SMA Logo

The red dot, completing the alphabet "A", signifies the entrepreneurial spirit, which SMA sets out to inculcate among its students. The blue circle represents the stylised globe, the collaboration and link halfway round the world between Singapore and MIT, and also depicts the use of interactive distance education technology as a new tool for education and research.

Front Cover Design Concept

The band around the globe, draws parallel to that in the SMA logo and symbolises the global perspective that SMA adopts for its programmes. The finger pointing on the globe appears to be starting the ripples of innovative and creative energy and sending them around the globe. The energy then spreads all over and its effects of which will self-multiply. The globe exudes a faintly glowing aura that shows abstract images of science and technology. A refreshing blue is used for the overall colour scheme. Blue is the colour of the world as seen from outer space and is also taken to symbolise the intellect and academia.

The benefits that SMA have brought, and will continue to bring, to our universities and to Singapore as a whole, are clear. Already, SMA has done well in attracting and retaining the best of regional talent, thus facilitating our development of human capital for the New Economy. The SMA has also generated an exciting ecosystem of research and idea creation through close links with our research institutes, industry partners, and other programmes within NUS and NTU. Singapore's effort to spearhead our competitive advantage in the global marketplace through the creation of new frontiers in tomorrow's science and technology will certainly be given a boost by SMA.

Dr Tony Tan Keng Yam
Deputy Prime Minister and Minister for Defence
Singapore

Preamble •────────────────────

The SMA Annual Report 2001/2002 documents SMA's initiatives and effort made during the past year and serves to inform the Ministry of Education (MOE), Agency of Science, Technology and Research (A*STAR), participating academic departments of National University of Singapore (NUS), Nanyang Technological University (NTU), Massachusetts Institute of Technology (MIT), SMA students, SMA Alumni, SMA Fellows, Associates and Research Fellows and members of industry of these developments.
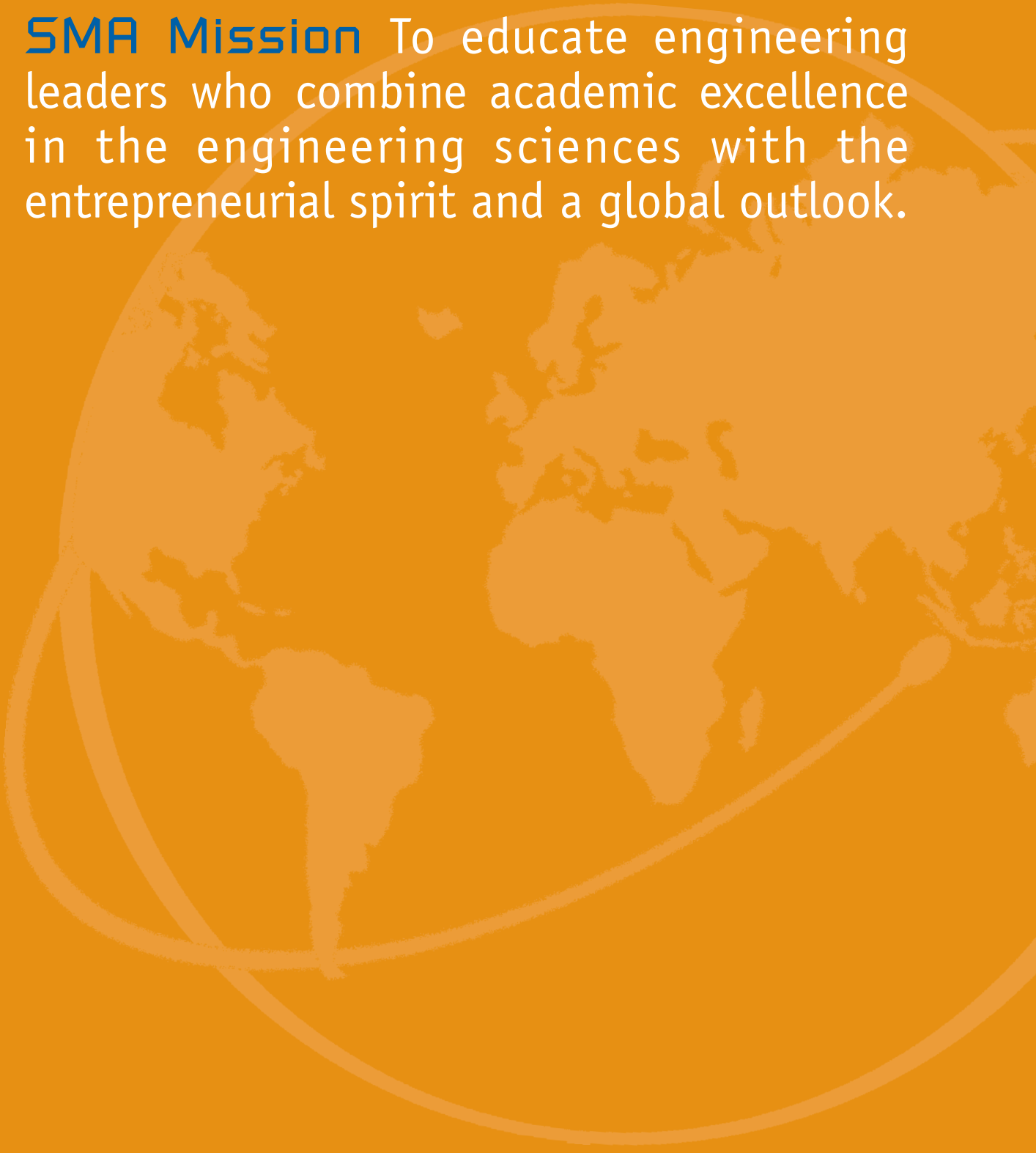
Contents

