and industry around the world.

The ISSWOV conference is held every two years in locations across the globe, but had not previously been held in Asia, largely because of the distance from Europe and North America. However, NTU’s Nanyang Business School (NBS) won the right to host this year’s conference because of its reputation for research excellence and industry relevance.

The conference, which was held at Carlton Hotel, Singapore from 22 to 25 June 2008, featured a series of interactive sessions and research papers on management issues. Topics included are work-family balance, careers, diversity and discrimination, organisational change, occupational health and safety, entrepreneurship and developing countries, values-based training and education.
There were also two special forums:
- Meet the Editors of 4 international journals, and

The conference was participated by 100 delegates from 28 countries, as well as 40 people from local government, industry and business, who took part in a scientist-practitioner forum on “Best Practices in Diversity Management”.

After the event, participants commented that they were delighted with the high quality academic programme and vibrant social programme and very impressed with NBS’ organisation of the 2008 conference.

**Thin Films 2008**

The International Conference on Technological Advances of Thin Films and Surface Coatings is a biennial event of knowledge exchange and interactive platform for researchers and engineers from industry, research laboratories and academia. Thin Films 2008 is the 4th of this series. Following its success as Thin Films 2002, Thin Films 2004 and Thin Films 2006, Thin Films 2008 brought together state-of-the-art developments on all aspects related to the processing, characterisation and applications of thin films and surface coatings. Thin Films 2008, which was held from 13 to 16 July 2008, attracted more than 800 participants from all over the world and was held in conjunction with The 1st International Conference on NanoManufacturing (nanoMan2008). Thin Films 2008 also organised a poster competition with 3 top prizes awarded to the winners.
NTU Showcases Its Strengths in Science and Technology at the 3rd Euroscience Open Forum (ESOF) in Barcelona

NTU made its ‘debut’ at the Euroscience Open Forum (ESOF) when a team of NTU faculty and staff members, led by NTU Provost, Professor Bertil Andersson and Associate Provost (Graduate Education and Special Projects), Professor Lam Khin Yong, attended the 3rd instalment of the biennial event, held this year in Spain from 18 to 22 July 2008.

Together with representatives from the National University of Singapore (NUS) and the Agency for Science, Technology and Research (A*STAR), NTU joined the Singapore contingent, a first-time participant at the prestigious event, to showcase excellent R&D capabilities in the public research sector, as well as the range of educational and research opportunities available for international students and faculty at the two universities.

Organised by Euroscience, a representative group for European scientists of all disciplines, the forum provides both the European and international science and business communities an open platform for debate and communication. The event includes a forum for discussion of topical issues, a conference cum exhibition to showcase achievements across the scientific and technological spectrum, as well as an outreach programme targeted at the public.

At the NTU booth at the Singapore Pavilion in the exhibition hall, eye-catching posters on postgraduate education and research collaboration opportunities at NTU were prominently displayed, to reach out to promising young talent in the community. Visitors to the booth were also keen to learn more about the Nanyang Assistant Professorship (NAP) scheme, which awards promising young faculty research funding of S$1 million over three years, as well as the prospect of a tenure track appointment.
International Symposium on Advances in Steel and Composite Structures (ISASCS) 2008

More than 150 practicing engineers gathered in NTU for the International Symposium on Advances in Steel and Composite Structures (ISASCS) organised by the NTU’s School of Civil and Environmental Engineering (CEE) on 1 August 2008. This 2nd international symposium is a sequel to the inaugural symposium on the same theme which was held successfully back in May 2006. It is important for practicing engineers to keep abreast with some of the advances and developments in steel and composite structures which have taken place since then. Singapore’s construction industry is currently bursting with activities and the high demand for infrastructural developments will certainly continue over the next few years. Steel and composite constructions are ideally suitable for high-rise buildings, long-span bridges and roof structures due to its speed and ease of construction, inherent ductility, and structural efficiency with large strength-to-weight ratios as well as large flexural rigidities against instability and serviceability problems. Similar to the inaugural symposium, this 2nd international symposium provided a technical forum for the dissemination of recent advances in steel and composite construction technology and for the participants to interact with all the invited speakers.

Professional Development Workshop on “Cultural Intelligence and Global Identity” at the 68th Annual Academy of Management (AOM) Meeting

NTU’s Centre for Leadership and Cultural Intelligence (CLCI) conducted a joint workshop together with Professor Miriam Erez from Technion University, and Professor Gili Drori from Stanford University at the Academy of Management (AOM) Meeting, held at Anaheim, Los Angeles in August 2008. The workshop had an excellent turnout, with approximately 50 academics and practitioners from different parts of the world, including US, Canada, UK, Germany, The Netherlands, Australia, Korea, Taiwan, Malaysia, and Singapore, participating in the workshop.

High-Level Symposium on Asian Economic Integration

A high-level symposium on Asian Economic Integration was held at the Orchard Hotel on 4 and 5 September 2008. It was organised by Dr Pradumna B Rana from the School of Humanities and Social Sciences (HSS) on behalf of the Division of Economics and Centre for Liberal Arts and Social Sciences (CLASS).

There were 11 papers authored by eminent economists from around the globe. At the plenary session of the symposium, keynote speakers were Dean Masahiro Kawai of the Asian Development Bank (ADB) Institute, Japan and Ambassador Ong Keng Yong. Representatives of the diplomatic community included ambassadors, senior policymakers, academics, and representatives of the media were present at the plenary session.

The papers will be revised and considered for a special issue of the Singapore Economics Review on Asian Economic Integration.
Panel Discussion on Financial Crisis

At a panel discussion held at the NTU’s Nanyang Auditorium on 20 October 2008, six distinguished professors from the Nanyang Business School (NBS) gave their insights on the various aspects of the current global financial crisis and what it meant for Singapore’s economy. The session was chaired by Professor Jitendra Singh, Dean and Shaw Foundation Chair, NBS. The discussion was attended by approximately 250 participants. The other five professors were:

- Professor Hwang Chuan Yang, Director, PhD programme (Division of Banking and Finance);
- Professor Lilian Ng, Nanyang Professor, (Division of Banking and Finance);
- Associate Professor Low Buen Sin, Director, MSc (Financial Engineering), (Division of Banking and Finance);
- Associate Professor Tan Khee Giap, Associate Dean (Student Affairs), (Division of Banking and Finance);
- Assistant Professor Suman Banerjee (Division of Banking and Finance)

NTU BioInformatics Research Centre (BIRC) Workshop on Protein Structure and Function

Proteins are the functional entities of biological systems and most biological activities are a result of protein-protein interactions. Their importance has spurred on the active inquest and advancement in both experimental and computational techniques, to discover protein structure and function which are mostly determined by their 3D structure. These scientific breakthroughs of protein structure and function have made significant contributions to understanding biological phenomena and the discovery of novel drugs. It has also made room for active dialogue among experts present at the NTU BioInformatics Research Centre (BIRC) Workshop on Protein Structure and Function, organised by the School of Computer Engineering (SCE) on 25 October 2008.

This full day workshop highlighted the recent advancements in the prediction of protein structures and functions, through a series of informative speeches and talks delivered by Singapore’s prominent experts. The event received positive feedback from the 93 participants who were present.

Collaboration with Chulalongkorn University on Research Workshop and Symposium

The Faculty of Economics and Centre for Liberal Arts and Social Sciences (CLASS) of NTU’s School of Humanities and Social Sciences (HSS) collaborated with Chulalongkorn University on the workshop “Interdisciplinary Studies on Happiness”. 6 papers on various aspects of happiness were presented, ranging from ‘Shakespeare’ to ‘State Intervention versus Individual Freedom’, from ‘Asian Wellbeing’ to ‘Economic Openness’, and from ‘Life Aspirations of Youth’ to the ‘Concerns of Elderly’. This workshop took place in Bangkok.
A second sequel to the above workshop was held in Singapore on 20 and 21 November 2008, entitled “Symposium on Interdisciplinary Studies on Happiness”. International speakers, academics and scholars from various disciplines were invited to discuss and share their research findings at the symposium and it is hoped that it will further encourage new ideas and discourse that might be useful to policy and decision makers.

**Regency Steel Asia International Symposium on Innovations in Structural Steel (RSA ISISS) 2008**

In recognition of the generous donation from Regency Steel Asia Private Limited to set up the RSA Research Fund to support steel research, NTU’s School of Civil and Environmental Engineering (CEE) launched The Regency Steel Asia (RSA) International Symposium series in Singapore as a platform to disseminate steel research information and to reach out to the industry. The theme for this year’s inaugural symposium on 1 December 2008 focused on Innovations in Structural Steel and this included works that have already been completed, on the use of high strength steel in construction. Prominent overseas and local speakers from US, Europe, Australia, China, Hong Kong, and Singapore who are all experts in steel structures were invited to share their experiences with practicing engineers and professionals from various government agencies, local engineering consulting firms and construction companies. Practical experiences on innovations design, latest developments and applications of new technologies in using structural steel in actual projects were also presented. This symposium provides a platform for engineers and professionals as well as researchers to interact and learn from the experts in exploring and applying new applications in structural steel.

**International Conference on Control, Automation, Robotics and Vision (ICARCV) 2008**

The 10th International Conference on Control, Automation, Robotics and Vision (ICARCV) 2008 was held from 17 to 20 December 2008 in Hanoi, Vietnam. Inaugurated in 1990 by the School of Electrical and Electronic Engineering (EEE), ICARCV is a biennial event and has proved to be a premium forum where researchers and engineers interested in the area of control, automation, robotics and vision meet to interact and exchange the latest theoretical and experimental results. An exciting technical programme was assembled for ICARCV 2008, which comprised of 3 keynote speeches, 2 panel discussions, 416 papers presented in 57 oral sessions and 3 poster sessions. The papers presented were selected from a total of 818 submissions from 47 countries, a record number in the ICARCV history. Each submitted paper was subjected to rigorous peer reviews to ensure the quality of accepted papers, and all accepted papers vied for the Best Paper Award. The future ICARCV will strive to continue as a premium conference; for this purpose a permanent email address (secretariat@icarcv.org) and website (http://www.icarcv.org) have been setup.
SIGGRAPH Asia 2008

SIGGRAPH Asia 2008, which was held at Suntec City, Singapore, on 10 to 13 December 2008, is the inaugural Asian counter-part to the SIGGRAPH conference which takes place annually in the US. Associate Professor Lee Yong Tsui, Assistant Chair of the School of Mechanical and Aerospace Engineering (MAE) was the Conference Chair.

SIGGRAPH is the world’s largest and most prestigious conference on computer graphics and interactive techniques, routinely attended by more than 20,000 people who eagerly look forward to attending the event because of the presentations on high quality and the new cutting-edge materials that are delivered during the conference. Many ground breaking techniques are first reported at SIGGRAPH and SIGGRAPH is a conference where you get totally “wowed”.

As SIGGRAPH takes place in the US, where many of the people in Asia do not have much of an opportunity to get to, ACM SIGGRAPH, the organisation that runs SIGGRAPH, decided to bring it to Asia and call it SIGGRAPH Asia. SIGGRAPH Asia has the same breadth, depth and quality as SIGGRAPH. It has seven different programmes to keep delegates busy and enthralled - technical papers, courses, sketches and posters, digital art and emerging technology gallery, computer animation festival, educators programme and trade exhibition.

The conference had two very notable keynote speeches. The first speaker was Professor Don Greenberg, reportedly the world’s first professor of computer graphics at Cornell University. He has produced more than 200 PhD students, many of whom are now industry leaders. The other was Dr Rob Cook, who is the Vice President of Technology at Pixar. Dr Cook talked about the technologies behind Pixar’s blockbusters.
Awards and Recognition

Individuals of passion and research are behind the achievements of the University. These outstanding individuals have been recognised not just by the University, but also by the international community. In this section, we highlight some of the contributions and achievements of our faculty members, staff and students.
Awards and Recognition

Abstract and Poster Wins Award at the 10th International Symposium on Dendritic Cells

A poster from the School of Biological Sciences titled “Polycomb Group Protein Ezh2 Controls Physiological Functions of Dendritic Cells” was presented at the 10th International Symposium on Dendritic Cells held in October 2008 at Kobe, Japan. The poster received the Nature Immunology Award, an award given only to two papers chosen from all the papers at the symposium. The research done by Merry Gunawn, Rosni Bhanu, and supervised by Assistant Professor Su I-Hsin, showed that polycomb group protein Ezh2 also exists in cytosol and plays a role in cell signalling. It was found that Ezh2 plays an important role in regulation of endocytosis, migration and the T-cell stimulatory capacity of dendritic cells.

Two PhD Students and Two Post-Doctoral Fellows from the School of Electrical & Electronic Engineering (EEE) shine at International Competitions with their Winning Science and Art

Yoga Divayana, the first Singapore-based winner of the 2008 IEEE-LEOS graduate student award

Yoga Divayana, a Singapore Millennium Foundation Post-doctoral Fellow, was lauded with the 2008 IEEE Laser & Electro-Optics Society (IEEE-LEOS) Graduate Student Award from the Institute of Electrical and Electronics Engineers, IEEE-LEOS, for his outstanding work on interface modification, exciton confining structures and quenching effects in organic light-emitting diodes. Yoga happens to also be the first Singapore-based graduate student to win the fellowship award since it was established in 1999.

Dr Yang Huiying turns an interesting close-up of zinc oxide into a serene image of a mountain range

Dr Yang Huiying, a Lee Kuan Yew Post-doctoral Fellow, showcased her talents at the intersection of art and science, taking home the second prize in the “Science as Art” competition at the 2008 Materials Research Society (MRS) Spring Meeting, held in San Francisco. Her award-winning impression of zinc oxide nanoneedles, created by ion beam sputtering, was obtained using a scanning electron microscope and processed to create an interesting close-up reminiscent of a scenic mountain range in China. She also won a prize in an NTU nano-art competition and her piece of work is one of the images featured on a set of commemorative NTU coasters.
PhD students Ong Yi Ching and Li Xiang bagged the bronze and commendation awards at the 3rd Taiwan Semiconductor Manufacturing Company (TSMC) Outstanding Student Research Award earlier in 2008. Winning in category III of the competition (for Physics, and Chemistry of Material for Nano-Scale Devices, respectively), two of them earned praise for advancing the study of the failure mechanisms of advanced dielectric materials using physical characterisation tools such as scanning tunnelling microscopy, scanning transmission electron microscopy and electron energy loss spectroscopy.

**EEE Staff and Students Recognised by Various Institutions for their Contributions**

Professor Xie Lihua was named Fellow, Institute of Electrical and Electronics Engineers (FIEEE) for his outstanding contributions to robust control and filtering. The grade of Fellow is conferred by the IEEE Board of Directors for contributions that have significant value to society.

Associate Professor Chang Chip Hong was named Fellow, Institution of Engineering and Technology (IET), in recognition of his significant individual responsibility, sustained achievement and exceptional professionalism during his academic career.

The IES Prestigious Engineering Achievement Award is given by the Institution of Engineers Singapore (IES) to projects that have made significant contributions to Singapore’s development and quality of life. It was awarded to Professor Tay Beng Kang and his team members for their outstanding engineering project, “Nano-Engineered Carbon Hybrid System”.

Teaching Fellow Ms. Flora S. Tsai received the International Business Machines (IBM) Real Time Innovation Award for 2008, an international award competition designed to encourage the use of open source and open standards-based tools for academic curricula and research, as well as the 2007 IBM Corporation Faculty Award, in recognition of the quality of her programme and its importance to the industry.

Associate Professors Ng Geok Ing, Radhakrishnan K., and Wang Hong and team members received the Defence Technology Prize (DTP) 2007 in recognition of the team’s innovation in creating technological breakthroughs for Singapore’s capability development in the field of Monolithic Microwave Integrated Circuits. It is the most prestigious award given by Singapore’s Ministry of Defence (MINDEF) annually to recognise outstanding contributions in defence science and technology.

At the 2nd World Congress of the World Association of Sleep Medicine (WASM) held in 2007, Mr Andrew Ng was awarded the prestigious Young’s Investigator Award for the paper entitled “Could Formant Frequencies of Snore Signals be an Alternative Means for the Diagnosis of Obstructive Sleep Apnea?” The paper was co-authored by Associate Professor Koh Tong San, Teck Hock Lee, as well as Eugene Baey from Respironics Incorporated, Udantha Ranjith Abeyrathne from the University of Queensland, and...
Kathiravelu Puvanendran from the Sleep Disorders Unit, Singapore General Hospital.

Two students under the supervision of Associate Professor Shum Ping won Best Paper awards for their research: Mr Cheng Xueping won the Best Paper Award at the Asia Pacific Optical Communications Conference (APOC) held in November 2007 at Wuhan, China for his research titled “Influence of FBG sidelobe on Bragg Grating-based Q-Switched Fibre Laser”, while Ms Hu Juan received the Best Paper Award for her project “Compact Two-Dimensional Finite-Difference Time-Domain Method Utilizing Auxiliary Differential Equations for the Full-Vectorial Analysis of Photonic Crystal Fibres” at the Symposium of Microstructured and Nanostructured Optical Fibres, International Conference on Materials for Advanced Technologies (ICMAT) in July 2007.

**SCE Staff Awarded Merit Grant from EADS**

Assistant Professor Vinod Achutavarrier Prasad and Associate Professor A S Madhukumar from School of Computer Engineering (SCE) were awarded a grant of merit from the European Aeronautic Defence and Space Company (EADS), for their project titled, “Advanced Baseband Algorithms and Low Power Implementations for Wireless Communications”. This project aims to develop signal processing architectures for multi-standard wireless communication transceivers, with opportunistic spectrum access. It is said to be potentially applicable to in-flight cellular communication and was jointly reviewed by EADS and the Singapore Economic Development Board (EDB).

**Proposal from SCE Chosen for HP Labs Innovation Research Programme Award**

Notably the only proposal selected from Singapore, the paper titled, “Understanding and Exploiting the Dynamics of Collaboration Ecosystems” submitted by Assistant Professor Anwitaman Datta from the School of Computer Engineering (SCE) stood out from among 450 submissions from 200 universities. It was one of the 45 projects chosen for the Hewlett Packard (HP) Labs Innovation Research Programme Award in 2008. The proposal focuses on exploiting the dynamics in collaborative social networks, to enhance productivity in the workplace. Joining him in this project is SCE counterpart, Assistant Professor Sun Aixin. The two professors will work closely with researchers from HP Labs, Tokyo. This global scale award is designed to encourage open cooperation with HP Labs, HP’s central research arm, in aims of producing mutually beneficial and impactful research.

**PhD Student Receives Microsoft Research Asia 2008-2009 Fellowship Award**

PhD student Huang Yi has been shortlisted by Microsoft Research Asia (MSRA) lab as one of the ‘best and the brightest in Asia and the Pacific Area’, for her outstanding research work. Rewarding her for her contributions and diligence in the field of science, she was among the 32 students that had been awarded with the Microsoft Research Asia Fellowship (2008-2009). This year, 99 distinguished PhD candidates from 48 leading research institutions were nominated for fellowships, where each had their credentials and research projects thoroughly evaluated by a reviewing committee. The MSRA Fellowship Programme started ten years ago of which, only two hundred and fifty PhD candidates from fifty institutions have served as fellows. The programme has been highly successful in fostering advances and collaboration in computer science and research.
Awards and Recognition

SCE Paper Lauded for Best Paper at the International Conference on Grid and Cooperative Computing (GCC) 2008

The International Conference on Grid and Cooperative Computing (GCC), looks to address the rapid advances in various grid-related technologies, grid middleware and grid applications. As such, it has earned great popularity as the world’s largest scientific event in the area of grid and cooperative computing.

Participating at the 7th GCC 2008 held in Shenzhen, China, was PhD student Zhang Junwei. Junwei’s paper titled, “Impact of Parallel Download on Job Scheduling in Data Grid Environment”, co-authored by School of Computer Engineering (SCE) Associate Professors Lee Bu Sung, Yeo Chai Kiat and Assistant Professor Tang Xueyan, managed to clinch the title of Best Paper and was lauded at this prestigious conference.

Institution of Engineers Singapore (IES) Prestigious Engineering Achievement Award for CEE

Associate Professor Darren Sun Delai and his team from the School of Civil and Environmental Engineering (CEE) were awarded the 2008 Institution of Engineers Singapore (IES) Prestigious Engineering Achievement Award for their work in “Nanostructured Microsphere Photocatalyst for Membranes”. IES bestowed the prestigious national award on the team for its research achievements in the field of membrane water treatment technology. For the first time in the world, an engineering system using Titanium Dioxide (TiO$_2$) nanostructured microspheric photocatalyst has been successfully applied for membrane fouling control and water quality improvement at Choa Chu Kang Waterworks, Singapore. This pilot-plant project is a two-year collaboration between NTU, Stanford University and the Public Utilities Board (PUB). The Enterprise Challenge, an initiative under the Prime Minister’s Office Singapore, supported the S$2 million pilot project by providing S$1 million in matching funds. This home grown technology is able to remove foulants like natural organic matter, bacteria and trace organics which contribute to the fouling of membranes and poor water quality, thereby reducing water treatment costs and improving water quality. The photocatalyst can also be regenerated for reuse. For the past ten years, Associate Professor Sun’s team has been heavily involved in the development of hybrid membrane system for water and energy. Since then, it has filed five patents, published about 80 academic journal papers including *Nano Letters* and *Journal of the American Chemical Society (JACS)*. The TiO$_2$ nanofibre research work was highlighted in the October 2006 issue of *Nature*.

Best Student Paper Award at Joint Conference in Digital Libraries 2008

PhD student Huang Yi won the Best Student Paper Award at the recent Joint Conference in Digital Libraries (JCDL) 2008. Her paper titled “User-Assisted Ink Bleed Correction for Handwritten Documents”, co-written with former supervisor Michael S Brown, took center-stage at this conference. The event was hosted from 16 to 20 June 2008 at Pittsburgh, Pennsylvania and serves as a major international forum focused on digital libraries and associated technical, practical, and social issues.

The paper describes a user-assisted framework for correcting ink-bleed found in old handwritten documents. The goal is to provide a semi-automated approach that strives to provide good results while minimising user involvement. This user-assisted approach helps bridge the gap between full automation and manual editing to provide a practical tool for removing ink-bleed in handwritten documents.
Awards and Recognition

Tan Chin Tuan Centennial Professorship awarded to CEE staff

Professor Ng Wun Jern from the School of Civil and Environmental Engineering (CEE) was awarded the inaugural Tan Chin Tuan Centennial Professorship for his contributions to and merits in the discipline of engineering and research. Professor Ng has held key positions in the academia and was also the Singapore director of the Singapore-MIT Alliance in 2005. His research output can be found in some 400 publications and his research and development efforts have been brought to full-scale applications. Professor Ng’s contributions to the industry, research and education have also been recognised with accolades such as the ASEAN Engineering Award and the Outstanding University Researcher Award.

Honour Award of the International Water Association’s (IWA) Innovation Award for East Asia and the Pacific in Applied Research

In 2008, Associate Professor Darren Sun Delai and his team from the School of Civil and Environmental Engineering (CEE) won the Honour Award of the International Water Association’s (IWA) Innovation Award for East Asia and the Pacific in Applied Research – an award that recognises excellence and innovation in water engineering projects throughout the world. The project – a pilot plant featuring nano-sized crystal-like material that eats up micro-organisms in the water and produces no waste-material in the process – makes innovative use of nanotechnology to improve the cleansing of membrane filters to enable more cost efficient water purification. The project is a joint collaboration between Nanyang Technological University (NTU), Stanford University and the Singapore Public Utilities Board (PUB), and is supported by The Enterprise Challenge of the Prime Minister’s Office of Singapore.

2008 ASAIHL-Scopus Young Scientist Awards

The Association of Southeast Asian Institutions of Higher Learning (ASAIHL) based at the Asian Institute of Technology (AIT) launched the First Annual ASAIHL-Scopus Young Scientist Awards in 2008. Associate Professor Nguyen Nam-Trung from the School of Mechanical and Aerospace Engineering (MAE) was awarded as runner up from among a large number of highly competitive applicants in the category of ‘Engineering and Technology’ for the 2008 ASAIHL-Scopus Young Scientist Awards. The ASAIHL - Scopus Young Scientist Awards are given annually to outstanding young scientists and researchers in Asia-Pacific who have made significant contributions to scholarship and research.
Professor is Editor-in-Chief for Nanoscience and Nanotechnology Letters (NNL)

Professor Sam Zhang of the School of Mechanical and Aerospace Engineering (MAE) has been invited to serve the journal Nanoscience and Nanotechnology Letters (NNL) as the Editor-in-Chief since April 2008 and has also been featured in the “Who's Who in World” (published in November issue, 2008).

Nanoscience and Nanotechnology Letters (NNL) is a multidisciplinary peer-reviewed journal consolidating nanoscale research activities in all disciplines of science, engineering and medicine into a single and unique reference source. NNL provides the means for scientists, engineers, medical experts and technocrats to publish original short research articles as communications/letters of important new scientific and technological findings, encompassing the fundamental and applied research in all disciplines of the physical sciences, engineering and medicine.

MAE Project Wins Top Award in Intelligent Mechatronics and Automation Competition

A School of Mechanical and Aerospace Engineering (MAE) project that explores the motion control of a robotic puppet through human motion capture data has clinched the top prize of the 2007 International Student Experimental Hands-on Project Competition via Internet on Intelligent Mechatronics and Automation (Hands On’07). The winning project is the fruit of research efforts of Project Officer Nguyen Kim Doang and his supervisor, Associate Professor Chen I-Ming.

The MAE project was selected the top winner after the live final competition via internet on 7th December 2007. The award comes with a cash prize of US$2,500.

The Competition was organised by the National Chung Cheng University, Taiwan. Held annually, the aim of this international competition is to improve mechatronics education, with the emphasis on the training of students’ experimental hands-on abilities.
Public Sector Innovation Award

Associate Professor Sunita Chauhan of the School of Mechanical and Aerospace Engineering (MAE) and her team received the Public Sector Innovation Award for the research on “A Minimally Invasive Biomechatronic Approach for Breast Cancer Surgery”. The invention relates to method, technique and device for performing pre-planned multiple breast biopsies and more specifically to instruments and methods for complete removal of tumour/cancer/lumps together with a defined surrounding margin tissue removal, thus assuring a desired surgical intervention/excision of the abnormality. Technically, the areas involved encompass applications of mechatronic/robotic techniques to minimally invasive surgical procedures. Such a system can be used for single, multiple biopsies as well as for cancer treatment. The novel system thus devised is integrated with a 2D ultrasound scanning arm to render real time diagnosis, which yields enhanced accuracy of surgery. The method using a pre-operative diagnosis based on 2D ultrasound calculates a 3D volume of the tumour and plans for the number and type of biopsies to collectively result into lump removal. Besides this, on-line monitoring of the surgery allows the surgeons to perform any desired intervention during the procedure, or alteration in the planning, as may be needed on a case-by-case basis. Together these features allow for more accurate and complete sampling of the abnormality leading to the complete excision of tumour/cancer/lumps along with accurate removal of the surrounding margin tissue in an accurate and consistent manner.

A minimally invasive biomechatronic approach for breast cancer surgery
Innovative Approach to Biped Walking of LOCH Humanoid Robots Wins MAE Professors Best Paper Award

School of Mechanical and Aerospace Engineering (MAE)’s Associate Professor Xie Ming and his co-authors (including Associate Professor Zhong Zhaowei) were awarded the Industrial Robot Innovation Award at the 11th International Conference on Climbing and Walking Robots and the Support (CLAWAR2008) conference held in Coimbra, Portugal from 8 to 10 September 2008.

Professor Xie et al’s winning paper “A deterministic way of planning and controlling biped walking of LOCH humanoid robot” presents a unified approach for achieving both faster and more stable biped walking within a hybrid framework of planning and control. The basic idea behind this unified approach is a newly proposed innovative concept (i.e. leg stability) of biped walking, which has many advantages over the existing concept (i.e. foot stability) of biped walking. It is worth noting that the existing concept of foot stability has dominated the literature for 40 years until now. In addition, this paper gives more insightful details about the biped walking cycle, and has outlined the four distinct phases within a basic walking cycle. On the basis of the new concept and the proposed new principle governing its implementation, it becomes possible to make today’s humanoid robots practically achieve speedy and stable walking in real-time and in a changing environment, and also to make them to achieve the impressive biped walking behaviours demonstrated by Honda’s ASIMO (Advanced Step In Innovative MObility) humanoid robots, of which the key principles are still kept secret so far.

Associate Professor Xie Ming (front, right), Associate Professor Zhong Zhaowei (front, left) and the other members of the winning team
Awards and Recognition

The “Digital Repository” collaborative project between the Wee Kim Wee School of Communication and Information (WKWSCI) and NTU Library was carried out to build an Institutional Repository for NTU digital resources. The project won the eINDIA2008 Award for the “Best ICT enabled University of the Year (Digital Learning Category)” in July 2008. The project development team, comprising Mr. Jayan C Kurian and Associate Professor Dion Goh, both from WKWSCI, Ms Hazel Loh and Ms Joy Lynn Wheeler, both from the NTU Library, were able to contribute an innovative content ingestion methodology to the Open Source community. The eINDIA 2008 is organised by the Centre for Science, Development and Media studies (CSDMS), a Non-governmental Organisation (NGO) in India, and supported and co-organised by Ministry of Information Communication Technology, Government of India and the United Nations Global Alliance of ICT for Development.

eINDIA2008 Award for the “Best ICT enabled University of the Year (Digital Learning Category)”

The winners of the eINDIA Awards at the Valedictory session of eINDIA 2008. 1st row, Middle, Jayan C Kurian, one of the award winners in digital learning category, representing Wee Kim Wee School of Communication & Information (WKWSCI) and NTU Library.

Outstanding Paper Award at Literati Network Awards for Excellence 2008

Associate Professor Ravi Sharma from the Wee Kim Wee School of Communication and Information (WKWSCI) together with co-authors Ms Priscilla Teng from the Ministry of Education (MOE) and Mr Tan Meng-Wah from the National Trades Union Congress (NTUC) of Singapore, published a paper titled “Value-Added Knowledge Management for Financial Performance: the case of an East Asian conglomerate” in VINE, a journal of information and knowledge management systems, Vol. 37 no. 4, pp. 484-501, 2007. The paper was chosen as the Outstanding Paper Award winner at the Literati Network Awards for Excellence 2008. The research was conducted by Associate Professor Sharma and his team to study the economic significance of using a blended business and knowledge strategy through the lens of conventional financial management before and after the implementation of knowledge management initiatives in a knowledge-intensive, high-growth firm that had gone through business diversification through organic developments as well as mergers and acquisitions for over a decade.
Top Paper Award Received at International Communication Conference 2008

Assistant Professor Augustine Pang from the Wee Kim Wee School of Communication and Information (WKWSCI), Ms Marela Lucero and Mr Alywin Tan (both Master of Mass Communication students at WKWSCI) received the Best Academic Paper Award at the Conference on Corporate Communication International Conference in June 2008 in England, United Kingdom. The paper, titled “Effective Leadership in Crisis”, offers practical, research-based answers to the important strategic question of who speaks for the company, and when. Assistant Professor Pang is an expert in crisis communications.

IS Publication of the Year Awarded to Paper from NBS

“Vertical Information Systems (VIS) Standards Deployment and Integration: A Study of Antecedents and Benefits”, a paper co-authored by PhD student Xu Yun, Assistant Professor Boh Wai Fong and Associate Professor Christina Soh, received the IS Publication of the Year award, selected by the Senior Scholars at the International Conference on Information Systems (ICIS) at Paris in December 2008. This award is given to five journal articles out of the list of nominations obtained from editors of any journal. The award reflects the article’s importance as a contribution to the Information Systems (IS) field and entries are judged based on the article’s importance as a contribution to practice in the IS field, its importance as a contribution to theory in the IS field, the uniqueness/originality of the ideas, and the quality of the arguments.

NBS Professor Receives Outstanding Associate Editor Award from Decision Sciences Journal

Professor Ang Soon of the Nanyang Business School (NBS) was recently honoured with the Outstanding Associate Editor Award by the Decision Sciences Journal for her outstanding leadership and service, for the high quality of her developmental reviews and the academic leadership she has shown in advancing the decision sciences, in particular her high impact contribution to the special topic forum on sourcing. She was also the recipient of the prestigious NTU Nanyang Awards 2007 for Research and Innovation, for her pioneering research on cultural intelligence.
2008 Researcher of Division Awards, Nanyang Business School (NBS)

Dr Wu Shin-Yi is an Assistant Professor of Information Technology & Operations Management at Nanyang Business School (NBS). He received his PhD and MS from the Wharton School of the University of Pennsylvania and his MBA and BBA from National Taiwan University. His research interests include strategic pricing of information goods and services, telecommunications and efficient allocation of wireless network resources, economics of electronic markets and business, and strategic use of IT and management of IT/IS. His research has been published and/or presented in Management Science, Operations Research, European Journal of Operational Research, International Conference on Information Systems (ICIS), Workshop on Information Technology and Systems (WITS), Workshop on Information Systems and Economics (WISE), INFORMS Conference on Information Systems and Technology (CIST), INFORMS Telecommunications Conference, and INFORMS Annual Meeting.

Assistant Professor Luo Jiang is from the Division of Banking & Finance at NBS. His primary research interest is in theoretical corporate finance. Specifically, he focuses on the study of internal capital markets. He believes that it is important to examine how effectively these markets allocate funds to their best use and that the study of these markets can generate numerous insights on capital budgeting, managerial compensation, entrepreneurship and innovation, and guide corporate financial practices. To date, he has published three articles in this field (two as lead articles which indicate professional appreciation from the editor) and one more forthcoming at the top-tier finance journals. The most recent major work, “Motivating entrepreneurial activity in a firm” (a joint study with Antonio Bernardo and Cai Hongbin), is forthcoming in the Review of Financial Studies. According to Assistant Professor Luo Jiang, this article is the only one that provides a detailed analysis of the financing of internal ventures.

Dr Lim Chee Yeow is an Assistant Professor from the Division of Accounting at NBS. His research interest is in the area of auditing, corporate governance, and capital market research, both in the local and in the international context. He has published in the Journal of Accounting Research, Auditing: A Journal of Practice & Theory, International Journal of Accounting, Review of Quantitative Finance and Accounting, and Journal of International Financial Markets, Institutions and Money.

Joyce Lee Suet Lin is an Associate Professor from the Division of Business Law at NBS. Joyce teaches a range of law courses, including Business Law, Consumer and
Sharon Ng Sok Ling is an Assistant Professor from the Division of Marketing and International Business at NBS. She has a Bachelor’s Degree in Business (First Class Honours) from NTU, and graduated with a PhD from the University of Minnesota’s Carlson School of Management in 2004. Her research focuses primarily on the impact of culture on the way brand information is structured in memory and how people respond to various branding strategies. In addition, she also examines cross-cultural differences in other aspects of consumer behaviour such as counterfactual thinking, impatience and fairness perception. Sharon was awarded the Researcher of the Division from the Nanyang Business School in 2006 and 2008. She has published in journals such as Journal of Consumer Research and Journal of Marketing Research.

As the Director of Research at CLCI, she is actively involved in research projects to enhance the measurement as well as expand the nomological network of cultural intelligence. She is also co-leading a team of research investigators on a multi-year leadership project for the Singapore Armed Forces. In the SIOP (Society for Industrial and Organisational Psychology) Conference held in the United States in April 2008, she and her team won a top poster award for their paper on cultural influences on subordinates’ upward ratings in a leadership development context. This award recognises the top 20 posters, out of a total of 700 posters, featured in the international conference.

Her recent publications include a paper on cultural intelligence in Management and Organisation Review (2007), a meta-analysis on turnover of IT professionals in the MIS Quarterly (2007), and a paper on personality and leadership accepted for publication in the Journal of Applied Psychology.
Awards and Recognition

Team Awarded Top Poster Award by Society for Industrial and Organisational Psychology

The team of researchers at the Centre for Leadership and Cultural Intelligence (CLCI), Nanyang Business School (NBS), together with collaborators from the Singapore Armed Forces (SAF), won a top poster award at the 23rd Annual Conference of the Society for Industrial and Organisational Psychology held at San Francisco in April 2008. The paper titled “Effects of subordinates’ cultural value orientations on feedback ratings” co-authored by Associate Professor Ng Kok-Yee, Ms Christine Koh, Professor Ang Soon, Mr Jeffrey Kennedy, and Associate Professor Chan Kim-Yin was one of the 20 papers selected out of 700 papers to be featured in the Top Posters Session. This paper was based on the collaborative project between CLCI and SAFTI Military Institute (MI) on multisource leadership feedback. The study highlights that because of different belief systems, implementing upward or multisource feedback in different cultural settings requires careful considerations and interventions to be effective.

Stafford Beer Medal

Professor Christina Soh

Associate Professor Sia Siew Kien

Professor Christina Soh and Associate Professor Sia Siew Kien were awarded the Stafford Beer Medal 2007 by the Operational Research Society for their paper “The Assessment of Package-Organisation Misalignment”. The Stafford Beer Medal is awarded for the best paper published in the European Journal of Information Systems (EJIS) and Knowledge Management Research & Practice (KMRP), two of the Operational Research Society’s journals. The paper proposed a conceptual framework, based on institutional theory and systems ontology, to assess the misalignments between commercial software package functionality and organisational requirements. The paper concludes by suggesting strategies that implementing organisations and package vendors may pursue.

Best Paper Award at Finance Conference

At the National Taiwan University Annual Finance Conference, Professor Hwang Chuan-Yang received the Best Paper Award for the paper titled “Is Information Priced? – Evidence from the Price Discovery of Large Trades.” In this study, Professor Hwang and Qian Xiaolin from Nanyang Business School (NBS) develop an information risk measure that is based on the price discovery of large trades, estimated via the vector error-correction model. The measure is built on the observations that informed traders prefer to trade in large size and that prices of large trades and small trades are co-integrated. Using this new measure, it was shown that information risk is priced.
Awards and Recognition

Journal of Service Research

Best Article Award

Dr Xin Chang, Simba was awarded the 2nd place for the Best Paper Award at the 16th Conference on the Theories and Practices of Securities & Financial Markets by the National Sun Yat-Sen University. The paper “Market Timing and the Cost of Equity” found that firms that timed their external financing more in the past (i.e., that issued more capital when market conditions were good) have a lower expected cost of equity than those that timed their issuance less. This result is economically significant, and holds for numerous specifications. The benefits of market-timing activity are more pronounced for equity than for debt. These findings are consistent with the hypothesis that the gains from future market-timing activity are priced by current investors, and suggest that investors in the secondary market believe in the ability of firms to successfully time the market. It was also found that the benefits of timing activity are enhanced for firms with a higher fraction of shares held by dedicated long-term investors, and are reduced for firms with shareholders that are more likely to time their own trades.

Best Paper Award at Conference on the Theories and Practices of Securities & Financial Markets

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Peter Brownell Manuscript Award

Dr Xin Chang, Simba, Assistant Professor in the Division of Banking and Finance, Nanyang Business School (NBS), was the co-author of a paper titled “Effects of financial constraints on corporate policies in Australia” that won the Peter Brownell Manuscript Award for the best publication in Accounting & Finance, a journal published by the Accounting & Finance Association of Australia & New Zealand (AFAANZ).

The impact of financial constraints on Australian companies’ investment decisions and demand for liquidity was studied in the paper. In examining a large sample of Australian firms over the period 1990–2003, it was found that financial constraints not only reduced the sensitivity of investment to the availability of internal funds, but also increased the responsiveness of cash holdings to internally generated cash flows. Further analysis showed that the impact of financial constraints varied across different cash flow states; that is, financial constraints had a small effect on corporate investment and cash policies when cash flows were positive. In contrast, the severity of constraints was high in negative cash flow years in which the cost disadvantage of external finance coincided with deteriorating operating performance.

Journal of Service Research

Best Article Award

Together with his co-authors, Janet Parish (Texas State University) and Leonard Berry (Texas A&M University), Associate Professor Lam Shun Yin from NTU’s Nanyang Business School (NBS) (Marketing & International Business Division) won the Journal of Service Research ‘Best Article Award’ 2008 for their article titled “The Effect of the Servicescape on Service Workers”. The article considered the effects of three elements – pleasantness, safety and convenience, upon service worker’s job stress and job satisfaction, as well as their commitment to the organisation. A model was developed and tested on nurses working in a hospital that had recently added a new wing to its existing facility.
Alumni-Alumnae Award
University of Michigan

The Alumnae Council and the alumni of the University of Michigan (U-M) support scholarships for undergraduate and graduate students through endowed funds established in honour of alumnae and alumni, U-M club fundraising events, bequests, and annual gifts from individuals. The Alumni-Alumnae scholarships are awarded to enrolled students who demonstrated outstanding academic strength and involvement in the University community.

Assistant Professor Mandy Tham Tze-Minn was awarded the Elliot Alumni Scholarship for the academic year 2007/2008 which started from September 2007 and ended in April 2008.

HSS Professor Receives Best Paper Award

Professor David Reisman from the School of Humanities and Social Sciences (HSS) won the Best paper of the Year with “Superannuation and Housing in Singapore” published in the International Journal of Social Economics, 2007. The paper studies Singapore’s model as a non-welfare state. Singapore is used as a case study to derive lessons for other countries wishing to combine good housing with adequate retirement provisions.

Young Asian Researcher Award Presented to Staff from HSS

Assistant Professor Tamara S Wagner from the School of Humanities and Social Sciences (HSS) was awarded the Young Asian Researcher Award (YRA) at the 7th Conference of Asian University Presidents & 80th Anniversary of National Taiwan University, held in Taipei, Taiwan, in November 2008. The Young Researcher Award (YRA) is established under the auspices of the Conference of Asian University Presidents (CAPs) to encourage research by young scholars based in Asia. The YRAs are presented to young scholars in recognition of their achievement in completing research of the highest academic calibre. The winner is selected by a selection committee comprising of representatives of the Asian universities such as Chulalongkorn University, Pusan National University and Shanghai Jiao Tong University.

The following three articles by Assistant Professor Wagner were considered by the awarding body:

Autonomous Institutes & Research Institutes

Autonomous Institutes

Other than the four colleges – College of Engineering, College of Humanities, Arts & Social Sciences, College of Science and Nanyang Business School – NTU is also proud to be home to the following autonomous institutes:

**Earth Observatory of Singapore (EOS)**
- the region’s first Research Centre of Excellence in Earth Sciences

**National Institute of Education (NIE)**
- Singapore’s national institute for education of teachers

**S. Rajaratnam School of International Studies (RSIS)**
- a leading research and graduate teaching institution in strategic and international affairs in the Asia-Pacific region

Research Institutes

These Research Institutes at NTU have been formed to encourage multidisciplinary research in their respective fields of engineering and technology:

**Energy Research Institute @ NTU (ERI@N)**
- a strategic platform bringing together all research in Energy, to be launched in 2009

**Institute for Media Innovation (IMI)**
- an incubator for research in Interactive and Digital Media

**Nanyang Environment & Water Research Institute (NEWRI)**
- an ecosystem to house research and development of Environmental and Water technologies
Earth Observatory of Singapore (EOS)

Beginnings

NTU proposed the establishment of the Earth Observatory of Singapore (EOS) as a Research Centre of Excellence (RCE) in early 2008, and the proposal was approved on 1 February by the Academic Research Board (ARB) of the Ministry of Education and the National Research Foundation (NRF) Board of Singapore. On 28 March 2008, the Prime Minister of Singapore announced the government’s decision to invest in Singapore’s first Research Centre of Excellence in Earth Science. Founding Director Professor Kerry Sieh relocated to Singapore in July 2008, and together with Mr Sonny Lim, EOS’ newly recruited Administrative Director, began to put into place the necessary foundational financial, human resources and administrative structures and procedures. In the seven months leading up to the official opening of EOS, the first phase of construction was completed, administrative and education & outreach staff put in place, and the hiring of scientists and technicians well underway.

Official Opening of EOS

EOS was officially launched on 19 February 2009, by Dr Francis Yeoh, Chief Executive Officer of the National Research Foundation (NRF). The new offices are located in the North Spine, National Technological University (NTU); an excellent location for interactions with other schools and entities, such as the School of Civil and Environmental Engineering (CEE), the School of Computer Engineering (SCE), the S. Rajaratnam School of International Studies (RSIS) and the National Institute of Education (NIE). The setting up of the Earth Observatory of Singapore (EOS) as an autonomous institute at NTU highlights the university’s new commitment to the study of geological phenomena and their effects on mankind. NTU has been involved in earthquake engineering since the 1990s, and the EOS, as Singapore’s first Research Centre of Excellence (RCE) in Earth Science, will greatly expand efforts to study the causes of natural disasters in the region. The Ministry of Education (MOE) and National Research Foundation of Singapore have committed S$150 million over the next 10 years in joint funding for EOS research and development. To further demonstrate NTU’s commitment, a Division of Earth Science is being formed at NTU to provide for undergraduate and postgraduate demands.
International Standards

Founding director of the EOS is Professor Kerry Sieh, a leading paleoseismologist and tectonicist, who spent over 30 years in earth science at the California Institute of Technology before coming to NTU. He initiated the field of paleoseismology 30 years ago with his discovery of how often California’s infamous San Andreas fault has generated great earthquakes. In Asia, his work along the great under-sea Sunda megathrust revealed patterns of ancient rupture and current straining that led eventually to forecasts of recent and impending large Sumatran earthquakes and tsunamis, with his most recent findings published in the renowned journals *Nature* and *Science*.

Professor Chris Newhall, the world’s foremost authority on volcanism of Southeast Asia, was with the US Geological Survey and University of Washington prior to joining EOS, and leads the volcanology group.

Professor Paul Tapponnier of the Institut de Physique du Globe of Paris leads the earthquake science group. As an accomplished and influential neotectonicist, his interests include continental dynamics and tectonics, active faulting and seismotectonics, earthquake hazard assessment, and quantitative geomorphology.

EOS Scientific Advisory Board

An international Scientific Advisory Board is working with EOS leadership to ensure that EOS’ research is relevant and of the highest standard. Board members are themselves experts in the fields of EOS’ research and in science education. The Board is currently chaired by Professor Douglas Burbank.

Division of Earth Sciences

The EOS has proposed that NTU establish a Division of Earth Sciences (DES) within the School of Physical and Mathematical Sciences (SPMS) under the College of Science (COS). Earth Science is a fundamentally multidisciplinary field, involving chemistry, physics, mathematics, biology, ecology, and other fields. In addition, EOS expects there to be many interactions between EOS and faculty from engineering, humanities and social sciences.

DES faculty would initially comprise just the earth science faculty of the EOS, focusing on teaching courses relevant to understanding natural hazards such as earthquakes, tsunamis, volcanoes, rising sea-levels and climate change. Future plans could see faculty from other disciplines such as ecology, geobiology, or soil science being included in DES, should NTU develop an interest in these areas.

Research Focus @ EOS

EOS aspires to be a leading international institution for understanding and addressing civilisation’s most serious environmental threats with a focus on the Southeast Asian region. This is evident in its mission statement
“To understand and forecast natural hazards in ways that are useful to governments, communities and businesses in Southeast Asia”. The focus of research can broadly be classified into three categories: volcanic processes, tectonic processes and climate change processes.

Volcanic Science
Philippines and Indonesia are countries that frequently experience volcanic eruptions. Eruptions could be severe enough to affect large areas and populations, and have major impact on both the environment and society in the region. As such, EOS aims to develop tools and data for useful forecasts of eruptions and assessments of the environmental and societal impact of volcanic eruptions.

Earthquake Science
The movements of tectonic plates in the Southeast Asian region cause most of the dangerous earthquakes and tsunamis that affect countries such as Indonesia, Myanmar, Philippines and Taiwan. The study of tectonic processes beneath Southeast Asia will help EOS to understand and reliably forecast future occurrences of earthquakes and tsunamis to help the affected countries be better prepared to deal with the crises that could occur.

Climatic Science
Scientists have been predicting that climate change will disrupt rainfall, vegetative and flooding patterns in ways that could have adverse effects on agriculture and on man. Southeast Asia is a region of many island countries and extensive coastlines that will be threatened by rising sea levels caused by global warming. Only by improving knowledge and understanding of climate processes, can man successfully take action to adapt to climate changes and instability.

Research Programmes
In 2008, EOS formulated 18 projects to be implemented in 2009/2010. Of these, 15 are research projects on earthquakes, volcanoes and climate change, while three are on education and outreach. In the earthquake group, topics include: Tsunami Hazard Mitigation for Southern Bali and West Sumatra, Development of Standard Procedure for Seismic Hazard and Risk Assessment of Cities, Construction of a Neotectonic Map of Southeast Asia, and Paleoseismology and Paleogeodesy Studies of the Sumatran Subduction Zone. EOS’ volcano group will conduct detailed monitoring of two laboratory volcanoes in Indonesia and the Philippines, and also launch a global database on volcanic unrest. The climate change project will study the impact of the El Nino-Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) on climate in the Southeast Asian region.

In the education and outreach area, EOS will work with the volcano group and the National Institute of Education (NIE) to develop an educational module on volcano science for secondary schools in Singapore. In addition, EOS is supporting an Artist-in-Residence programme to foster interdisciplinary collaboration between art and science in partnership with NTU’s School of Art, Design and Media (ADM). Under its Writer-in-Residence programme, EOS is commissioning a narrative book on how west Sumatran communities cope with recent scientific findings showing that a tsunami will strike their region within the next generation.

The first annual scientific meeting was held on 19 and 20 February 2009, with the Scientific Advisory Board reviewing a total of 18 project proposals, 14 on research topics and 4 in the area of education and outreach.

Two research projects actually got underway in 2008:
**SuGAr: GPS Array in West Sumatra**

The Sumatran GPS Array (SuGAr) is a network of about 30 GPS stations, which monitor crustal deformations above the great megathrust that underlies western Sumatra. This network, SuGAr, established by Professor Sieh when at Caltech, was instrumental in understanding the great Sumatran earthquakes of 2005 and 2007 and the tectonic processes that preceded and followed them. With Professor Sieh’s move to NTU, the SuGAr will now by managed and expanded by the EOS, in close collaboration with its Indonesian partner, the Indonesian Institute of Sciences (LIPI). The coming year hopes to see improvements in instrumentation, telemetry and data archiving and analysis.

An experimental GPS station has been set up at NTU as a testbed and prototype for the next generation of advanced geophysical sensors. Data streaming in from the current, far-flung monitoring network stretching over 1,500 kilometres along the west Sumatran coast, merged with the information from new and upgraded sensors, will be collected and analysed both here in Singapore and in its collaborators’ laboratories. This valuable resource of earth observation data will soon be made available through the EOS website.

**WOVOdat: Interactive Global Database on Volcanic Unrest**

Working closely with the Smithsonian Institution in the United States, EOS aims to refine and scale up an interactive global database, WOVOdat, on volcanic unrest between and leading up to eruptions. The database will be indispensable to volcanologists who wish to understand volcanic unrest, including its causes and outcomes, in Southeast Asia or around the world.