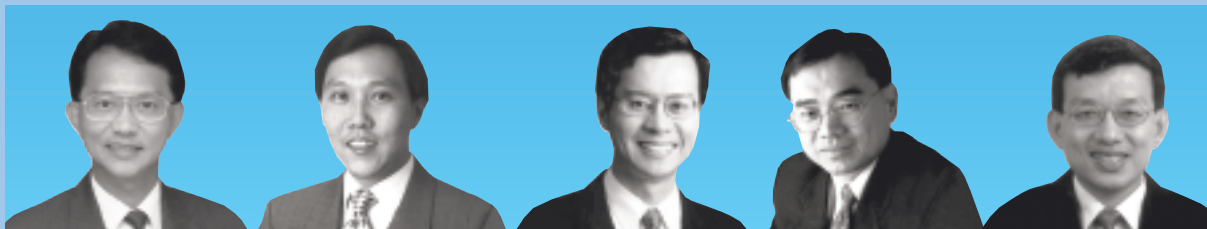**SMA Vision** To place SMA programmes at the forefront of graduate education in Asia and the world.

SMA Mission To educate engineering leaders who combine academic excellence in the engineering sciences with the entrepreneurial spirit and a global outlook.

Singapore-MIT Alliance Governing Board Members

(In Singapore)

1. **Mr Lim Hock San**
   Chairman,
   Governing Board,
   Singapore-MIT Alliance

   President & CEO,
   United Industrial Corporation Ltd

2. **Prof Andrew Nee Yeh Ching**
   Co-Director,
   Singapore-MIT Alliance

   Professor,
   Department of Mechanical
   Engineering,
   National University of Singapore

3. **Provost Chong Chi Tat**
   Deputy President & Provost,
   National University of Singapore

4. **Prof Lim Mong King**
   Deputy President,
   Nanyang Technological University

5. **Mr Chan Yeng Kit**
   Deputy Secretary – Policy,
   Ministry of Education

6. **Prof Hang Chang Chieh**
   Executive Deputy Chairman,
   Agency for Science, Technology
   and Research (A*STAR)

7. **Mr Andy Lim**
   President,
   Moneyworld Group of Companies

8. **Mr Ko Kheng Hwa**
   Managing Director,
   Economic Development Board

9. **Mr Phua Han Tian**
   Managing Director,
   Btg Consulting

10. **Mr Ho Meng Kit**
    (with effect from 1st Oct '02)
    Deputy Secretary - Industry,
    Ministry of Trade and Industry

11. **Mr Tan Chek Ming**
    (with effect from 1st Oct '02)
    Assistant Managing Director,
    Economic Development Board

12. **Dr Paul D. Rosso**
    (with effect from 1st Oct '02)
    Regional Managing Director
    (South and Southeast Asia),
    3M Asia Pacific Pte Ltd

13. **Mr Low Kee Tuan**
    (with effect from 1st Oct '02)
    General Manager,
    Hewlett Packard Consulting

(At MIT)

14. **Prof Anthony T. Patera**
    Co-Director,
    Singapore-MIT Alliance

    Professor,
    Mechanical Engineering
    Department,
    Massachusetts Institute of
    Technology

15. **Prof Robert A. Brown**
    Provost,
    Massachusetts Institute of
    Technology

16. **Prof Thomas L. Magnanti**
    Dean,
    School of Engineering,
    Massachusetts Institute of
    Technology

Singapore-MIT Alliance Joint Academic Committee Members

1   2   3   4

5   6   7   8

(In Singapore)