WOVOdat will capture historical volcanic unrest and make it freely web-accessible, for reference during volcanic crises and for basic research on pre-eruption processes. EOS will host WOVOdat through its 5 year main development stage and beyond. Historical, parametric data will be imported from the current myriad of data formats, database architectures, servers and storage media, into a single, comprehensive relational database with standardised formats.

**Tectonics Group**

**Tsunami Hazard Mitigation for Southern Bali and West Sumatra**

Catastrophic tsunamis are caused by tectonic events, large-scale landslides or volcanic eruptions. This project seeks to combine our understanding of tsunami science with effective engineering measures so as to minimise the risk that future tsunamis will cause loss of life and damage to structures along vulnerable coasts. Proposed activities over three years will include:

1. Evaluating the tsunami risk from local underwater earthquakes close to southern Bali and west Sumatra, and developing new models to predict initial tsunamis;
2. Modelling tsunami-induced debris flows and the associated hydrodynamic loads on coastal structures;
3. Investigating tsunami hazard mitigation by means of mangrove forests or coral reefs; and
4. Developing numerical models of the human evacuation process.

**EOS Projects Under Funding**

Summaries of the funded projects of EOS are provided:
**Fundamental Source-to-Site-to-Structure Study of Seismic Impacts and Hazards**

This project will develop large scale 3-D computational models which can perform ‘source-to-site-to-structure’ simulations. They will start with the rupture on an earthquake fault, followed by the propagation of the resulting seismic waves from the fault to engineered structures of interest, and conclude with an assessment of the structural responses to the imposed ground motion. For this initial study, seismo-tectonic models incorporating the 3-D crustal structure will be developed for part of the South-east Asian region covering Sumatra, Java and the Malay Peninsula. These models will incorporate the results of ongoing EOS research to characterise the major regional seismic sources. State-of-the-art parallel computing technology will be used to carry out the massive calculations. The results will be useful in assessing the effects and hazards to buildings and infrastructure in Singapore and neighbouring countries.

**Development of Standard Procedure for Seismic Hazard and Risk Assessment of Cities in Southeast Asia**

The severity of earthquake disasters increases tremendously when major earthquakes hit densely populated urban centres. Re-examining seismic hazard of major cities in Southeast Asia is an important focus at the Earth Observatory of Singapore in mitigating regional earthquake catastrophes. This project will develop a standard procedure to assess seismic hazard and risk levels of urban areas using the Indonesian city of Surabaya as a study case. The team will evaluate the seismic hazard deterministically by: first identifying scenario earthquakes based on geologic and tectonic evidence; then computing the expected ground motions using a 3D discrete model; establishing building inventory from satellite photos and estimating potential loss. The outcomes are expected to help local governments in Southeast Asia to formulate effective mitigation strategies.

**Data Sensing, Communications and Processing: Sumatran GPS Array**

The Sumatran GPS Array (SuGAr) monitors tectonic deformation above the megathrust of western Sumatra. This network of over 30 stations has provided a wealth of data relevant to understanding interseismic processes and captured coseismic and post-seismic deformation associated with the three great subduction earthquakes of 2004, 2005 and 2007. The Earth Observatory of Singapore (EOS) will assume responsibility for maintaining and operating the SuGAr from Caltech’s Tectonics Observatory. The network will be substantially upgraded in collaboration with EOS’s Indonesian partners. Upgrades will include more reliable telemetry, additional stations and sensors, as well as intelligent and even partially automated operation.

**Neotectonic Map of Southeast Asia**

Characterisation of active faults – the sources of destructive earthquakes – is a key element in understanding a region’s neotectonic architecture and in addressing seismic hazards. Thus, a GIS-based neotectonic map of Southeast Asia would be a strong step toward a better and more uniform understanding of the region’s active faults. The project proposes to construct such a “smart” map, drawing upon both existing maps of places such as Taiwan, Myanmar and Sumatra and original investigations of lesser-known areas.

**Earthquake Geology of Myanmar**

This project continues ongoing work on the behaviour of the southern portion of the Sagaing fault, one of the largest seismic sources in
Southeast Asia, one of the two most important active faults in Myanmar. Research will focus on its slip rate and its earthquake history of the past millennium. The project will integrate geomorphologic investigations, paleoseismologic and archaeological excavations, and CGPS geodesy to obtain the fault’s earthquake history and long- and short-term slip rates.

Submarine Landslides: Malacca Strait-Mergui Basin Shelf Margin

In 2007 and 2008, the project team identified several large, sequential submarine landslides on the Malacca Strait-Mergui Basin shelf margin. Simple sequence-stratigraphic modelling was applied to determine the ages and, thereby, the recurrence intervals of these paleo-slides. Results showed that at least three of these potentially tsunamigenic events have occurred in the past 600,000 years, all during sea-level low stands. This work will be published in 2009.

Paleoseismology and Paleogeodesy of the Sumatran Subduction Zone

The project uses datable, annually-banded corals to measure sea level changes above the Sumatran megathrust. This approach yields centennial to millennial records of repeated ruptures of the megathrust, which are critical to understanding the mechanics of strain accumulation and relief and are the basis for useful forecasts of future behavior. It is proposed to continue work on the Mentawai islands, above the likely source of the next giant Sumatran earthquake, in order to refine man’s knowledge of the events of the past two millennia. It is also proposed to focus on particular issues related to the great earthquakes of 2004 and 2005.

Interactive Visualisation Tools

An important component of earth science research is the ability to meaningfully visualise massive amounts of data. The voluminous nature of these data sets requires the effective design of both the visualisation techniques and the human-computer interface. The project will develop an interactive multi-touch visualisation tool to provide intuitive and seamless gesture-based exploration of geographical information such as high-resolution satellite images, real-time earthquake information etc. In the process of building these tools, the evolving data visualisation needs and strategies in the Earth Observatory of Singapore will be better understood, and strategic inhouse visualisation expertise will be developed as a response.

Climate Change

Regional Climate Downscale of El Nino and Indian Ocean Dipole

The project aims to elucidate the impact of El Nino-Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) on temperature, wind and rainfall in Western Maritime Continent, including Malay Peninsula, Sumatra, Borneo and Java. 25-year Re-Analysis data for Japan will be used to obtain present-day ENSO and IOD patterns for this highly convective region. Hypotheses on the factors affecting the regional climate will be tested with model simulations. Understanding the current regional climate is a necessary first-step in EOS’ objective of addressing climate change in Southeast Asia.

Volcano Group

Laboratory Volcanoes: Gede-Salak, West Java

Gede and Salak, high-risk volcanoes in West Java, are representative of many arc volcanoes that show only minor visible degassing yet exhibit seismic swarms (Gede) and thermal features (Salak) that suggest recent magma and gas input from depth. In the spectrum of open to plugged conduits, Gede is intermediate and Salak appears to be plugged. This project will study past magmatic and eruptive processes, and upgrade geophysical, geochemical, and hydrologic monitoring – all to
anticipate the next eruption of either volcano. The study will attempt to quantify magmatic gas budgets. One or two research wells will also be drilled in hopes of measuring transient, intrusion-induced increases in pore pressure that may contribute to multiple sector collapses at both volcanoes.

World Organisation of Volcano Observatories Database of Volcanic Unrest

Volcanoes are frequently restless but only a fraction of unrest leads to eruptions. Uncertainties in interpretation of volcanic unrest are unacceptably high. WOVOdat will capture historical volcanic unrest and make it freely web-accessible for reference during volcanic crises and for basic research on pre-eruption processes. WOVOdat will be to volcanology as epidemiological databases are to medicine – valuable tools for research and crisis response. The Earth Observatory of Singapore will host WOVOdat through its 5-year main development stage and, possibly, beyond. Historical, parametric data will be imported - from the current myriad of data formats, database architectures, servers and storage media - into a single, comprehensive relational database with standardised formats.

Laboratory Volcanoes: Mayon, Luzon, Philippines

Mayon, a near-perfect 2460m high stratovolcano in Southeast Luzon is representative of arc volcanoes that exhibit sustained SO2 degassing well in excess of what could have come from erupted magma volumes. In the spectrum from openly-degassing to plugged volcanoes, Mayon is near the openly-degassing end, producing mostly small, frequent eruptions. This project hypothesises that basaltic andesite magma convects in Mayon's conduit, and will study geologic evidence (petrologic, textural) for and against convection. It will also upgrade geophysical, geochemical and hydrologic monitoring of the entire system. New instrumentation will be added in research wells that respond to intrusion-induced volumetric strain, to supplement existing GPS for early detection of fresh magma batches. Instrumentation will also be added high on the cone to track changes immediately before eruptions.

Multiphase Vertical Chamber Exchange and Volcanic Plume Rise

This project would study the fluid mechanics of: (a) two-phase hypersaturated magma in a volcano conduit; and (b) non-Boussinesq modelling of volcanic plume rise, allowing for more realistic modelling of plumes in which there is a significant difference in density between the plume and the environment. The study would use both analytical (numerical) and analogue modelling. The analogue modelling will be in a specially designed vessel with transparent windows through which new laser imaging techniques can be used. The conduit study will simulate behaviour of magma in which a discrete gas phase has accumulated beneath a plug (e.g. Pinatubo). The volcanic plume study will simulate relatively dense ash plumes and is expected to improve on previous modelling by removing the Boussinesq (similar density) assumption.

Research Publications

The EOS has started its research publication tracking system for archiving and performance monitoring. An EOS Contribution Number is assigned to journal articles, book and book chapters, and papers in conference proceedings accepted for publication.

Two contributions were noted in 2008:

Earthquake Supercycles Inferred from Sea-Level Changes Recorded in the Corals of West Sumatra by Sieh et al., published in Science, Dec 2008.

Introduction

The National Institute of Education (NIE) was established in July 1991, through the amalgamation of the Institute of Education and the College of Physical Education. NIE is an autonomous institute of the Nanyang Technological University (NTU) and Singapore’s national teacher education institute. Its key role is to support Singapore’s education service through high quality programmes in initial teacher preparation, teacher professional development and higher degrees by research.

NIE adopts a ‘programme-driven’ matrix organisational structure. Instead of being organised into faculties/schools along the lines of the traditional structure in most other institutions of higher learning, NIE is organised according to the programmes that it offers, with two key divisions providing corporate support. They are: Foundation Programmes Office, Graduate Programmes & Research Office, Office of Educational Research, Academic Computing & Information Services and Corporate Planning & Development. The faculty of NIE are organised into 12 Academic Groups (AGs), each reflecting a major area of study under the Office of the Dean (Academic).

While NIE is known as the nation’s education institute, the programmes that it offers are not purely pedagogical-based. Instead, NIE programmes are known to have a unique blend of content with pedagogy and theory with practice. Over 430 faculty are responsible for the delivery of the unique programmes as well as conducting research in their respective disciplines which include both academic/content research as well as pedagogical/educational research. Supporting the 430 faculty, are some 100 research staff and 380 non-teaching staff.

Management of Research

The management of research in NIE is undertaken by two offices; the Graduate Programmes & Research Office (GPRO) and the Office of Educational Research (OER).

Graduate Programmes & Research Office

In addition to managing NIE’s programmes for higher degrees, teacher professional development and school leadership development, the Graduate Programmes & Research Office (GPRO) is responsible for the management of academic research. This includes monitoring the compliance by faculty with guidelines in the External Grants Management Framework,
overseeing the administration of the Academic Research Fund (AcRF), as well as managing the Applied Research in Education Fund (ARIEF), NIE/NTU grants and external grants. GPRO also oversees collaboration with the Office of Educational Research.

**Office of Educational Research**
The Office of Educational Research (OER) oversees the planning, design, management, evaluation and dissemination of educational research across NIE. Currently, there are two research centres under OER; they are the Centre for Research in Pedagogy and Practice (CRPP) and the Learning Sciences Laboratory (LSL).

CRPP, being the largest funded educational research centre in the Asia-Pacific region, brings together researchers, teachers and administrators to research and develop innovative ways of teaching and learning. Its aim is to help Singapore schools, teachers and students address the complex challenges of new economies, cultures and technologies.

Formed in 2005, LSL is the first centre in the Asia-Pacific devoted to conducting research based on theories and research perspectives from the learning sciences. It aims to enhance student learning with technology-enabled pedagogical practices that can develop in them 21st century knowledge and skills.

### Research Highlights
For the year 2008, over $7 million were awarded to NIE faculty from various sources of funding. Listed below are a few of the projects that have successfully bid for funding and some of more significant research activities that have taken place during the year.

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Principal Investigator (PI) and Co-PI(s)</th>
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| Understanding Human Self-Control and Decision Making                        | Principal Investigator: Associate Professor John Wang  
Physical Education & Sports Science AG  
Co-PIs:  
Associate Professor Nikos Chatzisarantis  
Physical Education & Sports Science AG  
Assistant Professor Liu Woon Chia  
Psychological Studies AG                                                     |
| Low Cost, Microcrystalline Silicon Thin-Film Solar Cells via Advanced Plasma Processing | Principal Investigator: Professor Xu Shuyan  
Natural Sciences & Science Education AG                                                                 |
| Trans-contextual Learning: Student Learning with Mobile Devices in a Persistent-world Game to Construct Meaning and Identities | Principal Investigator: Associate Professor Chee Yam San  
Learning Sciences & Technologies AG  
Co-PI: Assistant Professor Steven Zuiker  
Learning Sciences & Technologies AG |

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| Leveraging Mobile Technology for Sustainable Seamless Learning in Singapore Schools | **Principal Investigator:**  
*Associate Professor Chee Yam San*  
Learning Sciences & Technologies AG  
*Co-PIs:*  
*Assistant Professors Chen Wenli, So Hyo-Jeong and Zhang Baohui,*  
Learning Sciences & Technologies AG |
| Youth Tell: Bridging Formal and Informal Learning through Digital Storytelling with Singapore Youth | **Principal Investigator:**  
*Associate Professor Looi Chee Kit*  
Learning Sciences & Technologies AG  
*Co-PIs:*  
*Assistant Professors Mark Nelson and Prudence Wales*  
Learning Sciences & Technologies AG |
| Novel Fusion Reactor Material Studies and Pulsed Fast Neutron Analysis Using High Performance Repetitive Plasma Focus Device | **Principal Investigator:**  
*Associate Professor Augustine Tan*  
Natural Sciences & Science Education AG  
*Co-PI:*  
*Associate Professor Rajdeep Rawat*  
Natural Sciences & Science Education AG |
| Mastering Mathematics with the TI-Nspire | **Principal Investigator:**  
*Assistant Professor Ng Wee Leng*  
Mathematics & Mathematics Education AG |
| Reconceptualising Teaching and Learning in P1-P2 Classrooms Through Action Research: Exploring the Successes and Challenges of Engaging Young Minds | **Principal Investigator:**  
*Assistant Professor Tzuo Pei Wen*  
Early Childhood & Special Needs Education AG  
*Co-PI:*  
*Assistant Professor Nicole Green*  
Early Childhood & Special Needs Education AG |
| Data Bank on Language Policies of Hong Kong and Singapore | **Principal Investigator:**  
*Associate Professor Goh Yeng Seng*  
Asian Languages & Cultures AG |

*A sample of the research labs and types of the research done at NIE is given in the next section.*
**Applied Cognitive Developmental Laboratory (ACDL)**

Founded in 2002 by Associate Professor Kerry Lee, the Applied Cognitive Developmental Laboratory (ACDL) in the Centre for Research in Pedagogy and Practice (CRPP) focuses on research in children’s developing cognition.

In recent years, in collaboration with colleagues from NIE’s Mathematics and Mathematics Education AG, the Psychology Department in NTU and the University of Aberdeen, the work of ACDL has focused on the relationship between working memory capacity and individual differences in mathematical proficiencies. The study in identifying stages in mathematical problem solving has been highlighted in publications such the *Journal of Educational Psychology* and the *Journal for Research in Mathematics Education*. The next upcoming study will involve the development of digital interactive tools and pedagogical intervention to assist children whose mathematical performance may be held back by working memory limitations.

ACDL is also one of the first laboratories worldwide to use neuroimaging to investigate questions of direct relevance on the teaching of mathematics. This work has extended to the use of portable near-infrared spectroscopic devices to investigate processes involved in different levels of efforts expanded in mental arithmetic tasks.

**Plasma Radiation Sources Laboratory (PRSL)**

The Pulsed Plasma Group at Plasma Radiation Sources Laboratory (PRSL) based in the Natural Sciences and Science Education AG is an internationally renowned group that has established itself as the leader in research related to high-repetition rate plasma focus devices. The group is jointly headed by Associate Professors Rajdeep Rawat, Paul Lee, Stuart Springham and Augustine Tan.

The key research activities of PRSL include:

- investigation and characterisations of hot dense magnetised plasma, relativistic electrons, energetic ion and fast neutrons from focus devices,
- optimisation of repetitive focus device for higher soft x-ray yield for micro-lithography and micro-machining,
- development of sub kilo-joule miniature plasma focus as portable neutron source for possible applications in on-site interrogation of explosive materials,

*High Aspect Ratio Test Structures Using Neon Soft X-ray from Plasma Focus Device*
FMPF-1 Miniature Plasma Focus Device

- using energetic ions and electrons from plasma focus for thin films/nano-particles modification/synthesis specially that of magnetic material,
- short lived radioisotope production using energetic deuterons from focus device for applications in positron emission tomography.

Motivation in Educational Research Laboratory (MERL)

The Motivation in Education Research Laboratory (MERL) was set up to research on motivational issues in teachers and students in schools with the specific focus on educational research, using the Self-Determination Theory as a core theory and by integrating other motivational theories and translating research findings into practical guides for teachers and practitioners.

The core members of the MERL, Associate Professors John Wang and Nikos Chatzisarantis, and Assistant Professor Liu Woon Chia, have recently been awarded more than $500,000 by MOE to research on human motivation. The project investigates the psychological factors that influence the replenishment of ego-energy and capacity for self-control in actions that demand self-control. Building upon tenets of self-determination theory, ego-depletion is more likely to occur when individuals are pressured and/or coerced into exercising self-control and not when they freely choose to exercise self-control.

Findings from the project will pave the way for new avenues for research into the ego-energising strategies that individuals adopt during self-control operations. This research will break new grounds into investigating efficient self-regulatory strategies that help people “save” ego-energy and capacity for self-control.

Research on Game-based Learning

The Learning Sciences Laboratory (LSL) was awarded funding of over S$2.4 million from the IDM for Education Research Grant managed by MOE for the National Research Foundation (NRF) in 2008 to pursue research related to game-based learning. The focus of the research is on developing pedagogically sound ways of learning with games in the context of fostering 21st century new literacies. Headed by Associate Professor Chee Yam San, the funding covers the design and development of the following two games:
a) Legends of Alkhimia

Legends of Alkhimia is a multiplayer computer game designed to foster authentic learning of chemistry in fictionalised game environments. It is part of a broader learning programme for lower secondary school chemistry to help students understand chemistry through situated practice. Student learning involves extended problem solving in the context of performing scientific inquiry.

b) Statecraft X

Statecraft X is a 24/7 persistent-world, multiplayer game for students to construct meaning and identities in the context of citizenship education and social studies. The game is played on Apple iPhones. Its use is situated within the broader context of a learning program that explores how learning can be engendered across the boundaries of school, home, and other ‘outside’ environments such as in the train and the shopping mall.

International Alliance Report

The year 2008 also saw the publication of the first report by the International Alliance of Leading Education Institutes (IA) entitled ‘Transforming Teacher Education: Redefined Professionals for 21st Century Schools’. The IA was established in 2007 to act as a think tank to influence the education sector globally, drawing together existing expertise and research in education to generate ideas, identify trends and serve as a collective voice on important educational matters and thus influencing policies and practice in education. NIE is a founding member of and the inaugural chair of the IA which currently has 10 members.
Establishment of the Asia-Pacific Centre for Arts Research in Education

In 2008, NIE successfully bid to host the regional UNESCO Arts Research and Education Observatory, to be called the Asia-Pacific Centre for Arts in Research in Education. The Centre, to start operations in April 2009, will facilitate the collection, analysis and dissemination of information relating to arts education and its impact on society.

Dean’s Commendation for Research

In an effort to encourage NIE’s graduate students to develop the mindset of professional researchers in sharing their findings with the research community at large, and at the same time, provide a platform for graduate students to build a strong CV and portfolio of works by the time they graduate, GPRO instituted the Dean’s Commendation for Research in 2008. The award which takes the form of a certificate is given out every semester to deserving graduate students nominated by their supervisors.

At the inaugural ceremony in September 2008, 15 recipients were recognised for having excelled in their research by publishing papers with their supervisors in peer-reviewed international journals or international refereed book chapters during their candidature as graduate students of NIE. The list of recipients, the title of the paper and the name of the journal are as follows:

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<tr>
<th>Programme</th>
<th>Name of Recipient</th>
<th>Title of Paper</th>
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<tr>
<td>2</td>
<td>Master of Arts (By Research)</td>
<td>Yip Meng Fai</td>
<td>eP4C: Using Technology To Support Community Of Inquiry</td>
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<td>3</td>
<td>Master of Science (By Research)</td>
<td>Ma Zhen</td>
<td>Simultaneous Analysis Of Different Classes Of Phytohormones In Coconut (Cocos Nucifera L.) Water Using High Performance Liquid Chromatography And Liquid Chromatography-Tandem Mass Spectrometry After Solid-Phase Extraction</td>
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<td>4</td>
<td>Coral Lim Boon San</td>
<td>Perceived Autonomy Support, Behavioural Regulations In Physical Education And Physical Activity Intention</td>
<td>Psychology Of Sport And Exercise</td>
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<td>5</td>
<td>Atok Zulijanto</td>
<td>Gauges Of Baire Class One Functions</td>
<td>Journal Of Mathematical Analysis And Applications</td>
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<tr>
<td>6</td>
<td>Chian Lit Khoon</td>
<td>Motivational Profiles Of Junior College Athletes: A Cluster Analysis</td>
<td>Journal Of Applied Sport Psychology</td>
</tr>
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<td>7</td>
<td>Lim Wei Ying</td>
<td>“A Prophet Never Accepted By Their Own Town”: A Teacher’s Learning Trajectory When Using Technology</td>
<td>Asia-Pacific Journal Of Teacher Education</td>
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<td>8</td>
<td>Lin Jiaji</td>
<td>Backward Plume Deposition As A Novel Technique For HighDeposition Rate Fe Nanoclusters Synthesis</td>
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<td>Ng Siew Ling Connie</td>
<td>Solving III-Structured Problems In Asynchronous Online Discussions: Built-In Scaffolds Vs No Scaffolds</td>
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<td>11</td>
<td>Sa’eda Binte Buang</td>
<td>The Life And Future Of Muslim Education</td>
<td>Asia Pacific Journal Of Education Special Issue</td>
</tr>
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Partnerships

Boston College, USA

On 15 September 2008, a Memorandum of Understanding (MOU) was signed between NIE and Boston College (BC), USA. The MOU covers student exchange possibilities for BC and NIE’s students to spend up to a year abroad at each other’s institute and also possible research collaborations between NIE and the Teachers’ for a New Era Evidence-based research team. NIE will also work with the Trends in Mathematical and Science Study (TIMSS) and Progress in International Reading and Literacy Study (PIRLS) International Study Centre to assist in item development for the TIMSS as well as to explore the setting up of a Centre for International Comparative Studies for the purpose of identifying key success factors for high performing Asian countries in the TIMSS survey.
Conferences/Seminars

During the year, NIE also hosted a number of international conferences/seminars, some of which are highlighted as follows:

Workshop on the Importance of Forests in Mitigating Climate Change

NIE, together with the Center for Tropical Forest Science, a centre of the Smithsonian Tropical Research Institute (STRI), and the Arnold Arboretum of Harvard University, hosted a three-day workshop entitled Carbon and Functional Traits in Asian Forests on 7 April 2008. The workshop, was aimed to address questions such as “What role do forests play in mitigating climate change?”, “Do different types of forests contribute equally in absorbing carbon dioxide?”, “Does forest soil play a role in this process?” and “Can we put a dollar value on the climate-related phenomena that forests play?”.

Asia-Pacific Conference on Giftedness – Nurturing Talents for the Global Community

For the first time in its history, the Asia-Pacific Conference on Giftedness (APCG) was held in Singapore from 14 to 18 July 2008. Jointly organised by the Gifted Education Branch of the Ministry of Education and NIE, the 10th conference brought together prominent scholars and experts, who spoke on key educational issues and provided updates on their latest research. With the theme, ‘Nurturing Talents for the Global Community’, the conference provided a platform for local and overseas educators to explore and exchange views on the medium that education for the highly-able could and should take.

World Educational Research Association (WERA)

NIE hosted a meeting of Presidents from over 20 educational research associations from around the world on 24 to 25 November 2008, during which the World Educational Research Association (WERA), was established. WERA is a global body of research associations which aims to advance educational research as a scientific and scholarly field.


NIE hosted the 2nd Asia-Pacific Educational Research Association (APERA) Conference 2008 together with the Asia-Pacific Educational Research Association and the Educational Research Association of Singapore (ERAS) from 26 to 28 November 2008. Held biennially, the event has brought together 1,000 participants from 39 countries to discuss innovative ways to facilitate teaching and learning that can benefit every child in the classroom.

13th International Conference on English in Southeast Asia

The three-day conference which took place from 4 to 6 December 2008 attracted 320 presenters and participants from 27 countries. The conference covered a wide range of issues and topic of common interests to move beyond a purely monolithic perspective of English to a more pluralistic concern with English in the region and the emergent literatures written in English within this perspective.
Introduction

The Institute of Defence and Strategic Studies (IDSS) was upgraded and re-named the S. Rajaratnam School of International Studies (RSIS) on 1 January 2007, with IDSS as a core research centre within RSIS. The aim of this report is to provide an update of the School’s progress and activities in 2008.

Accomplishments

Multilateralism and Regionalism Programme

The Multilateralism and Regionalism Programme at the Institute of Defence and Strategic Studies, RSIS, is coordinated by Associate Professor Tan See Seng. Its academic and policy-relevant research on multilateralism and regionalism in the Asia-Pacific has achieved international renown. Funded by international foundations such as the Sasakawa Peace Foundation of Japan and the Friedrich Ebert Foundation of Germany (and, in due course, prospective funding from the MacArthur Foundation), the research output of the programme is comparable to that of more established centres elsewhere.

In 2008, the research output of the Multilateralism and Regionalism Programme included an edited book on the 1955 Asian-African Conference and its legacy on international order; a monograph on East Asian regionalism and regional institutions; a roundtable report on Asian security; a policy study on best practices and lessons learnt in preventive diplomacy (produced for the ASEAN Secretariat); a policy study on the East Asia Summit and the new architecture of East Asian cooperation (also produced for the ASEAN Secretariat); as well as numerous journal articles, book chapters, working papers, op-ed pieces and commentaries. The two policy studies conducted for the ASEAN Secretariat, both stemming from projects won on a competitive basis, demonstrate the programme’s robust facility for policy-relevant research as well as academic research. In fact, the study on preventive diplomacy received a special mention in the Chairman’s Statement of the 15th ASEAN Regional Forum in July 2008.

There was considerable networking activity, including the organisation of a conference, a study group workshop, various briefings and discussions with visiting delegations and project teams. Programme staff and associates also presented papers at various academic as well as policy-related conferences, workshops and roundtables both within and beyond Singapore. Among these, the annual Sentosa Roundtable on Asian Security is noteworthy. The programme also hosted visiting researchers and doctoral candidates working on Asian multilateralism and regionalism from around the world.

The Multilateralism and Regionalism Programme aspires to become a leading research hub for academic and policy research in multilateralism and regionalism in the Asia-Pacific region.

Military Transformations Programme

The Military Transformations Programme at the Institute of Defence and Strategic Studies, RSIS, is coordinated by Dr Bernard Loo. Known as the Revolution in Military Affairs Programme until recently, it accomplished a substantial number of written deliverables in 2008. These included:
• Seven article-length individual research projects in 2008, of which three were RSIS Working Paper projects by Dr Arthur Ding, a Visiting Senior Research Fellow at RSIS from August 2007 to March 2008.

• Two projects which would be forthcoming in the Journal of Strategic Studies.

• A chapter in an edited volume to be published by Ralph Rotte and Christoph Schwarz.

• Two book-length projects, one comprising speeches from the Global Air Power Conference 2008, which was organised under the rubric of RSIS’ Asia-Pacific Security Conference Series in conjunction with the Singapore Airshow, and the other currently being published by Routledge.

• A project, based on an RSIS conference on “The State of the Art in the Global Defence Industry: Implications for Revolution in Military Affairs”, held on 1-2 November 2007, which is forthcoming in the journal Security Challenges in 2009, with Mr Richard Bitzinger, a Senior Fellow in the programme, as guest editor.

In 2008, Mr Richard Bitzinger also began working to upgrade the RSIS Monograph series. The key audience for this monograph series will be major RSIS stakeholders, and policy makers, scholars and academicians from around the world. The monograph series will focus on issues pertaining to International Politics and Security (including military studies and maritime security), Conflict and Stability (including political violence and terrorism, and homeland security), Non-traditional Security, International Economics and Political Economy, Country and Area Studies (particularly touching on the Asia-Pacific region), Contemporary Islam, and Regionalism and Multilateralism.

In the realm of networking, Mr Richard Bitzinger traveled to Honolulu, Hawaii, in June 2008 to participate in the Western Economic Association’s annual conference, where he delivered a paper entitled “The US Defence Industry in the Post-Transformational Era”, and also met with officials from the US Pacific Command. The following month, Mr Bitzinger traveled to Sydney, Australia, where he delivered a paper on “Military Modernisation in the Asia-Pacific: Driving a New Arms Race?” at the Second Australasian Conference on the Economics and Politics of War and Peace. Programme Coordinator, Dr Bernard Loo, also presented a paper at the 1st China-ASEAN Dialogue for Senior Defence Scholars, held in March in Beijing. In addition, Dr Loo also spoke at the Annual Baltic Conference on Defence in September 2008, held at Tartu, Estonia. The programme also collaborated with the School’s China Programme in organising a conference on “The People’s Liberation Army in the New Century” from 13 to 14 November 2008.

Military Transformation staff continue to be heavily committed to teaching Military Studies. In 2008, they jointly taught a course in the M.Sc. in Strategic Studies Programme with Dr Paul Mitchell, an adjunct Senior Fellow from the Canadian Forces College. In addition to graduate teaching, the programme remains primarily responsible for RSIS teaching at the Singapore Command and Staff College and at the Singapore Armed Forces (SAF) Advanced Schools in the SAFTI Military Institute. Dr Bernard Loo also leads RSIS’s involvement in the SAFTI-NTU Continuing Education Project, which seeks to create transferable credits for NTU-taught components at the Singapore Command and Staff College. This Continuing Education Project will be implemented in 2009. As part of the project, Dr Loo accompanied a joint SAFTI-NTU team on a visit
to Sweden, Israel and the United Kingdom to study respective national models of post-graduate military education.

In conjunction with the Continuing Education Project, Dr Loo is also leading the School’s involvement in the Undergraduate Professional Military Education Programme that was first mooted by the Chief of Defence Force, SAF. Finally, also related to the Continuing Education Project, the Military Transformations Programme is working with other centres within RSIS, as well as partners from NTU’s Nanyang Business School and the College of Engineering to help SAFI create a research centre within the university that will engage in multi-disciplinary research to fulfill and support the SAF’s 3rd Generation (3G) transformational agenda.

Maritime Security Programme

LTC Joshua Ho coordinates the Maritime Security Programme at the Institute of Defence and Strategic Studies, RSIS. Research in maritime security started in 2004 following concerns over the security of ports and sea lanes. Due to this concern, the programme has maintained a research focus on piracy, armed robbery, maritime terrorism, and the security of sea lanes.

In terms of research output, programme staff have completed book chapters in five edited volumes which include *Globalisation and Defence in the Asia-Pacific*, the *Lloyd’s MIU Handbook of Maritime Security*, the *Australian Strategic Policy Institute Special Report*, *The Security of Sea Lanes of Communication in the Indian Ocean Region and Asian Energy Security: The Maritime Dimension*. The programme also finished two edited volumes based on conferences conducted in previous years. The edited volumes are *Globalisation and Defence in the Asia-Pacific: Arms Across Asia, and Security and International Politics in the South China Sea: Towards a Cooperative Management Regime*. Programme staff also had articles accepted by journals like *Asian Affairs, Marine Policy, Nautilus and Ocean Development and International Law*. They also contributed actively to the *RSIS Commentaries* series and produced quarterly reviews of maritime security in Southeast Asia.

The programme organised the 32nd Oceans Conference on the theme of “Freedom of the Seas, Passage Rights and the 1982 Law of the Sea Convention” on 9-10 January 2008 with Professor S Jayakumar, then Deputy Prime Minister of Singapore, gracing the occasion as the keynote speaker. The conference was organised jointly with the Centre for Oceans Law and Policy, University of Virginia School of Law, and examined the various passage rights that have been guaranteed under the United Nations Convention on the Law of the Sea (UNCLOS) and some of the challenges being posed to the regimes. A report on the proceedings of the conference was published in May 2008.

One of the panels of speakers at the 32nd Oceans Conference held on 9-10 January 2008
The programme also organised a closed door workshop on the issue of Pedra Branca on 17 June 2008 with participants from the Ministry of Foreign Affairs, the Ministry of Defence, the Attorney General’s Chambers and the Maritime and Port Authority. In addition, the programme also organised a joint conference with the National Maritime Foundation, New Delhi, on 18-19 November 2008 entitled “Between Rising Naval Powers: Implications for Southeast Asia of the Rise of Chinese and Indian Naval Power”. The conference is a follow-up to the inaugural conference held in October 2007 in New Delhi and will be an annual bilateral event alternating in venue between Singapore and India.

The programme has been active in the area of networking in the first half of 2008 with participation in major conferences and seminars in the region and beyond. These include conferences and seminars organised by the Combined Joint Operations from the Sea Centre of Excellence, NATO, the Council for Security Cooperation in the Asia Pacific, the National Maritime Foundation (New Delhi), the Naval Postgraduate School (US), the Ocean Policy Institutions Network in East Asia (OPINEA), the Shanghai Academy of Social Sciences, the Stimson Centre (Washington, D.C.), the University of Malaya, the US Naval War College, and briefings to the Brunei Ministry of Foreign Affairs and Ministry of Defence, and the Singapore Armed Forces (SAF) Command and Staff College. In addition, the programme conducted briefings on the issue of maritime security to visitors, including the EU Experts Group, the Australian Command and Staff College, the UK Royal College of Defence Studies, and a seminar for Swedish Defence Attachés in the Asia-Pacific. On 7 May 2008, members of the programme were involved in the Southeast Asia Cooperation Against Terrorism (SEACAT) Senior Leadership Seminar organised by the US COMLOGWESTPAC (Commander, Logistics Group Western Pacific) in Singapore.

For 2009, the programme will be planning a joint conference with the National Maritime Foundation, New Delhi, scheduled for the second half of 2009 and to be held in New Delhi. Following the positive response to the participation over the last two years, the programme is expected again to participate in the SEACAT Senior Leadership Seminar in 2009 organised by the US COMLOGWESTPAC in Singapore. The programme will also complete a policy paper on “Good Order at Sea” in March 2009 and is expected to co-organise a conference on piracy with the ReCAAP (Regional Cooperation Agreement on Combating Piracy and Armed Robbery against Ships in Asia) Information Sharing Centre in May 2009 that will coincide with Singapore Maritime Week.

**International Centre for Political Violence and Terrorism Research**

Now in its fourth year of existence, the International Centre for Political Violence and Terrorism Research (ICPVTR) headed by Professor Rohan Gunaratna at RSIS has grown to become one of the largest counter-terrorism research, education and training centres in the world. Its high international standing is evidenced by the fact that more than 70 briefings were given to visitors from other governments, the private sector and academia. These visitors included Carl Bildt, Foreign Minister of Sweden, Admiral Timothy J Keating, Commander of the US Pacific Command, and Paul O’Sullivan, Director-General of the Australian Security and Intelligence Organisation. The ICPVTR has 37 staff from nine countries and is truly an international centre.
The centre recently launched its Global Pathfinder II Database in November 2008. Built in-house by ICPVTR in collaboration with the NTU’s School of Computer Engineering (SCE), this signature database is designed to be a counter-terrorism data warehouse with rich functional interfaces that allow the user to navigate through the system with ease. This database has become an invaluable tool for frontline agencies involved in reducing the threat of terrorism and extremism.

During the year under review, the ICPVTR also continued with its capacity-building projects in Singapore and the region. It conducted a Counter-Terrorism Analysts Training Course for participants from Afghanistan, Pakistan, Bangladesh, Netherlands, and the New York Police Department on 14-18 January 2008. It hosted its annual ICPVTR Conference on 21 - 25 January, where research findings were shared with the counter-terrorism community and security industry in Singapore.

Overseas, it helped to launch the Philippines Institute for Political Violence and Terrorism Research in Manila on 6 March 2008, and the Bangladesh Centre for Terrorism Research in Dhaka on 9 March 2008. The director-designate of the latter is presently being trained by ICPVTR. The centre also continues to assist the Centre for Conflict and Peace Studies (CAPS) at Kabul, whose director, Hekmat Karzai, was also trained by the centre. An ICPVTR delegation that visited CAPS on 16-22 March received thanks from the Afghan President, Hamid Karzai, for the assistance rendered. The Government of Kurdistan has also sought ICPVTR support to establish the Institute of Strategic Studies in Irbil, Iraq.

As part of a broad-based approach dealing with the threat of terrorism, a new Counter-terrorism for Journalists Programme (CTJP) was inaugurated in June. This was an extension of the centre’s Counter-terrorism Leadership Programme (CTLP) that was established the year before. The new programme allows media personnel to learn more about the subject. One of the participants in the inaugural CTJP developed a website dedicated to the victims of terrorism.

In its strategic counter-terrorism efforts, the ICPVTR works on responses in the ideological, educational, legislative, financial, developmental and media areas. Some of its more significant work in strategic counter-terrorism includes the following:

- The centre’s Ideological Response Team, in cooperation with the Islamic Religious Council of Singapore (MUIS) and PERDAUS (Pelajar-Pelajar Agama Dewasa Singapura), published a booklet Don’t be Extreme in Your Religion. This free booklet, printed in English, Malay and Tamil, provides Quranic support for the rejection of extreme positions in the practice of Islam and provides indicators to identify those who are radicalised. The Centre also
conducted an advanced counter-terrorism and extremism course for the Religious Rehabilitation Group on 18-20 August. The group comprises clerics and scholars engaged in detainee rehabilitation and community engagement.

- Besides addressing students at schools and various other places, the centre’s Educational Response Team joined the Inter Agency Aftercare Committee to host the Student Convention 2008 – Countering Radicalisation: Shared Perspectives, Joint Action – at the Home Team Academy on 23 February. On 29 May 2008, the Permanent Secretary of the Ministry of Education, Mrs Tan Ching Yee, visited ICPVTR to discuss the parameters of a strategic partnership between the Ministry and RSIS.

- The centre’s Financial Response Team launched the Consortium for Counter-Terrorism Financing (CCTF) at a counter terrorist financing conference on 12 February 2008. Sir James Sassoon, President of the Financial Action Task Force, who spoke at the launch, praised ICPVTR for forging a partnership between the government, the private sector and academia. This international counter-terrorism financing effort is currently supported by the Monetary Authority of Singapore, the Ministry of Home Affairs, the Association of Banks in Singapore, and ICPVTR-RSIS. Working with academic, regulatory, and industry partners, CCFT conducted seminars in the Philippines (7-8 July), Bangladesh (6-7 August) and Thailand (11-12 December).

In 2008, the ICPVTR continued its commitment to cutting edge field research. Its staff conducted research in the Federally Administered Tribal Areas (FATA) of Pakistan in January; it had staff embedded within US forces in Tikrit, Iraq, in January, and, it had its researchers in Kashmir and Bangladesh in March. In response to requests from Chinese security agencies, ICPVTR staff provided briefings on potential threats to the 2008 Beijing Olympics. Centre staff also visited China including the restive Xinjiang province. They also briefed the hotel industry and hosted the Marriott’s Vice President for Global Security following their study of the bomb attack on the Marriott Hotel in Islamabad on 20 September.

The ICPVTR’s research has often been cited in Singapore and overseas. On 13 May 2008, for example, the Australian Home Minister, Mr Bob Debus, cited an ICPVTR assessment of Australia’s off-shore counter-terrorism policy and strategy vis-à-vis Indonesia.

In counter-terrorism networking, ICPVTR visited Washington, D.C., with Defence and Home Affairs officials in May 2008. ICPVTR also discussed cooperation with the Naval Criminal Investigative Service in Washington, D.C., and the Federal Law Enforcement Training Centre in Georgia. It also provided a briefing at the White House to Juan Carlos Zarate, Deputy National Security Advisor to the President for Combating Terrorism. On the current status of Al Qaeda, the Head of ICPVTR, Professor Rohan Gunaratna, also briefed Admiral Olson, Commander of the United States Special Operations Command (USSOCOM), and delegates at a joint USSOCOM and Joint Special Operations University meeting in Tampa on 23 May. ICPVTR has also embarked on collaborative research with the Swedish Defence Research Agency, FOI (Totalförsvarets forskningsinstitut), following a visit by a delegation from the Agency in March 2008.
Centre of Excellence for National Security

The Centre of Excellence for National Security (CENS) at RSIS was established in March 2006. It has the following objectives:

- To build up intellectual capital in support of national security management objectives
- To augment and provide new perspectives to national security policy-making and planning processes
- To plug into the international network of think tanks, universities and relevant government agencies to promote strategic partnerships for knowledge generation and intellectual exchange
- To help promote greater public awareness of national security

Headed by Associate Professor Kumar Ramakrishna, CENS covers three areas of research, namely, Risk Assessment and Horizon Scanning; Social Resilience; and Homeland Defence. CENS has grown from four staff members to include a total of eight researchers and professors today.

In the past year, CENS has been preparing policy-oriented analytical commentaries, along with op-ed pieces published in leading local newspapers — such as The Straits Times and Today — as well as foreign newspapers; CENS also participated in other media events including Channel News Asia’s Insight programme and radio interviews. In addition, CENS staff members have contributed to academic journals and book chapters on issues surrounding national security, homeland defence and social resilience.

In order to tap into global best practices in national security management, CENS has continuously sought to foster networking opportunities, both with local and international security agencies as well as foreign think tanks. For example, in September 2008, CENS staff visited the European cities of The Hague, Berlin, Copenhagen and London to have discussions with both government and non-governmental agencies on issues surrounding social resilience and radicalisation. Furthermore, in February 2008, CENS co-organised a workshop titled “Radicalisation: Foresight and Warning” with the Global Futures Forum. CENS has also fulfilled its public outreach function in several ways. CENS staff members participated in local and international media interviews, lectured to diverse local and foreign audiences on national security issues, and moderated public seminars on relevant topics such as religious extremism.

Working with other members of RSIS, CENS staff also taught modules for the Civil Defence Academy, the Home Team Academy’s Senior Commanders’ Course and the Civil Service College in Singapore. Besides such external teaching, Associate Professor Kumar Ramakrishna and Dr Norman Vasu also teach Master’s courses related to national security in the M.Sc. Programmes at RSIS.

In 2008, CENS organised a number of highly focused workshops and seminars as well as international conferences on its different areas of research. Some of them include: (i) a workshop on networked government and homeland security in January; (ii) a workshop on multiculturalism and social resilience in February; (iii) the Second Asia-Pacific Programme for Senior National Security Officers (APPSNO) in April; and, (iv) a workshop on global climate change in July. The proceedings for all these conferences and workshops have been published as conference reports. In 2009, building on its achievements thus far, CENS aims...
to be a global thought-leader in the theme of resilience vis-à-vis national security by focusing on issues surrounding Homeland Defence, Radicalisation and Social Resilience.

Centre for Non-Traditional Security Studies

2008 marked yet another eventful year for the Non-Traditional Security (NTS) Programme in RSIS. The most significant development was the establishment of the Centre for NTS Studies at RSIS on 6 May 2008. The Centre, which is headed by Associate Professor Mely Cabellero-Anthony, grew out of the School’s successful NTS Programme and its role as the Secretariat of the Consortium of NTS Studies in Asia (NTS-Asia). It was launched by the Minister for the Environment and Water Resources, Dr Yaacob Ibrahim, on 6 May 2008. In his opening remarks, Dr Ibrahim commented that the Consortium was not only “an intellectual hub for NTS but also part of the architecture for regional cooperation into these issues.” Dr Surin Pitsuwan, Secretary General of ASEAN, who delivered the keynote address, noted the Centre’s pivotal role in advancing NTS studies in the region.

In its first year, the Centre has already launched three major research programmes, which are of critical concern to the region:

- Pandemics and Global Health Governance
- Climate Change and Human Security,
- and Energy and Security.

These programmes will involve the development of research findings into actionable policy recommendations as well as proposing policy initiatives to address the range of NTS problems facing the Asia-Pacific region.

The Centre has also launched NTS Insight, a think piece that deals with pertinent NTS issues. Early editions of the publication include subjects like food security, energy security and human security. Several seminars have also been organised under the auspices of the NTS Centre. Speakers for the seminars have included Dr Takeshi Kasai, Senior Advisor, Western Pacific Regional Office, World Health Organisation (WHO), and Mr Jesse Fairall, Security Analyst, Corporate Affairs Security, Shell Oil Company. More information on the seminars and publications are available on the Centre’s newly launched website (www.rsis.edu.sg/nts).

In collaboration with the International Development Research Centre (IDRC) based in Canada, the Centre for NTS Studies introduced a Cambodian Research Fellowship scheme in July 2008. Under the scheme, two young scholars from Cambodia were given the opportunity to spend five months at RSIS to research and to engage and share experiences with policy makers and
other NTS scholars, including many from overseas through the school’s vast network of international associates. The Research Fellows were required to give a seminar on their research and to produce a publishable paper or monograph at the end of their fellowship.

With regards to Consortium matters, an NTS Curricular Development Meeting was held following the launch of Centre for NTS Studies. Selected members of the NTS-Asia Consortium were invited to discuss ways of mainstreaming NTS studies in research, teaching and policy work. They also explored the possibility of having a shared and/or common curriculum, as several NTS-Asia member institutes have gone beyond researching NTS to teaching it. Issues raised during the meeting were discussed at the 2nd NTS-Asia Annual Convention held in Beijing on 10-11 November.

Two sub-regional workshops were also organised under the NTS-Asia umbrella. They were:

- The workshop “Migration and Remittance: A Non-Traditional Issue in Asian Security Discourse”, organised by the Refugee and Migratory Movements Research Unit of the University of Bangladesh, Dhaka, on 21-23 August.
- The second workshop “Energy and Non-Traditional Security”, organised by the Centre for NTS Studies at RSIS, on 28 - 29 August.

A forthcoming sub-regional workshop on “Unhealthy Governance: Security Challenges and Prospects in Asia”, which will be organised by the Centre of Asian Studies, at the University of Hong Kong, to be held on 26-27 February 2009.

In 2008, the output from the first round of NTS-Asia research fellowships offered in 2007 was generated. Two research papers and one monograph were produced and cover the topics: the concept of “Security Community” in NTS; the securitisation of human trafficking in Indonesia; and the links between HIV/AIDS and Migration along the India and Bangladesh border. The publications are available on the NTS-Asia website. Recipients for the 2008 NTS-Asia research fellowships have also been selected. Their research will cover the Analysis of Media Reportage on Gender-based Violence in Jammu and Kashmir; Sino-ASEAN Energy Cooperation: Limitations, Potential and Prospects; and the Security Implications of Climate Change: A Case Study of the Philippines.

2008 editions of NTS Alert – a fortnightly news bulletin on various NTS themes – have covered a broad range of timely NTS issues including humanitarian emergencies such as responses to natural disasters; human trafficking; the impact of rising food and fuel prices and the implications for human security and regional stability; health security; and various climate change-related issues such as climate refugees; the rush for alternative energy sources such as biofuels and nuclear energy; and multilateral forums such as the ASEAN Ministerial Meetings, the G8 and D8 countries, and the UNFCCC (United Nations Framework Convention on Climate Change) Meeting in Bali that addressed NTS issues. These editions of NTS Alert and other NTS resources can be found on the newly revamped NTS-Asia website (www.rsis-ntsasia.org).

The 2nd NTS-Asia Annual Convention held in Beijing on 10-11 November 2008 rounded up NTS activities for the year. The convention was hosted by the Institute of Asia-Pacific Studies at the Chinese Academy of Social Sciences. The keynote address was delivered by Professor Zhang Yunling, the Director of the Academic Division of International Studies, at the Chinese Academy of Social Sciences, who was also RSIS’s inaugural Ngee Ann Kongsi
Professor in International Relations from 26 October to 7 November 2008. In addition to taking stock of the Consortium’s activities for the year, members of the NTS-Asia network also discussed a range of timely NTS issues such as Food Security, Energy Security, Disaster Diplomacy and Transnational Crime.

**Temasek Foundation Centre for Trade & Negotiations**

RSIS’s Negotiations Programme started in 2002 as the Mediation and Conflict Resolution Programme. A joint effort with Sea-Change Partners, a consulting firm specialising in the subject, the programme became known as the Asian Programme for Negotiation and Conflict Management (APNCM) in 2004. Since then, the APNCM has morphed into the Temasek Foundation Centre for Trade & Negotiations (TFCTN). This new centre was formally launched in October 2008, following a generous initial donation from the Temasek Foundation.

The TFCTN is dedicated to improving the process of international negotiations, with a particular focus on increasing capabilities and access for developing states. The Centre uses rigorous empirical research to create new ideas and to generate informed debate leading to practical policy alternatives for improving global negotiations on trade and economic issues. Headed by Dr Deborah Elms and administered by Mr Quak Swee Seng, the Centre assisted Singapore’s Ministry of Trade and Industry (MTI) in planning the 2008 Symposium for APEC (Asia-Pacific Economic Cooperation) senior officials. The keynote speaker from the APEC meeting, Professor Robert Lawrence, also served as the speaker at the Centre’s opening. TFCTN has also worked closely with Singapore’s Ministry of Foreign Affairs officials, particularly the mission staff in Geneva, in promoting trade and economic development activities in Singapore.

The flagship capacity-building course was a six-week long Executive Programme, and saw mid-level government officials from around the Asia-Pacific region in Singapore from 29 October to 5 December 2008. These officials, from countries as diverse as Hong Kong and the Maldives, learned about topics like intellectual property rights, trade in services and negotiating regional trade agreements. Instructors for the Programme included current and former World Trade Organisation (WTO) officials, government negotiators, international lawyers and prominent academics.