1. **Prof Andrew Nee Yeh Ching**
   Co-Director,
   Singapore-MIT Alliance

   Professor,
   Department of Mechanical
   Engineering,
   National University of Singapore

2. **Prof Lim Mong King**
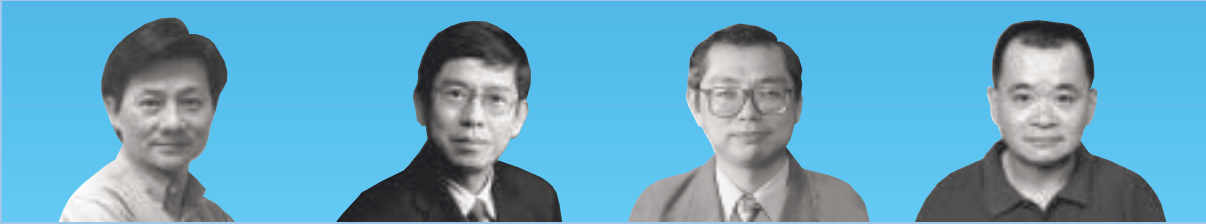   Deputy President,
   Nanyang Technological University

3. **Prof Ng Wun Jern**
   Dean,
   Faculty of Engineering,
   National University of Singapore

4. **Prof Joxan Jaffar**
   Dean,
   School of Computing,
   National University of Singapore

5. **Prof Lai Choy Heng**
   Dean,
   Faculty of Science,
   National University of Singapore

(At MIT)

6. **Prof Anthony T. Patera**
   Co-Director,
   Singapore-MIT Alliance

   Professor,
   Mechanical Engineering Department,
   Massachusetts Institute of
   Technology

7. **Prof Steven R. Lerman**
   Deputy Co-Director,
   Singapore-MIT Alliance

   Professor,
   Civil and Environmental
   Engineering Department,
   Massachusetts Institute of
   Technology

8. **Prof Thomas L. Magnanti**
   Dean,
   School of Engineering,
   Massachusetts Institute of
   Technology

Singapore-MIT Alliance Directors' Office

1   2   3   4

(In Singapore)

1. **Prof Andrew Nee Yeh Ching**
   Co-Director,
   Singapore-MIT Alliance

   Professor,
   Department of Mechanical Engineering,
   National University of Singapore

2. **Prof Chua Soo Jin**
   Deputy Co-Director,
   Singapore-MIT Alliance

   Professor,
   Department of Electrical and
   Computer Engineering,
   National University of Singapore

   Director,
   Opto & Electronic System Cluster,
   Institute of Materials Research
   and Engineering

(At MIT)

3. **Prof Anthony T. Patera**
   Co-Director,
   Singapore-MIT Alliance

   Professor,
   Mechanical Engineering Department,
   Massachusetts Institute of
   Technology

4. **Prof Steven R. Lerman**
   Deputy Co-Director,
   Singapore-MIT Alliance

   Professor,
   Civil and Environmental
   Engineering Department,
   Massachusetts Institute of
   Technology

Singapore-MIT Alliance Programme Co-Chairs

Advanced Materials for Micro- and Nano-Systems (AMM&NS)

1. **Assoc Prof Choi Wee Kiong**
   Programme Co-Chair (Singapore)

2. **Prof Carl V. Thompson**
   Programme Co-Chair (MIT)

High Performance Computation for Engineered Systems (HPCES)

3. **Assoc Prof Khoo Boo Cheong**
   Programme Co-Chair (Singapore)

4. **Prof Jaime Peraire**
   Programme Co-Chair (MIT)

Innovation in Manufacturing Systems and Technology (IMST)

5. **Prof Yue Chee Yoon**
   Programme Co-Chair (Singapore)

6. **Prof David E. Hardt**
   Programme Co-Chair (MIT)

Molecular Engineering of Biological and Chemical Systems (MEBCS)

7. **Prof Yap G. S. Miranda**
   Programme Co-Chair (Singapore)

8. **Prof Jackie Y. Ying**
   Programme Co-Chair (MIT)

Computer Science (CS)

9. **Assoc Prof Leong Tze Yun**
   Programme Co-Chair (Singapore)

10. **Prof Charles Leiserson**
    Programme Co-Chair (MIT)

Messages

Chairman's Message

"With the high quality of SMA students and an outstanding faculty of SMA Fellows, SMA is fulfilling its vision to be a global university - a global knowledge enterprise and a university of global significance for MIT, NUS and NTU respectively."