The Centre also made plans to collaborate in the future with key actors, including the WTO Secretariat and the International Centre for Trade and Sustainable Development (ICTSD) in Geneva. Joint projects for the future include capacity-building sessions for parliamentarians from around the region and a series of workshops on climate change and trade.
Contemporary Islam Programme

The Contemporary Islam Programme (CIP) at the Institute of Defence and Strategic Studies, RSIS, is coordinated by Dr Iqbal Singh Sevea. In 2008, the programme collated the research findings of its ongoing project on “Mapping Out the New Parallel Islamist Civil Society Network in Southeast Asia: New Networks, Modalities and Discourses in a Newly Emerging Imagined Community”. A team of scholars, supervised by the Associate Dean of RSIS, Dr Joseph Liow, and including Iqbal Singh Sevea, Farish Noor and Mohamed Nawab (all from RSIS), Greg Fealy (Australian National University), and Ahmad Fauzi Abdul Hamid (Universiti Sains Malaysia), is engaged in this project. The project aims to identify and analyse the primary actors and agents involved in the formation and development of a burgeoning pan-regional parallel civil society network; bringing together religiously-inspired Islamist Non-governmental Organisations (NGOs), civil society actors and agencies, media professionals’ associations and political parties, and to chart out a virtual map of the new Islamist activist geography of Southeast Asia.

In the year under review, the programme also embarked on a study of Islamic education institutions across Southeast Asia, focusing primarily on Indonesia, Malaysia and Southern Thailand. This project involves in-house researchers, including Dr Joseph Liow, Dr Leonard Sebastian and Dr Farish Noor, as well as Ahmad Fauzi Abdul Hamid and Dr Noorhaidi Hasan both of whom were with the programme as Visiting Fellows. There will also be local field researchers working on the project. The deliverables for this project will take the form of books and monographs, as well as closed door presentations for the funding agency. The first deliverable is a book titled *Islam, Education, and Reform in Southern Thailand: Tradition and Transformation*. It was written by Dr Joseph Liow and was published by the Institute of Southeast Asian Studies press in December 2008.

The programme is also currently laying the groundwork for a major survey project which will survey Muslim public opinion on social and political issues in Malaysia, Indonesia, Southern Thailand and Philippines. Supervised by Dr Iqbal Singh Sevea, this project seeks to ascertain the identity, issues and opinions of ordinary Muslims in Southeast Asia on issues such as the Islamic state, *sharia*, equality between genders, suicide bombings, non-Muslims and interfaith relations and governance as well as their opinions on significant contemporary world events such as the ‘war on terror’ and their attitudes towards the ‘West’. This survey project will start early in 2009. The deliverables include four country specific reports and one general report.

Aside from these projects, programme staff have been pursuing their own research. Dr Farish Noor is currently researching for his book on the Tablighi Jamaat and Dr Iqbal Singh Sevea is working on a manuscript examining the interaction between Muslim intellectuals in modern South Asia and western political thought. Dr

Besides the above-mentioned projects, the CIP also co-organised a joint workshop with the US-based National Bureau of Asian Research (NBR) on the topic of “Transnational Islam in South and Southeast Asia: Movements, Networks, and Conflict Dynamics” in June 2008. This workshop brought together international experts on South and Southeast Asian transnational Islamic movements, and was attended by Singapore-based scholars and officials from several government agencies. During the year in review, a number of reports, including *RSIS Working Papers*, and commentaries were published by programme staff members. The programme also hosted several talks by visiting scholars on the topic of Islam and its impact on society and politics in Asia.

**Civil and Internal Conflict Programme**

The Civil and Internal Conflict Programme at the Institute of Defence and Strategic Studies, RSIS, continued its active research on the conflict in southern Thailand over the past year. This included visits to the conflict area by Associate Professor Dr Joseph Liow, Associate Dean of RSIS and programme coordinator, as well as visiting researchers affiliated to the programme. As a result of this research, a monograph outlining and analysing the conflict from the perspective of insurgents based on extensive interviews with them was published in the International Institute for Strategic Studies (IISS) Adelphi Paper series. The monograph is co-authored by Dr Joseph Liow and Mr Don Pathan (Visiting Fellow at RSIS and Senior Editor of Thailand’s *The Nation*).

Aside from research on the southern Thai conflict, the programme has also been in discussion with the Henri Dunant Centre for Humanitarian Dialogue (Geneva, Switzerland) to launch a pilot course; a Conflict Mediation executive course for mid-level and senior officials from regional countries. The idea behind this course is to build understanding and capacity in regional countries about the possibilities and constraints to dialogue and mediation in regional and local conflicts. The pilot course is scheduled to be conducted in mid-2009. Pending its success, RSIS and HDC will discuss the possibility of the formation of an Asian Mediation Centre that will house this course, along with research capacity in the field of conflict negotiation and mediation.

**Science, Technology and Security Programme**

The Science, Technology and Security Programme (STSP) at the Institute of Defence and Strategic Studies, RSIS, is a multi-disciplinary programme that addresses the broad security issues of the region through the conducting of both qualitative and quantitative analyses. Coordinated by Dr Alvin Chew, the programme aims to drive security policy formulation by drawing on the work of the engineering and science disciplines.

The programme has been working closely with the University’s Earth Observatory Singapore (EOS) on a proposal to study the feasibility of establishing common nuclear facilities in Southeast Asia. This proposal ties in with RSIS’s Centre for Non-Traditional Security Studies (NTS), which is also interested in understanding the socio-political climate of energy security in Southeast Asia. Besides the EOS, the proposed study would link RSIS with possible collaborators such as Sweden’s Institute of Security and Development Policy (ISDP) and Japan’s University of Tokyo. The link-up with the EOS and the University of Tokyo is to leverage on their technical expertise to conduct respectively the geological survey as well as the design of nuclear power plants in Southeast Asia, while
collaboration with ISDP will primarily be on nuclear waste management.

The STSP also has plans to collaborate with scientific institutions in the UK to study the technological developments that would impact the global environment. It has plans to establish links with the Centre for Environmental Policy in London to tackle multidisciplinary issues on energy, food resources and pollution. On the military aspect, it has plans to forge partnerships with like-minded institutions in the US (such as the CISAC – the Centre for International Security and Cooperation) to study a broader security agenda.

In the area of teaching, programme staff members contribute to the School’s M.Sc. in Strategic Studies with an elective on Technology and Strategic Policy. The course aims to get students to appreciate the strategic decisions behind technological developments in both the traditional and non-traditional aspects of security. The STSP also hopes to collaborate with the Master’s programmes to introduce a course on protective technology, currently a focus in the engineering schools to provide a well-rounded curriculum that blends the hard sciences with the policy dimension.

In terms of publications, the STSP is in the process of producing an edited volume of the papers presented at an RSIS-ISDP conference on Asia’s energy security held in September 2007. It has also written papers on technological developments in the energy sector, as well as contributed to and assisted in the editing of a monograph for the Council for Security Cooperation in the Asia Pacific’s study group on Energy Security.

**International Political Economy Programme**

The International Political Economy Programme at the Institute of Defence and Strategic Studies, RSIS, has had a very successful year. The Programme Coordinator, Dr Richard Carney, together with Programme Associates, Dr Deborah Elms and Adjunct Associate Professor Dr Friedrich Wu, produced many publications with some still in the various stages of the publication process. To give an overview of some of the main ones, Dr Carney has two books forthcoming – one is an edited volume on the Asian financial crisis and another is a monograph on the political origins of financial institutions. Dr Carney also has several scholarly articles either published or under review. Dr Deborah Elms, who heads the Temasek Foundation Centre for Trade & Negotiations (TFCTN), published a journal article and several opinion pieces in *The Straits Times*. As for Dr Friedrich Wu, four of his papers were published in journals.

As RSIS faculty, Dr Richard Carney, Dr Deborah Elms and Dr Friedrich Wu teach courses in the School’s M.Sc. Programmes. In 2008, Dr Carney taught the “Theories and Issues in International Political Economy” core course and the “Varieties of Capitalism” course, while Dr Elms taught the “Political Economy of Development” course, and Dr Wu taught both “A Globalising China in the World Economy” and the “Monitoring, Forecasting and Managing Country Risk and Economic Crisis” courses. Dr Carney, in addition, taught “Quantitative Methods in the Study of International Politics”, which is a core course for Ph.D. students. He also taught a class on “Economic Security” at SAFTI’s Command and Staff College.

Of major significance was the organisation of a conference during the year to examine the analysis of the Warwick Commission on the systemic problems faced by the multilateral trade regimes and recommendations on how to advance the multilateral trade system. Held on 4 April 2008, and graced by
Mr Lee Yi Shyan, Minister of State for Trade and Industry, Singapore, who delivered the keynote address, conference speakers included Professor Richard Higgott, Pro Vice-Chancellor of the University of Warwick and Director of Studies of the Warwick Commission; Mr Patrick Low, Chief Economist of the World Trade Organisation (WTO) and Member of the Warwick Commission; other Members of the Warwick Commission such as Dr Heribert Dieter, Senior Fellow, Free University of Berlin, Dr Simon Evenett, Professor at the University of St. Gallen; and faculty and adjunct staff of RSIS such as Ambassador See Chak Mun, Senior Advisor to the Ministry of Foreign Affairs; Professor John Ravenhill, Professor at the Australian National University; and Dr Deborah Elms, Head of RSIS's Temasek Foundation Centre for Trade & Negotiations.

In other areas of networking, Dr Richard Carney presented three papers at the Academy of International Business Conference in Milan in July 2008. One of these was selected as a finalist for a best paper prize. Each paper selected for presentation at the conference underwent a rigorous peer-review process involving three anonymous reviewers, making it a good opportunity to illustrate the high quality research going on at RSIS.

Dr Carney also presented a paper (after a two-person anonymous review process) at the Asia Academy of Management Annual Meeting in Taipei in December. He has also been invited to present one of his papers at the Society for the Advancement of Socio-Economics Conference in Paris in July 2009, as well as at the American Political Science Association Conference in Toronto. The panels for both conferences consist of senior scholars from Harvard, Duke, Boston University, Warwick Business School, and the Hebrew University of Jerusalem. Finally, one of his papers is being translated into Chinese and published in a journal affiliated with the School of Economics at Fudan University, China.

China Programme

The China Programme at the Institute of Defence and Strategic Studies, RSIS, is coordinated by Senior Fellow Dr Tang Shiping. The programme is broadly interested in all aspects of China’s strategic thinking and behaviour, and has provided a distinctive regional voice on the issue of the role of China as a rising power.

In 2008, the programme largely completed its flagship project of 2006-07, which studied the dynamic interaction between China and other regional states through an empirical approach, i.e., by looking at specific crises and turning points in the interactive process between China and other regional states. The conference-based edited volume, titled Living with China: China and its Neighbors through Crises and Turning Points, will be published by Palgrave-Macmillan in 2009. Several chapters from the volume will also appear in Asian Survey. The programme has also largely completed its flagship project of 2007-8, which was based on a conference on China’s soft power, held on 18-19 October 2007. The conference-based edited volume, titled Soft Power: China’s Emerging Strategy in International Politics, will be published by Roman Littlefield in 2009. The China Programme is presently working on a project on the People’s Liberation Army (PLA). A conference on this, titled “The People’s Liberation Army in the New Century” organised jointly with the Military Transformations Programme, was held on 13-14 November 2008. A handbook on the PLA will be produced as a deliverable from the conference.

In 2008, the China Programme assisted RSIS in hosting the following visitors:

- Professor Yan Xuetong, Director of the Institute of International Studies, at Qinghua University
in Beijing, who visited from 20 to 25 May 2008. Professor Yan visited the School as part of RSIS’s Distinguished Speakers’ Programme.

Professor Harry Harding, University Professor at the Elliott School of International Affairs, George Washington University, who visited from 2 to 5 June 2008. Professor Harding is also a Member of RSIS’ Board of Governors.

Professor Zhang Yunling, Professor of International Economics and Director of the Division of International Studies, Chinese Academy of Social Sciences, who visited from 26 October to 7 November 2008. Professor Zhang visited the School as RSIS’s inaugural Ngee Ann Kongsi Professor of International Relations.

In 2008, the China Programme also hosted its second batch of visiting fellows. The two who came were:

- Professor Gu Xiaosong, Vice-President of Guangxi Academy of Social Sciences, who was a Visiting Senior Fellow from 17 March to 16 June 2008. During his stint, Professor Gu wrote a paper Beibu Gulf: Emerging Sub-regional Integration between China and ASEAN, which is presently being considered for publication as an RSIS Working Paper.

- Ms Do Thu Thuy from the Academy of Diplomacy, Vietnamese Ministry of Foreign Affairs, who was a Visiting Fellow from 3 June to 31 August 2008. Ms Do wrote a paper on the impact of the China-Vietnam Land Border Treaty on the bilateral relationship and the region, which is presently being considered for publication as an RSIS Working Paper. Ms Do also wrote two RSIS commentaries, both of which were re-published in The Straits Times.

In 2008, programme staff members published extensively besides teaching courses in the School’s M.Sc. Programmes. Overall, they published four book chapters, five journal articles, and eight commentaries / op-eds.

### Indonesia Programme

During the year in review, the Indonesia Programme at the Institute of Defence and Strategic Studies, RSIS, coordinated by Associate Professor Dr Leonard Sebastian, accomplished research on:

- Civil-military relations,
- Defence and security,
- Political Islam,
- Islamic militancy,
- Terrorism,
- Internal conflict,
- Foreign policy and international relations,
- The economy,
- Problems of underdevelopment, and
- Local politics and decentralisation in the Riau region.

The research output included a book-length study by Dr Sebastian entitled Contesting Islam in Indonesia: Understanding the Context of Muslim Militancy which was submitted to the United States Institute of Peace and a book by Dr Luthfi Assyaukanie on Muslim Ideologies and Utopias: A Search for an Ideal Model of State in Indonesia which is currently under review by the Institute of Southeast Asian Studies.

Two book-length studies, one focusing on the emergence of Partai Keadilan Sejahtera and its implications for Indonesia by Dr Sebastian, and the other on the Riau & Jambi, Palembang and Bangka-Belitung Malay pirate network by Dr Eric Frecon, are currently under progress. Ongoing research includes political Islam, developments relating to the Tentara Nasional Indonesia (TNI), local politics and democratisation, and regular monitoring of political,
economic, security and society-related developments in the Riau Archipelago and Riau Province which are reported in the Riau Bulletin; a fortnightly newsletter aimed at providing timely information to the Singapore policy community. The Indonesia Programme also completed a project to analyse the challenges faced by Indonesia as a consequence of the application of its Regional Autonomy policy in 2001.

To commemorate the 10th Anniversary of Reformasi, the Indonesia Programme hosted a closed-door Future Studies workshop for emerging Indonesian leaders and a conference entitled “The Future of Indonesia Beyond 2014: Prospects and Challenges”. The workshop held on 3 November was aimed at helping a select group of Indonesia’s young leaders and opinion formers (currently in their late 20s and mid 30s, many of whom played a leadership role in the 1998 Reformasi movement (whether as university students, NGO activists, or academics) to envision a better future for Indonesia as well as acquire the strategic mindset to achieve such a goal. This workshop was followed by a conference on the following day, which looked beyond the 2009 general elections. The conference involved speakers from the workshop as well as discussants from Australia, Europe, Singapore and the United States.

The workshop and conference were partly sponsored by PT Ancora International, which also agreed to endow a scholarship in RSIS’s M.Sc. Programme. To be named the Gita Wirjawan Scholarship for Emerging Indonesian Leaders, the scholarship is similar to the one endowed by PT Ancora International at the Kennedy School of Government at Harvard University.

Dr Bahtiar Effendy from the State Islamic University (IAIN) Syarif Hidayatullah in Jakarta will conclude his one-year visiting fellowship at IDSS, RSIS, in February 2009 and is expected to finish a book manuscript on Political Islam in Indonesia. Mr Andi Widjajanto, the Director of Defence Economics at Jakarta’s Institute of Defense and Security Studies, has been affiliated concurrently to the Indonesia Programme as a Ph.D. candidate since August 2007.

In networking, the Indonesia Programme hosted seminars by eminent Indonesians such as Mr Abdillah Toha (Partai Amanat Nasional) and Dr Suryama Sastro (Partai Kedilan Sejahtera) both of whom spoke on the subject of “Political Developments in Indonesia”, and a seminar on “New Developments in Indonesian Jihadism” by Ms Sidney Jones, Senior Advisor of the International Crisis Group in Jakarta. In August, Dr. Sebastian was invited by Indonesia’s Foreign Affairs Department to participate in its inaugural Presidential Friends of Indonesia Programme.

The Indonesia Programme will also be assisting the proposed Indonesian Defence University in the organising of its inaugural conference in February 2009. Leading presidential hopefuls are expected to speak at RSIS in 2009 as part of our special series on the Indonesian presidential elections.

South Asia Programme

Recognising the growing importance of the Indian Subcontinent in Asian and global affairs, the Institute of Defence and Strategic Studies, RSIS, initiated a new programme on South Asia in 2007. Incorporating the earlier initiative on a rising India, the South Asia Programme is now up and running. With two acknowledged experts as its nucleus – Professor C. Raja Mohan and Associate Professor Rajesh Basrur – the Programme has contributed to the various teaching and research activities of RSIS as well as participated in networking with the regional and global research community on South Asia.

In 2008, the programme completed teaching the first full cycle of the...
new courses that were designed on “South Asia’s International Relations”, “India’s Foreign and Security Policies” and “Asia’s Nuclear Politics”. The courses have sought to combine the study of the enduring historic trends in the region as well as major contemporary challenges.

The South Asia Programme has actively contributed to the academic and policy debate on one of the pressing nuclear issues in South Asia. Professor Mohan is revising his book, Impossible Allies: Nuclear India, United States and Global Nuclear Order following the implementation of the controversial civil nuclear initiative in late 2008.

During 2008, the programme hosted many leading scholars and policymakers shaping the global discourse on the Indian Subcontinent. Recent visitors include Professor Stephen Cohen, from the Brookings Institution, Washington, D.C.; Ambassador Shyam Saran, the Special Envoy of the Indian Prime Minister; and K Subrahmanyam, the doyen of the Indian strategic community.

United States Programme
The United States Programme at the Institute of Defence and Strategic Studies, RSIS, coordinates, facilitates, and promotes research, teaching, and networking activities on topics focused on or related to the United States.

Coordinated by Dr S R Joey Long, research during the year under review focused on the impact of US policies on Southeast Asia. It also continued its studies on (i) the revisionist tendencies of the United States as a hegemonic power and the implications on international security; and (ii) the implications of the US Global Defence Posture on regional security. Dr Long also undertook a research project entitled “The Impact of Existing and Emerging Global Powers on Southeast Asia”. The programme’s research has also been accepted for publication as articles in the refereed journals Diplomatic History and Journal of Southeast Asian Studies.

In 2008, RSIS hosted a number of distinguished scholars and practitioners at lectures and seminars on subjects related to the United States. They included Professor Burdett Loomis, Professor of Political Science, University of Kansas; Professor Neil MacFarlane, S. Rajaratnam Professor of Strategic Studies and Head of Department of Politics and International Relations, Oxford University; Professor William Tow, RSIS Visiting Professor and Professor of International Security, Australian National University; Dr Jon Alterman, Director and Senior Fellow, Middle East Program, Center for Strategic & International Studies; Dr Gerard Chaliand, Preeminent Observer of Insurgency and Counterinsurgency Warfare; Mr Richard Lawless, former Deputy Under Secretary of Defense for Asian and Pacific Affairs; and Professor Mitchell Reiss, Vice Provost for International Affairs, College of William & Mary, and former Director of the Office of Policy Planning at
the US Department of State. Core issues that the programme will continue to focus its research on include the future of US defence priorities and their impact on the region. There are also plans to convene a roundtable to discuss the priorities and security policies of the Obama administration following the 2008 presidential election. Also in the pipeline is a joint conference with the Stanley Foundation on “New Power Dynamics in Southeast Asia”.

Conferences and Workshops


7. Workshop on Social Resilience organised by the Centre of Excellence for National Security, RSIS, 21 February 2008


10. Curricular Development Workshop on “Advances in NTS Studies” organised by the Centre for NTS Studies, RSIS, 6 May 2008

11. 7th Asia Security Conference: The Shangri-La Dialogue organised by the International Institute for Strategic Studies, with support from the Institute of Defence and Strategic Studies, RSIS, on 30 May–1 June 2008

12. Workshop on “Transnational Islam in South and Southeast Asia: Movements, Networks and Conflict Dynamics” organised by the Contemporary Islam Programme, Institute of Defence and Strategic Studies, RSIS, and the National Bureau of Asian Research, 26 June 2008

14. 10th Asia-Pacific Programme for Senior Military Officers organised by Institute of Defence and Strategic Studies, RSIS, 3-10 August 2008

15. Regional workshop on “Energy and Non-Traditional Security” organised by the Centre for NTS Studies, RSIS, 28-29 August 2008


17. Future Studies Workshop for emerging Indonesian leaders organised by the Indonesia Programme, Institute of Defence and Strategic Studies, RSIS, 3 November 2008


19. Workshop on “Suicide Terrorism: Its Causes and How to Counter” organised by the Centre of Excellence for National Security, RSIS, 5 November 2008


Major Public Lectures

1. Ambassador Shyam Saran, Special Envoy of the Prime Minister of India, on “India and China: Rivals or Partners”, 17 January 2008

2. Dr Shashi Tharoor, former Under Secretary-General of the United Nations, on “The Soft Power of India”, jointly organised with the Asian Media Information and Communication Centre, the Wee Kim Wee School of Communications and Information, under the Asia Talks Lecture Series, 26 February 2008

3. Bapak Abdillah Toha, Partai Amanat Nasional, Member, Commission 1, Indonesian House of Representatives, Bapak Suryama M Sastra, Partai Keadilan Sastra, Member, Commission 1, Indonesian House of Representatives, on “Recent Developments in Indonesia”, 13 March 2008

4. Dr K Subrahmanyam, a prominent strategic analyst, diplomat, journalist and former Indian civil servant, on “Balancing Power in the 21st Century: An Indian View”, 9 April 2008


6. Dr Yan Xuetong, Director, Institute of International Studies, Tsinghua University, on “China’s Foreign Policy: Continuity and Change in the Short Term”, 22 May 2008

7. Professor Harry Harding, University Professor of International Affairs, The Elliott School of International Affairs, The George Washington University, and Member of the RSIS Board of Governors, on “The Asian Challenge Revisited”, 5 June 2008

8. Mr Rodrigo de Rato, Singapore International Foundation Distinguished Visitor, on “Implications for Asia of the New Global Environment”, jointly organised with Singapore International Foundation and Monetary Authority of Singapore, 24 June 2008

9. Bapak drh H Chaidir, MM, Former Speaker, Riau Province Regional House of Representatives (DPRD, Propinsi Riau) and Riau Gubernatorial Candidate, on “Political and Economic Developments in the Riau Province”, 31 July 2008
10. Professor Neil MacFarlane, S. Rajaratnam Professor of Strategic Studies and Head of Department, Department of Politics and International Relations, St. Anne’s College, Oxford University, on “Why did the US Intervene in Iraq?”, 14 August 2008

11. Mr Ali Soufan, Visiting Senior Fellow, RSIS, and Chief Executive Officer of the Soufan Group LLC, on “The Changing Face of Terrorism”, 21 August 2008

12. Dr A P J Abdul Kalam, President of India, 2002-07, and Professor of Technology and Societal Transformation at Anna University, Chennai, on “Dynamics of National Development”, 27 August 2008

13. Professor William Tow, Visiting Professor, RSIS, and Professor of International Security at the Australian National University’s Department of International Relations and a Chief Investigator for the Australian Research Council’s Centre of Excellence in Policing and Security (CEPS), on “The Asia-Pacific’s Evolving Balance of Power and the Future American Role”, 2 October 2008

14. Professor Leon Fuerth, Research Professor of International Affairs, The Elliott School of International Affairs, The George Washington University, on “Forward Engagement: The Role of Governance in Responding to and Shaping the Future”, 15 October 2008

15. Professor Zhang Yunling, Ngee Ann Kongsi Professor of International Relations, and Professor of International Economics and Director of the Division of International Studies, Chinese Academy of Social Sciences, on “China, Asia, and Asian Regionalism”, 29 October 2008


17. Professor Zhang Yunling, Ngee Ann Kongsi Professor of International Relations and Professor of International Economics and Director of the Division of International Studies, Chinese Academy of Social Sciences, on “Shifting Gear: China’s New Thinking on Economic Development”, 6 November 2008

18. Professor Mitchell B Reiss, Vice Provost for International Affairs and Professor of Law and Professor of Government, The College of William and Mary Law School, on “From Campaign Rhetoric to Global Leadership: Foreign Policy Challenges for President-elect Barack Obama”, 11 December 2008
The Energy Research Institute @ NTU (ERI@N) was set up with a mission of developing and maintaining a world class research program that will foster a multidisciplinary environment for scientists, engineers, and social scientists to interact and together promote relevant energy solutions and policies for the future.

The institute will focus on the areas of sustainable energy, energy efficiency and infrastructure, and socio-economic aspects of energy research. Research activities and considerable expertise in these areas exists within NTU’s research centres and schools. ERI@N will provide a unique platform, where the various disciplines such as materials, power electronics and systems, biological, physical, social sciences, as well as humanities and business communities can interact to explore new solutions to a host of issues including energy generation, harnessing, storage, distribution, efficiency, as well as impact on climate change and global warming.

The Institute and its research centres have considerable expertise and strength in areas of fuel cells, wind & tidal energy, charge storage devices, photovoltaics, microgrids and smart energy systems, and collectively provide an integrated set of expertise from materials design & synthesis, device fabrication & modelling, and systems integration & optimisation. Major facilities include three cleanrooms for microfabrication, complete facilities for solar cells, charge storage, fuel cells fabrication and characterisation, advanced materials synthesis and characterisation (TEMs/FESEM/XRD/FIB/surface analysis).

In the energy space, NTU has set up collaborative projects with Bosch GmbH (Photovoltaics), Vestas Technology (Wind), Atlantis Resources Corporation (Tidal), and Rolls-Royce (Fuel Cells).

The Centre for Sustainable Energy Research, the first of six research centres under ERI@N, will open in July 2009.
The Institute for Media Innovation (IMI) was founded by Professor Martin Reiser in April 2008 with the support of its Chairman, Professor Bertil Andersson, NTU Provost. Located within the Research Techno Plaza in NTU, IMI is formed in response to Singapore's national priority in the development of IDM, recognising it as a strategic R&D area of the future with a high global market value.

**IMI Overview:**
*Innovation through collaboration*

1. **Research**
IMI creates Research Clusters specific in Interactive Digital Media (IDM) topics, bringing together experts from various research disciplines, to create new innovation through collaboration.

2. **Education**
IMI helps equip and influence future leaders with the skills to produce the next generation of research in IDM.

3. **Platform**
To answer to Singapore's national priority in providing a platform for media innovation through collaboration amongst NTU academics, striving forward and building strong partnerships.
**IMI’s Role**

IMI’s fundamental role is to serve as an incubator of ideas for multidisciplinary cutting edge media related research ideas and to push for Singapore to become a key player at the forefront of global Interactive Digital Media (IDM) technology.

**IMI PhD Program**

A part of the core foundation of IMI is its PhD Program. The IMI PhD Program was started to point the next generation of scientists and technologists in the right direction; exploring IDM from a broader perspective and to achieve new heights in new media innovations. IMI prepares our PhD candidates for research positions in leading academic institutions as well as private and public organisations. Candidates are required to do a number of seminar courses that are designed to provide them with fundamentals both in theory as well as in the analytical tools needed to do high-quality research. The unique structure of the PhD course allows candidates the opportunity to interact with faculty members in the various schools during their research. Examples of project titles from our first intake in August 2009 include: *Cyber-Learning In Cyber Worlds, Passive Approaches For Digital Image Forgery Detection, and Haptic Models For Interaction Between Real And Virtual Human.*

- The IMI-PhD program is a full-time multi-disciplinary PhD program

- Takes 4-5 years to complete the degree.

- Each year, the program admits 10-15 students.

Each student is affiliated to a College within NTU and follows the PhD program within the specific College. The IMI program hosts/adopts PhD students who intend to do research in Media and Technology domain with a multi-disciplinary approach.

For more information about the IMI PhD Program, please refer to our website at: [http://imi.ntu.edu.sg/IMI_graduate_programs/Pages/index.aspx](http://imi.ntu.edu.sg/IMI_graduate_programs/Pages/index.aspx)

**IMI Projects**

The close relationship that IMI has with the schools in NTU helps tie together media related projects created by a unique blend of diverse disciplines such as engineering, computer science, information,
education, art and design. IMI assists in the development of such potential media projects by providing IMI Seed Grants; which in turn facilitates and funds these collaborative projects in IDM. These potential research proposals are formulated, put to work and subsequently forwarded by IMI to appropriate agencies or industrial partners for substantial further funding leading to possible commercialisation.

IMI is offering seed grants up to 100,000 SGD for the development of multidisciplinary research proposals. Grant applications are called for and submitted to one of the IMI directors (Prof Martin Reiser, Prof Seah Hock Soon, Assoc Prof Russell Pensyl). They are distributed to the IMI Steering Committee for advice. The directors will then reach a decision based on the Committee’s recommendation within three weeks.

**Examples of projects:**

**The Application of Computational Aesthetics in the Acquisition and Treatment of Digital Images**

This project seeks to examine the ways that aesthetics, in the capture and rendering of digital images, can be enhanced with computational techniques. Bringing together quantitative computer vision methods from electrical and computer engineering, cognitive science disciplines and the Arts faculty for the study of aesthetic learning and artistic expression, it is an investigation on how computer vision techniques, which are normally concerned with the quantitative analysis of images, can be used for understanding and applying aesthetic values in photographic composition.

From a study of existing art works this project seeks to identify what it is that constitutes a style. Arrangements of attributes (colors, texture) and features (lines, curves, faces) which are identified can be digitally expressed and mashed, morphed, cross-bred and edited using computer vision techniques, to radically change the look and feel of the picture taken and allow consumer cameras to have the ability to give feedback on composition.

Abetting this will be a range of current-practice technology in Computational Photography such as re-focusing, re-lighting, single image based matting and automatic scene segmentation.

The Application of Computational Aesthetics in the Acquisition and Treatment of Digital Images

Funding: $119,078.34

Photo by Henri Cartier - Bresson. The CMU take detection method is used on the photo as a tool in the work done on master photographers - boxes show face orientation.
Autonomous Institutes & Research Institutes

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A High Impact User Centric Approach to Point-of-Purchase Information Delivery Using Biometric Data

Investigators Team:
Assoc Prof Russell Pensyl
School of ADM. IERC

Assoc Prof Ser Wee
School of EEE. Centre for Signal Processing, Project Administrator

Collaborators:
Mr Lee Shang Ping
IERC, project manager
Mr Tran Cong Thien Qui
IERC

External Collaborators:
Mr Craig Lindley
Blekinge Institute of Technology, Blekinge, Sweden
Ms Charlotte Sennersten
Blekinge Institute of Technology, Blekinge, Sweden

This project explores the feasibility of a user centric delivery of point-of-purchase information using biometric data capture, intelligent analysis of facial data, height, weight, body type, age, gender and other forms of data that can be directly captured in a non-invasive manner. The system will have an inherent intelligence that is ambient, and ubiquitous – allowing for interpretation of a wide variety of stimuli and that can be easily collected. The system’s intelligence must offer a range of options that can be autonomously responsive and give meaningful responses to the visual and sensor cues. Such a system prefigures an information delivery for advertising, social communication and even for forms emergency communications that may be needed in a public or social environment. The demonstrator will be designed to work in a real-world environment such as a point-of-purchase environment.

The significance of the research lies in the development of an autonomous, intelligent system that can deliver user specific information based on the collected data of a user’s gender, height, weight and other cues that allow for a definition of a user profile. One critical aspect to such a system is an ambient, and non-invasive data capture with a naturalistic, subtle response to the user.

An intelligent, user centric point-of-purchase system leverages on “consumer profiling” in order to increase consumer sales and delivers personalised information to the consumers, enhancing their shopping experience.

A High Impact User Centric Approach to Point-of-Purchase Information Delivery Using Biometric Data
Funding: $99,200

A personalised advertisement system based on biometric data
VisuaPedia – A Collaborative Learning Studio

Primary Investigator:
Prof Seah Hock Soon (SCE),

Co-Investigators:
Assoc Prof Margaret Tan (WKWSCI),
Asst Prof Steven Zuiker (NIE)
Asst Prof Feng Tian (SCE)
Mr Tomas Ho (IMI)

VisuaPedia will provide a platform and infrastructure and encourage youths to tap on the interactive rich digital media to build their perspectives of the world and global networking with other youths. It provides a fun and creative way of sharing knowledge, communicating knowledge and learning. The vision is to build VisuaPedia much like what Wikipedia is ‘knowledge through text’ but VisuaPedia is ‘knowledge through images’.

VisuaPedia will evolve existing Cacani animation software to encourage creative production by enlisting a series of uploaded and web-generated drawings in order to bring imaginary worlds to animated life. By engineering the software to provide a two-tier animation experience, VisuaPedia provides a web-based platform to support anyone with an interest in drawing to use animations in a process of digital storytelling. VisuaPedia will also provide an online catalogue of templates and to invite users to populate these existing template genres and generate new genres as well.

Users will begin to explore and, at times, challenge the ways that animated narratives shape perception, both in terms of the productions they generate and those of other users that are uploaded to the site. To the extent that users devise and take-on more elaborate storytelling sequences, VisuaPedia will also provide web-space and user account to store and build collaborative productions that build networks and negotiate roles for each team member.

VisuaPedia – A Collaborative Learning Studio
Funding: $100,000

Screen capture from VisualPedia website
Research Fields

To add on to this synergy for innovation, working groups add on to IMI’s bottom-up approach. These groups consist of researchers, building on their wide spectrum of expertise; thereby developing specialised subjects in Computational Photography: a new research field with worldwide attention, and Digital Heritage: a flowering area which helps conserve and document archives beyond the museum doors. In addition, digital film and animation are some other groups IMI is keen to build on.

IMI Achievement and Milestone Timeline

- **June 2007**: Deans and Chairs decided to start an institute in Interactive Digital Media
- **August 2007**: First White Paper for RCE (Research Centre of Excellence)
- **April 2008**: IMI launched, International Symposium
- **June 2008**: Martin Reiser, Founding Director on Board
- **July 2008**: Second White Paper for RCE
- **August 2008**: ISEA (International Symposium on Electronic Art) day at ADM (School of Arts, Design and Media)
- **December 2008**: First Distinguished lecture – SIGGRAPH Asia
- **January 2009**: Industrial Game Programming Course, DFTL (Digital Film Technology Lab) hosted by IMI

IMI Events

A world-class institute, firm partnerships are forged in the process of bridging academia and the industry together. With multiple roles to play in creating a cohesive environment for all media research, IMI has built its foundations on its international network support of researchers, specialists and industry partners. In addition to this, IMI takes the initiative to invite industry renowned distinguished speakers; using their specialised skills as leverage to harness and inspire through business round tables, educational symposiums, workshops and seminars.

Left to right: Professor Seah Hock Soon, Co-Director of IMI, Professor Martin Reiser, Founder IMI, Mr Benjamin Ng, Director of ACDN and Mr Raymond D Neoh, Founder and Director IDGT

IMI Team. Left to right: Tomas Ho –Operations Director, Elsie Sim –Senior Administrative Staff, Pam Yeo –Assistant PR Manager, Gwee Yi Chen –Assistant Project Development Manager, Professor Martin Reiser –Founding Director
Beginnings of NEWRI

NTU has supported development of environmental science and engineering (ESE) education and research and development (R&D) for a substantial period of time and pockets of competency have developed. While these have done well in the past, going forward there is also realisation of the need to organise, better coordinate efforts, leverage more strongly on these competencies, and so present a more coherent “face” to stakeholders. This effort at reconfiguring NTU’s ESE efforts gave rise to the idea of the Nanyang Environment & Water Research Institute (NEWRI) in 2007. The NEWRI will provide the environment needed to grow capabilities in the rapidly expanding environmental and water technologies industry in Singapore. NEWRI was officially launched on 19 March 2008 by Dr Yaacob Ibrahim, Minister for the Environment & Water Resources.

The NEWRI ecosystem

NEWRI is pan-NTU in its activities, reports to the Provost’s Office, and operates with the vision of creating an ecosystem which will address the needs for ESE research, translation, development, and applications. Underpinning all these is ESE undergraduate and postgraduate education. The mid-term objective is to position NEWRI as the leading ESE research organisation in Singapore and Asia.

NEWRI is organised as an ecosystem with interacting and mutually supporting members. The key ESE domains in which NEWRI seeks presence would be represented by the core interests and activities of its 5 centre members, 2 research groups, and a Masters ESE program. These entities are:

i. DHI-NTU Centre - urban environmental issues;

ii. Singapore Membrane Technology Centre (SMTC) – membranes and their applications;

iii. Residues & Resource Reclamation Centre (R3C) - residues management and resource reclamation;
Moving Forward…

Professor Ng Wun Jern, who was recruited in June 2007, serves as NEWRI’s founding Executive Director. The drive is towards positioning the NEWRI ecosystem as the key ESE player in Singapore and region in terms of R&D, and impact on society and industry. To do so requires the members of the ecosystem to be built up in terms of capabilities and range of activities. Two ecosystem members, DHI-NTU Centre and SMTC were substantially funded in 2007/2008 for this purpose. Two more, R3C and AEBG, will be guided towards such funding in 2009.

NEWRI intends to temper its drive for scientific leadership and industry relevance with sensitivity for environmental sustainability. Given that NEWRI spans the NTU domain it aims to draw interest from colleagues who can address issues concerning social, economic, and trans-boundary impacts.

iv. Advanced Environmental Biotechnology Group (AEBG) - environmental biotechnology and applications;

v. Environmental Chemistry & Materials Group (ECMG) - environmental chemistry and materials;

vi. Lien Institute for the Environment (LIFE) - window to society through philanthropic projects;

vii. Institute of Environmental Science and Engineering (iESE) - window to the industry through technology transfers;

viii. NEWRI Environmental Master of Science (NEMS) - preparing students to be at the forefront of Environmental Engineering and Science.
Members of NEWRI Ecosystem DHI-NTU Centre

This is a collaborative effort between DHI of Denmark and NTU, with funding support from the Environment and Water Industry Development Council (EWI)/Economic Development Board (EDB) of Singapore to conduct R&D and training courses in the broad domain of urban environmental issues with some focus on areas such as industrial water management, urban water planning and management, solid waste management and environmental impact assessment.

In the 2007–08 period, the centre, with its Co-Director, Associate Professor Tan Soon Keat initiated some 26 research projects and these included:

**Project:** Water-Energy-Policy in Singapore  
**Focus:** Industrial and urban water management;

**Project:** Coral Reef Monitoring and Management  
**Focus:** Environmental impact assessment;

**Project:** Estuarine Transport of Fine Suspended Sediments  
**Focus:** Urban water management and environmental impact assessment;

**Project:** Vegetated Open Channel Flows with Simulated Vegetation  
**Focus:** Urban water management and environmental impact assessment;

**Project:** Artificial Neural Networks Rainfall-Runoff Modeling  
**Focus:** Urban water management and Decision Support System (DSS);

**Project:** Detailed Flow and Aeration Processes in Controlled Watercourses  
**Focus:** Urban water management and environmental impact assessment;

**Project:** Collection and Dissemination of Hydrographic Data  
**Focus:** Decision Support System (DSS).

Singapore Membrane Technology Centre (SMTC)

The Singapore Membrane Technology Centre (SMTC) headed by Professor Anthony Fane and funded by EWI/EDB and industry was established to undertake fundamental and applied research in membrane technology with emphasis on applications in the environmental and water industries. The research is multi-disciplinary involving teams of scientists and engineers in theoretical, experimental, and piloting work.

The range of projects undertaken by SMTC includes:

- Desalination - improved and novel;
- Membrane distillation - solar driven;
- Membrane bioreactors - carbon neutral;
- Trace pollutant removal with membranes;
- Membranes in water reclamation – NEWater;
- Novel membranes for water/wastewater treatment;
- Sensors for smart membrane systems;
- Decentralised membranes systems for water/wastewater treatment.
Two examples of projects are:

1. **Integration of Novel Forward Osmosis Membranes and Optimised Bioprocess for Water Reclamation**

The integration of the Forward Osmosis (FO) membrane and the activated sludge bioprocess is a new variant of the membrane bioreactor (MBR) technology known as the forward osmotic membrane bioreactor (FOMBR) *Figure 2*. The FOMBR offers advantages such as lower energy requirement and high quality product water. The FO membrane retains recalcitrant organics and hence increases opportunity for their biodegradation. However, major impediments to industrial FOMBR applications include the availability of an appropriate FO membrane.

With funding from EWI, SMTC is developing novel FO membranes suitable for use in the FOMBR. The multidisciplinary team includes Professor Anthony Fane, Associate Professor Wang Rong, Assistant Professor Tang Chuyang and Associate Professor Liu Yu, and collaborators from PUB’s Centre for Advanced Water Technology (CAWT) (Dr Qin Jianjun, Mr Kiran Kekre) and Imperial College (Professor Li Kang). The team has expertise encompassing membrane making and characterisation, membrane separation and fouling, biological reaction, modelling, and operational experience.

2. **UV Pre-treatment for the Control of Biofilm Formation on RO Membranes**

Biofouling is one of the most problematic types of fouling in the reverse osmosis (RO) process. The microorganisms causing this are dominated by ‘viable but not culturable’ (VBNBC) bacteria and these are too small to be removed by the upstream microfiltration (MF). Due to recovery and polarisation, concentrations of nutrients at the RO membrane can increase 2-3 fold. The increased nutrient levels combined with the extensive membrane surface provide a favourable environment for the VBNBC to form biofilms. Control of biofouling by chlorination has been shown to be not particularly effective for VBNBC. This project assesses the efficacy of UV pre-treatment. It aims to confirm the approach by means of well-controlled laboratory trials and thereafter a pilot study at a NEWater plant to allow process optimisation. The project has Professor Harvey Winters (FDU, USA) as collaborator and funding support from PUB and Trojan UV.
Residues & Resource Reclamation Centre (R3C)

This new research centre which builds on the previous EERC (Environmental Engineering Research Centre) is anticipated to be established in February 2009 and shall then be led by Professor Rainer Stegmann and Associate Professor Wang Jing-Yuan. R3C will be NEWRI ecosystem’s platform for residues management and resource reclamation research and development. R3C is positioned to support Singapore’s emerging residues management and resource reclamation industry. Consequently R3C aims to develop novel and appropriate technologies for the local and regional markets on urban and industrial (including agro-industrial) waste management. The centre will have three research themes: (1) waste to materials, (2) waste to energy, and (3) contaminated site remediation; and these themes shall be pursued in research, education, and industry collaboration.

Outcomes of R3C efforts can include at least $7.5M of competitively funded research projects, 32 researchers trained in the residues and resource reclamation domain, and 4 international and regional conferences to disseminate knowhow within 5 years.

Advanced Environmental Biotechnology Group (AEBG)

This research group coordinated by Associate Professor Liu Yu supports the centres where work involves biological processes. It has also been responsible for novel work as in biogranulation which was awarded the National Technology Award in 2003. Based on intellectual property generated and patents granted, AEBG and iESE are already working with the industry to develop the design and operating protocols for the Granular Membrane Bioreactor (GMBR), anticipated to replace the current generation of membrane bioreactors (MBR). An example of such collaborative R&D with industry is the project with Hitachi Plant Technologies Ltd and Hitachi Asia Ltd in developing a high-performance aerobic granular sludge MBR. Combination of membrane separation with activated sludge
has resulted in a more compact MBR capable of high quality treated effluent. However, membrane fouling which adversely impacts on productivity and operating costs is a major challenge in MBR application. The GMBR aims to avoid these. Aerobic granules have excellent settleability, strong microbial structure, high biomass retention, and good ability to handle toxic compounds. It has been shown in the study that the GMBR is capable of maintaining transmembrane pressures below the threshold for cleaning for longer periods of time.

This research group is being prepared for transition into research centre status. The Centre shall operate with three research platforms: Environmental Microbiology and Ecology, Bioprocess Development, and Marine Biotechnology.

**Environmental Chemistry and Materials Group (ECMG)**

ECMG is coordinated by Associate Professor Lim Teck Thye. The group’s research interests include development of novel functional materials for environmental applications and environmental monitoring of emerging contaminants. The functional materials developed for water treatment include adsorbents, redox-active agents, and catalysts. The research on environmental monitoring focuses on assessing the occurrence and fate of both microbial and chemical contaminants in water and sediments and includes trace level organic pollutants in reclaimed water, algal toxins and pathogens in surface waters. The group is currently undertaking three NRF-EWI funded projects (at $4.5M). There are some 20 full-time faculty members and researchers in this group and numbers are expected to increase.
Institute of Environmental Science and Engineering (iESE)

An NTU spin-off company managed by Mr Mathew Tan, iESE is NEWRI’s window to the industry. It draws on the research generated by other members within the ecosystem and undertakes development of technologies for dissemination to the industry. In doing so iESE generates a return flow of revenue to the ecosystem. This return flow can for example take the form of royalties or equity in spin-off companies. A recent example of the second mode is a company set-up to exploit proprietary biofuels manufacturing knowhow. Another example is the novel membrane-based sensor for on-line membrane integrity monitoring. This arose from a collaboration between SMTC (Professor Anthony Fane) and iESE (Dr Wong Fook Sin). Integrity sensors can play a key role in determining if a membrane in a system has been compromised. Currently available integrity sensors are complex and costly. The novel integrity sensor is being developed by SMTC and iESE with funding support from EWI. In-plant trials are in progress at three sites - a water treatment plant, a NeWater plant and a MBR plant. The novel sensor is based on passage of a side-stream sample across a double membrane sandwich. Measurement of the relative pressure drops provides a sensitive measure of contaminant load. The new sensor is low cost and can detect down to 0.1 NTU (turbidity units). Plans to commercialise the sensor are being formulated.
LIFE is led by Associate Professor Li Bing with support from the LIEN Foundation. Its focus is on philanthropic activities related to water, sanitation and shelter in developing countries of Asia. LIFE serves as a very important counterbalance to the industry related activities of the NEWRI ecosystem and is the window to rural communities in the region. LIFE identifies research findings from within the NEWRI ecosystem or sponsors R&D which it believes can have value to developing communities or communities adversely impacted by natural disasters and seeking recovery. It develops such knowhow into appropriate, scalable technologies that can be shared with the communities working a self-help basis. An example of LIFE’s contribution to the community is its work on arsenic in drinking water. Drinking arsenic contaminated water over time leads to arsenic poisoning or arsenicosis with consequent health problems such as cancers and skin problems. In recent years, severe and widespread contamination (which can be natural) of groundwater by arsenic has been found in rural and sub-urban areas in and around the Vietnamese capital of Hanoi, with magnitudes many times above the World Health Organisation provisional guideline value for arsenic of 0.01 mg/L. LIFE initially modified existing sand filter designs prevalent in Vietnam to better utilise the iron present in the water to remove arsenic. Next, LIFE identified suitable, affordable and readily available natural materials to serve as adsorbents. Once such materials were identified, laboratory investigations leveraging on student participation provided the basis for use of the adsorbent, laterite. Seventy treatment units have been built and are being pilot tested. The results so far have shown the treated water had arsenic levels lower than the World Health Organisation provisional guideline value for arsenic of 0.01 mg/L.
Innovations and Patents

From the quality of research and through the hard work put in by the researchers at the University, new discoveries and exciting breakthroughs are happening every day. Here, we showcase successful innovations and inventions that have resulted from our research endeavours.
Innovations and Patents

Method, Software, and Device for Hiding Data in Binary Image, while Preserving Image Quality

Inventors:
Alex Kot Chichung; Yang Huijuan; Lu Haiping

School:
School of Electrical and Electronic Engineering (EEE)

Patent No:
US 7,324,662 B2

Grant Date:
29 January 2008

Country:
United States of America

A method of embedding watermark data into a two-colour (binary) image includes dividing the image into blocks and assessing the suitability of each block to embed a bit of watermark data by assessing whether or not the flipping of a defined pixel in each block affects the visual attributes of said block in manner to be perceptible by the human eye. Data is only embedded in those blocks determined to be suitable for data embedding, by flipping the defined pixel, as required. A recipient of the document may similarly assess which blocks contain watermark data, by assessing the suitability of each block in the document to embed such data. Conveniently, watermark data may be extracted without further information about the data’s location within a document.

Microfabricated System for Magnetic Field Generation and Focusing

Inventors:
Poenar Daniel Puiu; Qasem Ramadan; Victor Samper; Chen Yu

School:
School of Electrical and Electronic Engineering (EEE)

Patent No:
128064 [WO/2005/122194]

Grant Date:
31 January 2008

Country:
Singapore

This invention relates generally to the fabrication of micro electromagnetic devices such as micro electromagnetic coils, which can be used as transducers within micro electromechanical systems (MEMS).

Polymeric Stent and Method of Manufacture

Inventors:
Venkatraman Subramanian; Freddy Boey Yin Chiang

School:
School of Materials Science and Engineering (MSE)

Note: Pink - External Inventors
Innovations and Patents

**Patent No:**
117370 [WO 2004/110315]

**Grant Date:**
31 January 2008

**Country:**
Singapore

This stent is formed of polymeric material which is useful for the expansion of a lumen and the delivery of one or more therapeutic agents in situ. The stent may be multi-layered, and may change shape at a state transition temperature governed by the materials forming the layers.

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**Method and Transducers for Dynamic Testing of Structures and Materials**

**Inventors:**
Ling Shih Fu; Hou Xiaoyan

**School:**
School of Mechanical and Aerospace Engineering (MAE)

**Patent No:**
US 7,332,849 B2

**Grant Date:**
19 February 2008

**Country:**
United States of America

A transducer for dynamic testing of specimen is disclosed. The transducer comprises at least two equally-spaced actuators, and a supporting block for supporting the at least two equally-spaced actuators and for mounting the transducer to the specimen. Each of the at least two equally-spaced actuators is an electrically powerable for providing to the specimen: force or moment. The actuators may be bimorphs and the transducer may be able to operate as an actuator, a sensor, and simultaneously as an actuator and a sensor. This may be for the transducer being able to operate as a sensor, for measurement of at least one selected from the group consisting of: an excitation force exerted on the specimen, an excitation moment exerts on the specimen, a resultant translational velocity of the specimen at an excitation point, and a rotational velocity of the specimen at the excitation point. The at least two equally-spaced actuators are able to produce a force on the specimen when electricity supplied to the at least two equally-spaced actuators is in phase, and a moment on the specimen when the electricity supplied to the at least two equally-spaced actuators is out of phase.

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**Sample Preparation Integrated Chip**

**Inventors:**
Gong Haiqing; Chen Longqing; Eric Yap Peng Huat

**School:**
School of Mechanical and Aerospace Engineering (MAE)

**Patent No:**
US 7,338,760 B2

**Grant Date:**
4 March 2008

**Country:**
United States of America

Funded by A*STAR/BMRC, a team led by Associate Professor Thomas

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**A Transducer**

**Inventors:**
Cai Wenjian; Xie Li Hua; Soh Yeng Chai; Fang Yue; Lim Beng Tiong; Feng Shaohua; Shao Jianliang

**School:**
School of Electrical and Electronic Engineering (EEE)

**Patent No:**
119583 [WO/2006/043899]

**Grant Date:**
29 February 2008

**Country:**
Singapore

The invention concerns a new Intelligent Chemical Multi-transducer for waste chemical treatment process.

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Note: Pink - External Inventors
Gong of School of Mechanical and Aerospace Engineering’s BioMEMS Laboratory at NTU, in collaboration with Defence Medical and Environmental Research Institute (DMERI) has developed a biochip platform technology for DNA analysis for applications in molecular diagnostics of diseases. This project aimed at developing a biochip technology to meet the current challenges in molecular diagnostics like the high consumption of reagents due to the use of large reaction tubes and the lack of high throughput diagnostics capability. The molecular biology chemistries used on the biochip are the polymer chain reaction (PCR) and strand displacement amplification (SDA), where the former is routinely used in molecular diagnosis. To substantially reduce the reagent consumption,

integrate the multiple DNA analysis steps, and increase its throughput, the team proposed and developed a dual-fluid microfluidics platform technology to microfluidically generate a large array of liquid phase reaction microwells. This biochip is to be used with an in-house whole-chip fluorescence imaging system for real-time detection of DNA amplification from all wells on the chip simultaneously.

Methods and Kits for Quantitative Detection of Specific Microorganisms and Nucleic Acid Sequences

Inventors:
Tay Joo Hwa;
Stephen Tay Tiong Lee;
Volodymyr Ivanov

School:
School of Civil and Environmental Engineering (CEE)

Patent No:
111927

Grant Date:
30 April 2008

Country:
Singapore

This invention relates to a method for the qualitative and quantitative evaluation and detection of microorganisms or nucleic acid sequences in a sample. In particular, this application relates to the quantitative evaluation and detection of microorganisms and nucleic acid sequences in an environmental, medical, veterinary, agricultural or biotechnological sample.
Method of Producing Germanosilicate with a High Refractive Index Change

Inventors:
Kantisara Pita; Rajni; Tjin Swee Chuan; Kam Chan Hin; Yu Siu Fung

School:
School of Electrical and Electronic Engineering (EEE)

Patent No:
132050 [WO 2006/062486]

Grant Date:
30 April 2008

Country:
Singapore

Invention of a method to fabricate high refractive index change in inorganic materials. The present invention relates to a method of producing germanosilicate that includes a refractive index change $\Delta n$ (within the formed germanosilicate). The invention also relates to the formation of a waveguide, including a waveguide that can be used in optical circuits. The method of the invention includes forming a gel from a sol comprising of germanium oxide and silicate by means of a sol-gel process. The method further includes forming germanosilicate by annealing the gel under elevated temperatures and exposing the formed germanosilicate to pulsed UV light of at least 350mJ/pulse.

Method and Device for Computer-Based Processing a Template Minutia Set of a Fingerprint and a Computer Readable Storage Medium

Inventors:
Ser Wee; Jiang Xudong; Yau Wei Yun

School:
School of Electrical and Electronic Engineering (EEE)

Patent No:
US 7,369,688 B2

Grant Date:
6 May 2008

Country:
United States of America

A template minutia set of a fingerprint comprising template minutiae and a template interest region is provided. Further, an input minutia set comprising input minutiae and an input interest region according to an input fingerprint is provided. The input minutia set is matched with the template minutia set. All matching template/input minutiae are determined. Furthermore, an updated template minutia set is determined dependent on the matching template/input minutiae and the non-matching template/input minutiae, and dependent on whether the template minutiae are inside the input interest region or outside of it and whether the input minutiae are inside the template interest region or outside of it.

Radiation Detector Having Coated Nanostructure and Method

Inventors:
Marian Cholewa; Lau Shu Ping; Yi Gyu-Chul; Yoo Jin Kyoung; Adrian Paul Burden; Huang Lei; Gao Xingyu; Andrew Wee Thye Shen; Herbert Oskar Moser

School:
School of Chemical and Biomedical Engineering (SCBE)

Patent No:
US 7,388,201 B2

Grant Date:
17 June 2008

Country:
United States of America

A radiation detector has an electron emitter that includes a coated nanostructure on a support. The nanostructure can include a plurality of nanoneedles. A nanoneedle is a shaft tapering from a base portion toward a tip portion. The tip portion has a diameter between about 1 nm to about 50 nm and the base portion has a diameter between about 20 nm to about 300 nm. Each shaft has a length between about 100 nm to about 3,000 nm and an aspect ratio larger than 10. A coating covers at least the tip portions of the shafts. The coating exhibits negative electron affinity and is capable of emitting secondary electrons.
Innovations and Patents

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electrons upon being irradiated. The nanostructure can also include carbon nanotubes (CNTs) coated with a material selected from the group of aluminium nitride (AIN), gallium nitride (GaN), and zinc oxide (ZnO). The detector further includes an electron collector positioned to collect electrons emitted from the electron emitter and to produce a signal indicative of the amount of electrons collected, and a signal processor operatively connected to the electron collector for processing the signal to determine a characteristic of the radiation. The detector can be used to detect radiations of changed particles or light such as X-ray.

Contaminated Inflow Treatment with Membrane Distillation Bioreactor

Inventors:
Anthony Fane; Jirachote Phattaranawik; Wong Fook-Sin

School:
School of Civil and Environmental Engineering (CEE)

Patent No:
138728 [WO 2006/137808]

Grant Date:
30 June 2008

Country:
Singapore

The method comprises providing a bioreactor vessel defining a reaction chamber; providing a distillation membrane located within the reaction chamber and in fluid communication with an outlet conduit; placing a biological agent, such as activated sludge, and the contaminated inflow in the reaction chamber to biodegrade a contaminant in the contaminated inflow with the biological agent, thus producing a lower contaminant inflow (i.e. with lower contaminant concentration); distilling, by membrane distillation, the lower contaminant inflow through the distillation membrane to produce an outflow; and extracting the outflow out of the reaction chamber though the outlet conduit.

Compositions and Methods for the Treatment of Wastewater and Other Waste

Inventors:
Tay Joo Hwa; Stephen Tay Tiong Lee; Volodymyr Ivanov; Olena Stabnikova; Wang Jing-Yuan

School:
School of Civil and Environmental Engineering (CEE)

Patent No:
US 7,393,452 B2

Grant Date:
1 July 2008

Country:
United States of America

A method for processing environmental samples to remove or otherwise reduce the level of certain chemical species. In a preferred embodiment, the present invention contemplates a process for reducing the level of inorganic and/or organic chemical species in wastewater or other aqueous or semi-aqueous environments or other waste environments. The present invention further provides compositions of bacteria useful in modulating the redox potential of an environment to generate redox mediator species which facilitate the removal of particular inorganic or organic molecules from the environment or from samples therefrom. The redox potential is preferably modulated through microbial-mediated oxidation or reduction of metal cations under aerobic or anaerobic conditions, respectively. The present invention is further directed to a computer program which facilitates the controlled modulation of the redox potential of an aqueous or semi-aqueous environment or other environments.
**Method and Apparatus for Imaging Latent Fingerprints**

**Inventors:**
Seah Leong Keey; Vadakke Matham Murukeshan; Ong Lin Seng; Chao Zhixia; Unnimadhava Kurup Soudamini Amma Dinish; Ong Sock Koon

**School:**
School of Mechanical and Aerospace Engineering (MAE)

**Patent No:**
144701

**Grant Date:**
30 September 2008

**Country:**
Singapore

The invention relates to methods and an apparatus for visualising images of a sample on a substrate making use of fluorescence. In particular, the invention relates to methods and an apparatus for visualising images of latent fingerprints for forensic purposes.

**Landmine Avoidance and Protection Device**

**Inventors:**
Franz Konstantin Fuss; Adin Tan Ming

**School:**
School of Chemical and Biomedical Engineering (SCBE)

**Patent No:**
US 7,437,986 B2

**Grant Date:**
21 October 2008

**Country:**
United States of America

A mine avoidance and protection device has a frame adapted to be secured to a source of a load, such as the foot of a person. Attached to the frame are at least three support legs each extending from the frame. Each leg has a releasable joint between the leg and the frame. At least one detector is operable to provide a detection capability for each support leg, operable to detect a characteristic of a mine when at least a portion of the support leg is located proximate to the mine. An actuator operable to provide an actuation capability at the joint of each leg, to: constrain the joint to allow a load to be transmitted from the frame, through the joint and the support to the terrain. The actuator can also release the joint such that a load cannot be transmitted from the frame through the joint. The joint between the plate and each leg may be a one degree-of-freedom prismatic joint or revolute joint.

**Apparatus and Method for Removing Abnormal Tissue**

**Inventors:**
Sunita Chauhan; Ranjan Kumar Mishra; Wee Siew Bock; Mona Tan Poh Choo

**School:**
School of Mechanical and Aerospace Engineering (MAE)

**Patent No:**
US 7,440,793 B2

**Grant Date:**
21 October 2008

**Country:**
United States of America

A computer assisted, minimally invasive method and apparatus for surgically removing abnormal tissue from a patient, for example, from a breast. The method involves imaging of the breast to locate the abnormal tissue, and determining a volume encapsulating the abnormal tissue and including a margin of healthy tissue. Based on the volume, a sequence of movements of a surgical instrument for tissue removal device is planned, so as to predictably excise the desired volume of tissue.

**Process for Producing Nanocrystalline Composites**

**Inventors:**
Zhu Weiguang; Wang Zhihong; Tan Ooi Kiang; Zhao Changlei

**School:**
School of Electrical and Electronic Engineering (EEE)

**Patent No:**
107103

**Grant Date:**
31 October 2008

**Country:**
Singapore
The present invention relates in general to producing nanocrystalline composites, including ceramic bodies, coatings and multi-layered products, and more particularly, to producing nanocrystalline composites by dispersing nanocrystalline particles into a related organo-metallic precursor solution to produce nanocrystalline composites.

**Block Motion Estimation Method**

**Inventors:** Zhu Ce; Lin Xiao; Chau Lap Pui  
**School:** School of Electrical and Electronic Engineering (EEE)  
**Patent No:** US 7,457,361 B2  
**Grant Date:** 25 November 2008  
**Country:** United States of America

To provide a block motion estimation method which can be carried out with improved processing speed compared to the search algorithms of the related art. This is achieved by providing a block motion estimation method which increases the speed of the motion estimating process by checking only a part instead of all inner search points within a polygonal search area without a significant loss of accuracy.

**Detection Apparatus and Method Utilising Membranes and Ratio of Transmembrane Pressures**

**Inventors:** Anthony Fane; Jirachote Phattaranawik; Wong Fook-Sin  
**School:** School of Civil and Environmental Engineering (CEE)  
**Patent No:** 147239  
**Grant Date:** 29 November 2008  
**Country:** Singapore

The failure of an upstream filtration membrane, or the presence of a foulant in a fluid detected using a membrane-based detector. The fluid or an effluent from the filtration membrane is directed to permeate through a first permeable membrane, and from the first membrane to permeate through a second permeable membrane. The ratio between (P1-P2) and (P2-P3) is determined, where P1 is a first pressure at a feed side of the first membrane, P2 is the second pressure between the first and second membranes, and P3 is a third pressure at a permeate side of the second membrane. The ratio is correlated with the failure of the filtration membrane or with the presence of the foulant.

**A Fibre Optic Force Sensor for Measuring Shear Force**

**Inventor:** Tjin Swee Chuan  
**School:** School of Electrical and Electronic Engineering (EEE)  
**Patent No:** US 7,466,879 B2  
**Grant Date:** 16 December 2008  
**Country:** United States of America  
**Patent No:** MY-137025-A  
**Grant Date:** 31 December 2008  
**Country:** Malaysia

A small-sized sensor to measure shear force which can operate with high accuracy and sensitivity in a wide range of shear forces including forces well above 100N, and immune to external interference like EMI. The sensor is a fiber optic force sensor with a Bragg grating incorporated in the fibre core.
The quality and commitment of the faculty play a large part in contributing to the University’s success as a research intensive institution. Active recruitment for top faculty and researchers at senior and junior levels worldwide has led to the appointment of new faculty members in the year.
New Faculty Members

For the contact details, biographies, research interests, current projects and selected listing of publications of individual faculty members, please refer to their Academic Profile at http://research.ntu.edu.sg/expertise

School of Art, Design and Media (ADM)

Danne Ojeda Hernandez
Assistant Professor
MA (Art History); University of Havana, Cuba.

Fabrizio Galli
Assistant Professor
BArch; Florence University, Italy.

Nanci Takeyama
Assistant Professor
PhD; Kobe University, Japan.

Peer Mohideen Sathikh
Assistant Professor
MDes; Royal College of Art, UK.

Vladimir Todorovic
Assistant Professor
MFA (Art Studio); University of California, Santa Barbara, US.

School of Civil and Environmental Engineering (CEE)

Wang Rong
Associate Professor
Division of Environmental and Water Resources Engineering
PhD; Chinese Academy of Sciences, China.

School of Electrical and Electronic Engineering (EEE)

Andy Khong Wai Hoong
Assistant Professor
Division of Information Engineering
PhD; Imperial College, University of London, UK.

Lu Wenmiao
Assistant Professor
Division of Information Engineering
PhD; Columbia University, New York, US.

Yu Hongyu
Nanyang Assistant Professor
Division of Information Engineering
PhD; National University of Singapore, Singapore.

Earth Observatory of Singapore (EOS)

Hsu Hao-Te a.k.a. Shyu J. Bruce
Holder
Academic Assistant Director
PhD (Geology); California Institute of Technology, US.

School of Humanities and Social Sciences (HSS)

Genaro Castro Vazquez
Assistant Professor
Division of Sociology
PhD (Sociology of Health Sciences); University of Tsukuba, Japan.

Goh Geok Yian
Assistant Professor
School of Humanities and Social Sciences
PhD (History); University of Hawaii, Manoa, US.

James Patrick Williams
Assistant Professor
Division of Sociology
PhD (Sociology); University of Tennessee, US.

Kampon Adireksombat
Assistant Professor
Division of Economics
PhD (Economics); Michigan State University, US.
Qiu Lin
Assistant Professor
Division of Psychology
PhD; Northwestern University, US.

Sulfikar Amir
Assistant Professor
Division of Sociology
PhD (Science and Technology Studies); Rensselaer Polytechnic Institute, US.

Teo Gin Swee Ernie
Assistant Professor
Division of Economics
PhD (Philosophy); University of New South Wales, Australia.

Walter Philip Wadiak
Assistant Professor
Division of English
PhD (English); University of California, Irvine, US.

Chen Shen-Hsing Annabel
Associate Professor
Division of Psychology
PhD; Indiana University – Purdue University Indianapolis, US.

School of Mechanical and Aerospace Engineering (MAE)

Castagne Sylvie J.C.
Assistant Professor
Division of Manufacturing Engineering
PhD; University of Liege, Belgium.

Chen Songlin
Assistant Professor
Division of Systems and Engineering Management
PhD; Hong Kong University of Science and Technology, Hong Kong.

Fei Duan
Assistant Professor
Division of Thermal and Fluids Engineering
PhD (Mechanical & Industrial Engrg); University of Toronto, Canada.

Jaspreet Singh Dhupia
Assistant Professor
Division of Mechatronics and Design
PhD (Mechanical Engrg); University of Michigan, Ann Arbor, US.

Lau Gih Keong
Assistant Professor
Division of Engineering Mechanics
PhD; Delft University of Technology, Netherlands.

Martin Skote
Assistant Professor
Division of Thermal and Fluids Engineering
PhD; Royal Institute of Technology (KTH), Sweden.

Park Taezoon
Assistant Professor
Division of Systems and Engineering Management
PhD; Purdue University, West Lafayette, US.

Qu Xingda
Assistant Professor
Division of Systems and Engineering Management
PhD; Virginia Polytechnic Institute and State University, US.

Son Hungsun
Assistant Professor
Division of Aerospace Engineering
PhD; Georgia Institute of Technology, US.

Wong Chee How
Assistant Professor
Division of Engineering Mechanics
PhD; Nanyang Technological University, Singapore.

Yang Jinglei
Assistant Professor
Division of Aerospace Engineering
PhD (Materials Science); University of Kaiserslautern, Germany.

Zheng Lianxi
Assistant Professor
Division of Engineering Mechanics
PhD; University of Hong Kong, Hong Kong.
<table>
<thead>
<tr>
<th><strong>School of Materials Science and Engineering (MSE)</strong></th>
</tr>
</thead>
</table>
| **Alex Yan Qingyu**  
*Assistant Professor*  
Division of Materials Technology  
PhD (Materials Science and Engineering); State University of New York, Stony Brook, US. |

<table>
<thead>
<tr>
<th><strong>Nanyang Business School (NBS)</strong></th>
</tr>
</thead>
</table>
| **Soh Star**  
*Associate Professor*  
Division of Strategy, Management and Organisation  
PhD; Ohio State University, US. |

| **Chiu Chi-Yue**  
*Professor*  
Division of Strategy, Management and Organisation  
PhD; Columbia University, New York, US. |

| **Hong Ying-Yi**  
*Professor*  
Division of Strategy, Management and Organisation  
PhD; Columbia University, New York, US. |

| **Kang Jun-Koo**  
*Professor*  
Division of Banking and Finance  
PhD (Finance); Ohio State University, USA. |

<table>
<thead>
<tr>
<th><strong>School of Biological Sciences (SBS)</strong></th>
</tr>
</thead>
</table>
| **Tobias Carl Cornvik**  
*Assistant Professor*  
Division of Structural and Computational Biology  
PhD (Biochemistry); Stockholm University, Sweden. |

| **Eugene Makeyev**  
*Nanyang Assistant Professor (NRF Fellow)*  
Division of Molecular and Cell Biology  
PhD (Molecular Biology); University of Helsinki, Finland. |

<table>
<thead>
<tr>
<th><strong>School of Chemical and Biomedical Engineering (SCBE)</strong></th>
</tr>
</thead>
</table>
| **Chen Tao**  
*Assistant Professor*  
Division of Chemical and Biomedical Engineering  
PhD; University of Newcastle, UK. |

| **Kim Donghwan**  
*Assistant Professor*  
Division of Bioengineering  
PhD; University of Michigan, Ann Arbor, US. |

| **Lee Jong-Min**  
*Assistant Professor*  
Division of Chemical and Biomolecular Engineering  
PhD; Columbia University, US. |

| **Lou Xiong Wen**  
*Assistant Professor*  
Division of Bioengineering  
PhD; Cornell University, Ithaca, New York, US. |

<table>
<thead>
<tr>
<th><strong>School of Computer Engineering (SCE)</strong></th>
</tr>
</thead>
</table>
| **Dusit Niyato**  
*Assistant Professor*  
Division of Computer Communications  
PhD; University of Manitoba, Canada. |

| **Fu Chi Wing**  
*Assistant Professor*  
Division of Computer Science  
PhD (Computer Science); Indiana University, US. |

| **Luo Jun**  
*Assistant Professor*  
Division of Computer Communications  
PhD; Swiss Federal Institute of Technology, Lausanne, Switzerland. |
Tsang Wai Hung, Ivor
Assistant Professor
Division of Computer Science
PhD (Computer Science & Engrg); Hong Kong University of Science and Technology, Hong Kong.

Wang Ping
Assistant Professor
Division of Computer Communications
PhD; University of Waterloo, Canada.

Tao Dacheng
Nanyang Assistant Professor (NTU)
Division of Computer Communications
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Bertil Schmidt
Associate Professor
Division of Computing Systems
PhD; Loughborough University, UK.

Ramakrishna Kakarala
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PhD (Mathematics); University of California, Irvine, US.

School of Physical and Mathematical Sciences (SPMS)

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Division of Mathematical Sciences
PhD; University of Washington, US.

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PhD (Mathematics/ Communications Systems); Swiss Federal Institute of Technology, Lausanne, Switzerland.

Fu Haifeng
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Division of Mathematical Sciences
PhD; National University of Singapore, Singapore.

Pan Guangming
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PhD (Mathematical Statistics); University of Science and Technology of China, China.

Pang Zhen
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PhD; National University of Singapore, Singapore.

So Cheuk Wai
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PhD (Chemistry); Chinese University of Hong Kong, Hong Kong.

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Chee Yeow Meng  
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PhD; University of Waterloo, Canada.

Li Tianhu  
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Park Cheol-Min  
Associate Professor  
Division of Chemistry and Biological Chemistry  
PhD (Organic Chemistry); Seoul National University, South Korea.

Sinai Robins  
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PhD (Mathematics); University of California, Los Angeles, US.

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Wee Kim Wee School of Communication and Information (WKWSCI)

Fernando De La Cruz Paragas  
Assistant Professor  
Division of Public and Promotional Communication  
PhD (Mass Communications); Ohio University, US.

Adam Joel Knee  
Associate Professor  
Division of Electronic and Broadcast Media  
PhD; New York University, US.

Stephen Teo Kian Teck  
Associate Professor  
Division of Electronic and Broadcast Media  
PhD; Royal Melbourne Institute of Technology University, Australia.
Facts and Figures

Numbers tell the story of the significant milestones NTU has achieved in research.
Facts and Figures

1. Grants

1.1 Grants Awarded

Distributions of Competitive Grants Awarded in FY 2007* and FY 2008* annualised based on their maximum projection durations

FY 2007 Competitive Grants Awarded

S$95.3 M (Total NTU inclusive of NIE & RSIS) figures calculated on an annualised basis

- MOE, AcRF Tier 2: 14%
- A*Star: 28%
- NRF (CRP-5 Yrs Projects): 4%
- NRF (Others): 6%
- Other Govt Bodies: 10%
- Mindef: 18%
- RCE: 16%

FY 2008 Competitive Grants Awarded

S$128.8 (Total NTU inclusive of NIE & RSIS) figures calculated on an annualised basis

- MOE, AcRF Tier 2: 14%
- A*Star: 17%
- NRF (CRP-5 Yrs Projects): 7%
- NRF (Others): 17%
- Other Govt Bodies: 6%
- Mindef: 21%
- RCE: 12%

* The financial year runs from 1st April to 31st March every year.
1.1 Grants Awarded
Trend of Competitive Awards (figures calculated on an annualised basis)

Competitive Grants Awarded
(Total NTU inclusive of NIE & RSIS) figures calculated on an annualised basis

![Bar chart showing competitive grants awarded from FY05 to FY08](chart.png)

1.2 Performance and Grant Types
The major sources of funding for research are the competitive grants from the National Research Foundation (NRF), the Ministry of Education (MOE) Academic Research Fund (AcRF) Tier 2, the Agency for Science, Technology and Research (A*STAR) and the Ministry of Defence (MINDEF).

National Research Foundation (NRF)
The National Research Foundation (NRF) is a department under the Prime Minister’s Office of the Republic of Singapore set up to implement national research, innovations and enterprise strategies. NRF, together with agencies such as the Clean Energy Programme Office (CEPO), the Economic Development Board (EDB), the Environment and Water Industry Development Council (EWI), the Media Development Authority (MDA), the Ministry of Education (MOE), and the National Medical Research Council (NMRC) administers and implements various important research programmes which offer research grants on a competitive basis.

These research initiatives include:
- NRF Competitive Research Programme (CRP) launched in 2007
- NRF Proof of Concept (POC) Call for Proposals launched in 2008
- Environment and Water Technology (EWT) administered by EWI
- Clean Energy Research Programme (CERP) administered by the EDB, launched in 2007
- Interactive and Digital Media (IDM) administered by MDA
- IDM Research and Development (R&D) in Education administered by MOE
- Biomedical Science (BMS) Initiative Phase II administered by NMRC
The performance of NTU (including NIE) in 2008 at these highly competitive grant calls has been more than respectable, as can be seen in the following tables:

<table>
<thead>
<tr>
<th>Grant Call</th>
<th>Number of Proposals submitted by NTU</th>
<th>Number of Proposals shortlisted from NTU</th>
<th>Number of Proposals shortlisted at national level</th>
<th>Number of awards to NTU</th>
<th>Number of awards at national level</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007 – 2nd CRP (General)</td>
<td>26</td>
<td>7</td>
<td>12</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2008 – 3rd CRP (Scenario-based)</td>
<td>16</td>
<td>6</td>
<td>14</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2008 – 4th CRP (General)</td>
<td>29</td>
<td>9</td>
<td>16</td>
<td>Results Pending</td>
<td>Results Pending</td>
</tr>
</tbody>
</table>

It can be seen that NTU has been able to clinch awards at each CRP grant call despite the highly competitive nature of the programme.

<table>
<thead>
<tr>
<th>Grant Call</th>
<th>Number of Proposals submitted by NTU</th>
<th>Number of awards to NTU</th>
<th>Number of awards at national level</th>
<th>Success Rate (no. of awards to NTU / no. of proposals submitted by NTU, %)</th>
<th>Success Rate (no. of awards to NTU / no. of awards at national level, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st POC Call for Proposal (2008)</td>
<td>35</td>
<td>3</td>
<td>9</td>
<td>8.6</td>
<td>33.3</td>
</tr>
<tr>
<td>EWI Challenge Call 07</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>EWI Request For Proposals 08/01 and 08/02</td>
<td>21</td>
<td>7</td>
<td>13</td>
<td>33.3</td>
<td>53.8</td>
</tr>
<tr>
<td>CERP Nov 07</td>
<td>30</td>
<td>3</td>
<td>8</td>
<td>10.0</td>
<td>37.5</td>
</tr>
<tr>
<td>CERP Aug 08</td>
<td>12</td>
<td>2</td>
<td>8</td>
<td>16.7</td>
<td>25.0</td>
</tr>
<tr>
<td>NRF IDM (MDA) Jan 07</td>
<td>25</td>
<td>6</td>
<td>14</td>
<td>24.0</td>
<td>42.9</td>
</tr>
<tr>
<td>NRF IDM (MDA) Jul 08</td>
<td>23</td>
<td>10</td>
<td>15</td>
<td>41.7</td>
<td>66.7</td>
</tr>
<tr>
<td>IDM R&amp;D in Education (MOE) Aug 07</td>
<td>20</td>
<td>3</td>
<td>4</td>
<td>15.0</td>
<td>75.0</td>
</tr>
<tr>
<td>IDM R&amp;D in Education (MOE) Mar 08</td>
<td>10</td>
<td>4</td>
<td>5</td>
<td>40.0</td>
<td>80.0</td>
</tr>
</tbody>
</table>

NTU has also put up a good showing at the various other NRF grant programmes that NTU has participated in, particularly in the field of IDM where NTU managed to obtain more than half the number of nationally successful awards for both the IDM grants administered by MDA and MOE.

**Ministry Of Education (MOE) Academic Research Fund (AcRF) Tier 2**

The MOE AcRF Tier 2 funds research projects on a competitive basis across Singapore based universities. This is one of the longest running research funding programmes available. NTU was able to win more than 40% of the amount awarded nationally for both grant calls in 2008, a testament to the quality of research proposals that were submitted.

<table>
<thead>
<tr>
<th>Grant Call</th>
<th>Number of Proposals submitted by NTU</th>
<th>Number of awards to NTU</th>
<th>Number of awards at national level</th>
<th>Amount awarded (inclusive of RSS, exclusive of indirect costs, $M)</th>
<th>Amount awarded nationally (inclusive of RSS, exclusive of indirect costs, $M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 2007</td>
<td>61</td>
<td>8</td>
<td>28</td>
<td>5.07</td>
<td>19.21</td>
</tr>
<tr>
<td>Feb 2008</td>
<td>49</td>
<td>16</td>
<td>27</td>
<td>10.61</td>
<td>19.39</td>
</tr>
<tr>
<td>Aug 2008</td>
<td>60</td>
<td>11</td>
<td>25</td>
<td>9.94</td>
<td>22.97</td>
</tr>
</tbody>
</table>
1.2 Performance and Grant Types (cont’d)

**Agency for Science, Technology and Research (A*STAR)**

A*STAR is a statutory board established to promote and support research and development in Singapore. As one of the key competitive local research funding agencies, it has two councils – the Biomedical Research Council (BMRC) and the Science and Engineering Research Council (SERC) – that manage the funding schemes. For the year of 2008, NTU has been able to secure a significant amount of funding from A*STAR for research purposes. Please refer to the table below for the various grants that were called for in 2008.

<table>
<thead>
<tr>
<th>Grant Call</th>
<th>Number of Proposals submitted by NTU</th>
<th>Number of projects awarded</th>
<th>Amount awarded (inclusive of indirect costs, $M)</th>
<th>Success Rate (no. of projects awarded / no. of proposals submitted, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMRC¹ May 08</td>
<td>40</td>
<td>9</td>
<td>6.67</td>
<td>22.5</td>
</tr>
<tr>
<td>SigN² May 08</td>
<td>2</td>
<td>2</td>
<td>0.57</td>
<td>100</td>
</tr>
<tr>
<td>SBIC³ – SigN Aug 08</td>
<td>3</td>
<td>1</td>
<td>1.04</td>
<td>33.3</td>
</tr>
<tr>
<td>PSF⁴ Jan 08</td>
<td>53</td>
<td>7</td>
<td>4.69</td>
<td>13.2</td>
</tr>
<tr>
<td>TSRP SMCL⁵ Aug 08</td>
<td>11</td>
<td>4**</td>
<td>4.25**</td>
<td>36.4</td>
</tr>
<tr>
<td>TSRP CCU⁶ Sep 08</td>
<td>3</td>
<td>2**</td>
<td>1.99**</td>
<td>66.6</td>
</tr>
<tr>
<td>A*STAR-NKTH⁷ Sep 08</td>
<td>7</td>
<td>1 (in-principle approved)**</td>
<td>Results Pending</td>
<td>Results Pending</td>
</tr>
<tr>
<td>SERC NSF MWN⁸ Nov 08</td>
<td>3</td>
<td>Results Pending</td>
<td>Results Pending</td>
<td>Results Pending</td>
</tr>
</tbody>
</table>

NB: National results are unavailable.

** Results of Grant Call were released in FY2009.

1. BMRC: Biomedical Research Council
2. SigN: Singapore Immunology Network
3. SBIC: Singapore Bioimaging Consortium
4. PSF: Public Sector Funding
5. TSRP SMCL: Thematic Strategic Research Programme – Sustainable Materials: Composites and Lightweights
6. TSRP CCU: Thematic Strategic Research Programme – Carbon Capture and Utilisation

**MINDEF/ DSTA/ DSO/ Other Defence related funding**

Research Funding from the Ministry of Defence (MINDEF) comes from 3 main agencies – MINDEF (Land, Sea and Air), the Defence Science Organisation (DSO) and the Defence Science & Technology Agency (DSTA). Funding received from MINDEF and DSO is targeted and non-competitive, while DSTA manages a competitive grant programme called the Defence Innovation Research Programme (DIRP).

<table>
<thead>
<tr>
<th>Defence Related Projects (2008)</th>
<th>Number of Proposals submitted to MINDEF / DSO/DSTA</th>
<th>Number of projects awarded</th>
<th>Amount awarded (inclusive of RSS and indirect costs, $M)</th>
<th>Success Rate (no. of projects awarded / no. of proposals submitted, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive basis</td>
<td>11</td>
<td>8</td>
<td>3.83</td>
<td>72.7</td>
</tr>
<tr>
<td>Non-competitive basis</td>
<td>NA</td>
<td>45</td>
<td>37.73</td>
<td>NA</td>
</tr>
</tbody>
</table>
### Technology Disclosures submitted - Profile (1995 - 2008)

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Technology Disclosures</th>
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<tbody>
<tr>
<td>2008</td>
<td>81</td>
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<tr>
<td>2007</td>
<td>82</td>
</tr>
<tr>
<td>2006</td>
<td>68</td>
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<td>91</td>
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<td>2004</td>
<td>74</td>
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<td>2003</td>
<td>56</td>
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<td>2002</td>
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- **NIE**: 2
- **MSE**: 15
- **MAE**: 19
- **CEE**: 2
- **SPMS**: 5
- **CED**: 1

**Legend**

- **CED**: Centre for Educational Development
- **CEE**: School of Civil and Environmental Engineering
- **EEE**: School of Electrical and Electronic Engineering
- **MAE**: School of Mechanical and Aerospace Engineering
- **MSE**: School of Materials Science and Engineering
- **NIE**: National Institute of Education
- **PWTC**: Positioning and Wireless Technology Centre
- **SBS**: School of Biological Sciences
- **SCBE**: School of Chemical and Biomedical Engineering
- **SCE**: School of Computer Engineering
- **SPMS**: School of Physical and Mathematical Sciences
2. Output Measures (cont’d)

**Patents Filed & Granted - Profile (1995 - 2008)**

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3. Publications & Citations

3.1 Publications

List of 20 High Impact Factor Journals in which NTU has published articles in 2008

Source: Web of Science

1. Science
2. Progress in Materials Science
3. Nature Chemical Biology
4. PLOS Biology
5. Progress in Polymer Science
6. Journal of the American College of Cardiology
7. Molecular Pharmaceutics
8. Blood
10. Nano Letters
11. Proceedings of the National Academy of Sciences of the United States of America
12. Molecular & Cellular Proteomics
13. PLOS Pathogens
14. Embo Journal
15. Advanced Materials
16. Journal of the American Chemical Society
17. Trends in Biotechnology
18. Advanced Functional Materials
19. Journal of Neuroscience
20. Development
3.1 Publications (cont’d)

Top 20 Articles published in 2008 (listed by Times Cited)


3.2 Citations

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## Institution Rankings in Materials Science

### World’s Top 30 Institution Rankings in Materials Science by Citations

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<th>Research Staff</th>
</tr>
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<td>34</td>
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<td>11</td>
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<td>8</td>
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<td>4</td>
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<td>20</td>
<td>120</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>1019</strong></td>
<td><strong>96</strong></td>
<td><strong>143</strong></td>
<td><strong>908</strong></td>
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**Faculty Staff as at 15 Nov 2008**

**Research Staff as at 15 Nov 2008**
## 5. Research Graduate Student Strength

### 5.1 Enrolment

<table>
<thead>
<tr>
<th>School</th>
<th>PhD</th>
<th>MAS</th>
<th>Total Research</th>
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<tbody>
<tr>
<td>College of Business (Nanyang Business School)</td>
<td>47</td>
<td>11</td>
<td>58</td>
</tr>
<tr>
<td>S. Rajaratnam School of International Studies</td>
<td>1</td>
<td>0</td>
<td>1</td>
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<tr>
<td>School of Biological Sciences</td>
<td>141</td>
<td>34</td>
<td>175</td>
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<tr>
<td>School of Chemical and Biomedical Engineering</td>
<td>145</td>
<td>2</td>
<td>147</td>
</tr>
<tr>
<td>School of Civil and Environmental Engineering</td>
<td>130</td>
<td>21</td>
<td>151</td>
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<tr>
<td>School of Computer Engineering</td>
<td>210</td>
<td>61</td>
<td>271</td>
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<tr>
<td>School of Electrical &amp; Electronic Engineering</td>
<td>437</td>
<td>170</td>
<td>607</td>
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<tr>
<td>School of Humanities and Social Sciences</td>
<td>32</td>
<td>3</td>
<td>35</td>
</tr>
<tr>
<td>School of Materials Science &amp; Engineering</td>
<td>130</td>
<td>68</td>
<td>198</td>
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<tr>
<td>School of Mechanical &amp; Aerospace Engineering</td>
<td>247</td>
<td>57</td>
<td>304</td>
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<tr>
<td>School of Physical &amp; Mathematical Sciences</td>
<td>171</td>
<td>6</td>
<td>177</td>
</tr>
<tr>
<td>Singapore-MIT Alliance Programme</td>
<td>23</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>Wee Kim Wee School of Communication and Information</td>
<td>14</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>Grand Total</td>
<td>1732</td>
<td>442</td>
<td>2174</td>
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</tbody>
</table>

Research Graduate Students: Enrolment AY2008 by School & Course Type

Grand Total: 2174 (PhD) + 344 (MAS) = 2518

![Bar chart showing enrolment by school and course type](chart.png)
### Research Students - Official Enrolment AY2008 by Course Type and Nationality

<table>
<thead>
<tr>
<th>School</th>
<th>Full-Time</th>
<th>Part-Time</th>
<th>Grand Total</th>
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</thead>
<tbody>
<tr>
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<td>SPR</td>
<td>FS</td>
</tr>
<tr>
<td>MAS</td>
<td>65</td>
<td>11</td>
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</tr>
<tr>
<td>PHD</td>
<td>215</td>
<td>180</td>
<td>1337</td>
</tr>
<tr>
<td>Grand Total</td>
<td>280</td>
<td>191</td>
<td>1502</td>
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</tbody>
</table>

### Research Graduate Students:

Enrolment AY2008 by Nationality

- Singapore Permanent Resident, 18%
- Singapore Citizen, 17%
- Foreign Student, 65%
## 5.2 Intake

### Research Students - Intake AY2008 (1st Intake) by Department and Course Type

<table>
<thead>
<tr>
<th>School</th>
<th>PhD</th>
<th>MAS</th>
<th>Total Research</th>
</tr>
</thead>
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<tr>
<td></td>
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<td>P</td>
<td>T</td>
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<tr>
<td>College of Business (Nanyang Business School)</td>
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<td>4</td>
<td>18</td>
</tr>
<tr>
<td>S. Rajaratnam School of International Studies</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>School of Biological Sciences</td>
<td>30</td>
<td>5</td>
<td>35</td>
</tr>
<tr>
<td>School of Chemical and Biomedical Engineering</td>
<td>32</td>
<td>0</td>
<td>32</td>
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<tr>
<td>School of Civil and Environmental Engineering</td>
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<td>4</td>
<td>33</td>
</tr>
<tr>
<td>School of Computer Engineering</td>
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<td>2</td>
<td>61</td>
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<td>School of Electrical &amp; Electronic Engineering</td>
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<td>113</td>
</tr>
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<td>School of Humanities and Social Sciences</td>
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<td>0</td>
<td>8</td>
</tr>
<tr>
<td>School of Materials Science &amp; Engineering</td>
<td>33</td>
<td>7</td>
<td>40</td>
</tr>
<tr>
<td>School of Mechanical &amp; Aerospace Engineering</td>
<td>67</td>
<td>4</td>
<td>71</td>
</tr>
<tr>
<td>School of Physical &amp; Mathematical Sciences</td>
<td>46</td>
<td>1</td>
<td>47</td>
</tr>
<tr>
<td>Singapore-MIT Alliance Programme</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Wee Kim Wee School of Communication and Information</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>440</td>
<td>30</td>
<td>470</td>
</tr>
</tbody>
</table>

**Grand Total:** 470 (PhD) + 48 (MAS) = 518

### Research Graduate Students: Intake AY2008 by School & Course Type

#### Graph

- **No. of students**
- **Schools**: NBS, RSIS, SBS, SCBE, CEE, SCE, EEE, HSS, MSE, MAE, SPMS, SMA, WKWSCI
- **PhD Students**
- **MAS Students**

**Grand Total:** 470 (PhD) + 48 (MAS) = 518
5.2 Intake (cont’d)

### Research Students - Intake AY2008 (1st Intake)* - By Course Type and Nationality

<table>
<thead>
<tr>
<th>Course Type</th>
<th>Full-Time</th>
<th>Part-Time</th>
<th>Grand Total</th>
</tr>
</thead>
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<td>SPR</td>
<td>FS</td>
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<tr>
<td>MAS</td>
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<td>1</td>
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<tr>
<td>PHD</td>
<td>51</td>
<td>19</td>
<td>370</td>
</tr>
<tr>
<td>Grand Total</td>
<td>58</td>
<td>20</td>
<td>401</td>
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</tbody>
</table>

* Figures for the 2nd intake are not available as it starts only in January 2009

### Research Graduate Students: Intake AY2008 by Nationality

- Singapore Citizen, 15%
- Foreign Student, 80%
- Singapore Permanent Resident, 5%

5.3 Trend - Enrolment, Intake, Graduate

<table>
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<tr>
<th></th>
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<th></th>
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</thead>
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<td>192</td>
<td>268</td>
<td>230</td>
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<td>532</td>
<td>701</td>
<td>433</td>
<td>368</td>
<td>700</td>
<td>682</td>
<td>435</td>
<td>264</td>
<td>463</td>
<td>631</td>
<td>719</td>
<td>518</td>
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<td>204</td>
<td>338</td>
<td>524</td>
<td>593</td>
<td>695</td>
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<td>1472</td>
<td>1405</td>
<td>1329</td>
<td>1615</td>
<td>1705</td>
<td>1793</td>
<td>1809</td>
<td>2060</td>
<td>2262</td>
<td>2518</td>
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<tr>
<td>Graduate</td>
<td>34</td>
<td>35</td>
<td>50</td>
<td>93</td>
<td>154</td>
<td>180</td>
<td>168</td>
<td>337</td>
<td>366</td>
<td>450</td>
<td>295</td>
<td>205</td>
<td>327</td>
<td>329</td>
<td>372</td>
<td>368</td>
<td>87</td>
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</tbody>
</table>

* For Intake - Number is for 1st intake only. Number for the 2nd intake is not available as it starts only in January 2009
* For Graduate - Number is as at 26 November 2008 (Convocation 2009). The full number will be available after July 2009
The pursuit of learning is the life blood of a university. In NTU, faculty and students have created a thriving environment and culture of teaching, learning and research. The NTU Research Support Office (RSO) strives to contribute to this vitality and vibrancy of university life by facilitating and coordinating numerous programmes, initiatives and activities that pertain to research.
NTU Research Support Office (RSO)

Role of RSO

Nanyang Technological University (NTU) has invested heavily in research, with some of the best laboratories and research centres in the world. Both students and staff enjoy a host of opportunities for research in a vibrant multidisciplinary environment. To support and cultivate a culture of excellence in research, the NTU Research Support Office (RSO) was set up with the purpose of facilitating and coordinating the numerous research programmes, initiatives and activities that are available.

Functions of RSO

RSO reports to the Provost and is responsible for research related matters in NTU.

The office serves as the key focus for interaction with external funding bodies, acting as the main contact point, liaising between external funding bodies and schools within NTU.

As the main information point for all research funding opportunities – national, regional and global – available to NTU, RSO monitors the progress of such research opportunities and notifies the Schools of the issuance of grant calls.

RSO also promotes NTU responses to the various research opportunities, such as by organising information sessions, workshops and meeting sessions for Principal Investigators (PIs).

As a service to the Schools, RSO provides support and advice to faculty in preparation of proposals and during project duration, including:

- Coordination and submission of research proposals for external competitive funding opportunities;
- Coordination and submission of scientific progress reports and finance reports during project duration;
- Review and ranking of proposals for specific opportunities, through the NTU review system and working with the Chair of the Peer Review Panel.

In addition, RSO provides information and statistics on the research output of NTU to the University management and external funding bodies.

Hereunder are the organisation chart and overview of the projects handled by the office:
<table>
<thead>
<tr>
<th>Staff</th>
<th>Designation</th>
<th>Contact</th>
<th>Job Responsibilities</th>
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<tbody>
<tr>
<td>Assoc Prof Tjin Swee Chuan</td>
<td>Director, RSO</td>
<td><a href="mailto:D-RSO@ntu.edu.sg">D-RSO@ntu.edu.sg</a></td>
<td>Directs and oversees the activities of the entire office.</td>
</tr>
</tbody>
</table>
| Ms Valerie Loh Wai Kuan  | Manager           | valeriel@ntu.edu.sg        | - National Research Foundation (NRF) Grants  
- Clean Energy Research Program (CERP)  
- Competitive Research Program (CRP)  
- Environment & Water Institute Development Council (EWI)  
- Lee Kuan Yew (LKY) Fellowship SUGs  
- National Medical Research Council Grants (NMRC)  
- Exploratory/ Developmental Grant (EDG)  
- Individual Research Grant (IRG)  
- New Investigator Grant (NIG)  
- Neptune Orient Lines (NOL)  
- R&D on Interactive Digital Media (IDM) in Education  
- East Asia and Pacific Summer Institutes (EAPSI) Program |
| Ms Joanne Liang Mingzhu  | Executive Officer | mzliang@ntu.edu.sg         |                                                                                                                                                      |
| Ms Adeline Tan Dro Dro    | Manager           | ddtan@ntu.edu.sg           | - Ministry of Education (MOE) Grants  
- Tier 1, Tier 2  
- Agency for Science, Technology and Research (A*STAR) Grants  
- Ministry of National Development (MND) Grants  
- Media Development Authority (MDA) Grants  
- Review Research Centres  
- Rolls-Royce Grants |
<p>| Ms Jesmine Yeo Mui Siam   | Executive Officer | <a href="mailto:jesmineyeo@ntu.edu.sg">jesmineyeo@ntu.edu.sg</a>      |                                                                                                                                                      |</p>
<table>
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<th>Staff</th>
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<tr>
<td>Ms Lee Siew Leng</td>
<td>Manager</td>
<td><a href="mailto:leesl@ntu.edu.sg">leesl@ntu.edu.sg</a></td>
<td>• Budgeting</td>
</tr>
<tr>
<td>Ms Frances Tang Po Tim</td>
<td>Higher Executive Officer</td>
<td><a href="mailto:epttang@ntu.edu.sg">epttang@ntu.edu.sg</a></td>
<td>• Tier 1 Projects</td>
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<td>• Progress and Completed Reports</td>
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<td>• Coordination of Audit Exercise as requested by Funding Agency</td>
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<tr>
<td></td>
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<td></td>
<td>• Research Statistics (Grant Awards)</td>
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<tr>
<td>Ms Yennie Kadarusman</td>
<td>Assistant Manager</td>
<td><a href="mailto:ykadarusman@ntu.edu.sg">ykadarusman@ntu.edu.sg</a></td>
<td>• Events / Visits</td>
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<td>• Research Related Publications</td>
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<td>• Nanyang Awards (Research &amp; Innovations)</td>
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<td>• Tan Chin Tuan (TCT) Exchange Fellowship in Engineering</td>
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<td>• Young Defence Scientists Programme (YDSP)</td>
</tr>
<tr>
<td>Ms Jane Ang Yi Ling</td>
<td>Executive Officer</td>
<td><a href="mailto:janeang@ntu.edu.sg">janeang@ntu.edu.sg</a></td>
<td>• Research Information Management System (RIMS)</td>
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<td>• Research Drivers</td>
</tr>
<tr>
<td>Ms Ketut Nita Santoso</td>
<td>Research Associate</td>
<td><a href="mailto:ketut@ntu.edu.sg">ketut@ntu.edu.sg</a></td>
<td>• MINDEF Project</td>
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<td>• JSPS (JSPS) Project</td>
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<td></td>
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<td>• Director Rolebase</td>
</tr>
<tr>
<td>Ms Toh Han Wei</td>
<td>PA to Director</td>
<td><a href="mailto:hwtoh@ntu.edu.sg">hwtoh@ntu.edu.sg</a></td>
<td></td>
</tr>
</tbody>
</table>
Contacts

College of Engineering
College of Science
Nanyang Business School
College of Humanities, Arts & Social Sciences
Autonomous Institutes
Research Institutes
Contacts

College of Engineering
Prof Pan Tso-Chien, Dean

Schools under College of Engineering:

- Chemical and Biomedical Engineering (SCBE)
  Prof Ching Chi Bun, Chair
    - Chemical and Biomolecular Engineering
      Block N1.2 B3-13, 62 Nanyang Drive, Singapore 637459
      Tel: (65) 6790 6742
      Fax: (65) 6794 7553
      Website: http://www.ntu.edu.sg/scbe/cbe
    - Bioengineering
      Block N1.3 B5-01, 70 Nanyang Avenue, Singapore 637457
      Tel: (65) 6790 6741
      Fax: (65) 6791 1761
      Website: http://www.ntu.edu.sg/scbe/bioe

- Civil and Environmental Engineering (CEE)
  Block N1, Nanyang Avenue, Singapore 639798
  Tel: (65) 6790 5265
  Fax: (65) 6791 0676
  Website: http://www.ntu.edu.sg/cee
  Assoc Prof Edmond Lo, Chair

- Computer Engineering (SCE)
  Block N4, Nanyang Avenue 639798
  Tel: (65) 6790 5786
  Fax: (65) 6792 6559
  Website: http://www.ntu.edu.sg/sce
  Prof Angela Goh Eck Soong, Acting Chair

- Electrical and Electronic Engineering (EEE)
  Block S1, 50 Nanyang Avenue, Singapore 639798
  Tel: (65) 6791 1744
  Fax: (65) 6793 3318
  Website: http://www.ntu.edu.sg/eee
  Prof Kam Chan Him, Chair

- Materials Science and Engineering (MSE)
  Block N4.1, Nanyang Avenue, Singapore 639798
  Tel: (65) 6790 4586
  Fax: (65) 6790 9081
  Website: http://www.ntu.edu.sg/mse
  Prof Freddy Boey Yin Chiang, Chair

- Mechanical and Aerospace Engineering (MAE)
  Block N3, 50 Nanyang Avenue, Singapore 639798
  Tel: (65) 6790 5487
  Fax: (65) 6792 4062
  Website: http://www.ntu.edu.sg/mae
  Prof Ling Shih Fu, Chair

College of Science
Prof Lee Soo Ying, Dean

Schools under College of Science:

- Biological Sciences (SBS)
  60 Nanyang Drive, Singapore 637515
  Tel: (65) 6316 2801
  Fax: (65) 6791 3856
  Website: http://www.ntu.edu.sg/sbs
  Prof Alex Law, Acting Chair

- Physical and Mathematical Sciences (SPMS)
  1 Nanyang Walk, Singapore 637616
  Tel: (65) 6790 3711
  Fax: (65) 6316 6984
  Website: http://www.ntu.edu.sg/spms
  Prof Ling San, Chair

Nanyang Business School
Nanyang Avenue, Singapore 639798
Tel: (65) 6790 5692
Fax: (65) 6791 3697
Website: http://www.nbs.ntu.edu.sg
Prof Gillian Yeo Hian Heng, Interim Dean
College of Humanities, Arts, & Social Sciences
Prof Lawrence Wong Wang-Chi, Dean

Schools under College of Humanities, Arts, & Social Sciences:

- Art, Design, and Media (ADM)
  #4-19, 31 Nanyang Link, Singapore 637718
  Tel: (65) 6790 6667
  Fax: (65) 6795 3140
  Website: http://www.ntu.edu.sg/adm
  Assoc Prof Suresh Sethi, Acting Chair

- Wee Kim Wee School of Communication and Information (SCI)
  31 Nanyang Link, Singapore 637718
  Tel: (65) 6790 4577
  Fax: (65) 6791 5214
  Website: http://www.ntu.edu.sg/sci
  Assoc Prof Benjamin Detenber, Chair

- Humanities and Social Sciences (HSS)
  Nanyang Avenue, Singapore 639798
  Tel: (65) 6790 6450
  Fax: (65) 6794 2830
  Website: http://www.hss.ntu.edu.sg/
  Prof Euston Quah, Acting Chair

Autonomous Institutes

- National Institute of Education (NIE)
  1 Nanyang Walk, Singapore 637616
  Tel: (65) 6790 3869
  Fax: (65) 6896 9446
  Website: http://www.nie.edu.sg/
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