With the introduction of two new programmes, viz Molecular Engineering in Biological and Chemical Systems and Computer Science this past year, SMA operates for the first time the full slate of five programmes. Four of the SMA programmes are hosted by NUS and the other by NTU. There are 181 students in residence. The quality of the students is ensured through the rigorous selection jointly conducted by both the MIT and Singapore SMA Fellows.

With the increase in the number of students, two additional facilities for the live beaming of lectures were set up at NUS, with two more rooms equipped for research interaction. These state-of-the-art facilities were also put to good use in the live beaming of seminars by Nobel laureates from MIT to audiences at both NUS and NTU. Outreach programmes were launched with a Music Master Class held between MIT and the Music and Drama Centre of NUS and a simulcast between NUS and MIT. Such outreach events are open to the public and serve to bring the MIT culture across to a wider audience in Singapore. We are proud

that to date, SMA is the largest interactive distance education collaboration in the world using state-of-the-art facilities to achieve interaction across twelve time zones as one single community in pursuit of knowledge.

With the full academic programmes in place, the SMA Fellows are now focusing on developing research and in increasing the number of Ph.D. students. To further promote research interaction, the SMA Annual Symposium, which was held in January saw the participation of the MIT Professors together with some of their graduate students. The presence of MIT President Charles Vest, Chancellor Clay and Provost Brown at the Symposium demonstrates the commitment of MIT in fulfilling the vision of SMA to be a global university - a global knowledge enterprise and a university of global significance for MIT, NUS and NTU respectively. Through SMA, NUS and NTU will have the opportunity to adapt and improve on the best MIT institutional practices on research and education.

Research institutes and industry in Singapore will also be the beneficiaries of the SMA as they participate in the SMA Industry Consortium (SMAIC). These organisations and their staff will have access to the recorded lectures and lecture materials, be invited to participate in outreach seminars, as well as involve SMA students in their relevant research projects.

With the high quality of SMA students and an outstanding faculty of SMA Fellows, SMA represents a partnership of graduate science and engineering education and research in a globalised economy.

Mr Lim Hock San
Chairman
SMA Governing Board

Co-Director's (Singapore) Message

"SMA has had a very good head start. This momentum will be upheld and further strengthened in years ahead."

The success of an academic programme depends on a number of crucial factors. The outstanding reputation of the university and its faculties, and the high calibre of its students are the two major elements. For a new programme, it is the former that provides the pull factor. Other enabling factors include excellent infrastructure, strong technical support and a conducive learning environment. The Singapore-MIT Alliance (SMA) Programme, started in 1999, has met all of the above criteria. Over a relatively short period of just over three years, the Programme has attracted top students from the region and beyond and has firmly entrenched itself as one of the best graduate programmes in the world. However, even with all these elements in place, without strong leadership, the Programme would not have been what it is today. This address will be totally incomplete without giving due credit to Professor Hang Chang Chieh, the first Singapore Co-Director of the Programme, for his vision and dedication in guiding SMA through its formative years. The Chairman, Members of the Governing Board and Professor Lam Khin Yong, the former Singapore Deputy Co-Director have played equally pivotal roles and provided their unfailing support.

As SMA enters into its fourth year of operation, it is important to reflect on what we have achieved and determine where we should be heading.

1) Research

All the five graduate programmes and their curricula have been firmly established over the last three years, with research beginning to take on a much stronger emphasis. Faculties have clearly defined joint research as the next most important activity. During the three years of close interaction with MIT faculties, the NUS and NTU faculties as well as the researchers at the National Research Institutes (NRIs) have developed a deep understanding of one another's research strengths and foci. Many joint research projects and co-supervision of Ph.D. students are already in place. Large flagship research projects will clearly be the next phase of SMA's natural development. Without the initial co-teaching and co-development of the curricula and nurturing of relationships among the faculties of the three partner universities and the NRIs, this would not have been possible.

2) Organisational learning

MIT's standing as one of the world's premier tertiary institutions is anchored upon several major thrusts which include education, research and commercialisation. For NUS and NTU to be global and world-class universities, it would be most beneficial to learn from the success factors of our partner university. Through the close interaction of Singapore fellows with the MIT faculties, many of the best practices are shared with one another. A systematic examination and dissemination of such traits and practices among the local tertiary institutions would enable us to leap-frog and benefit from one of the best academic systems in the world.

3) Industry relations

Close working relationship with industry is one of the most important factors of any engineering- and science-based programmes. Industry can be a leader in science and technology in many respects. Having joint projects with industry is an important feature of the SMA Programme, especially for the Professional Master's Programme. The SMA Industry Consortium (SMAIC) was set up last year. Through this effort, we are able to attract companies to join the Consortium as its members. By providing opportunities for interaction through regular seminars, talks, projects and co-supervision of Ph.D. students, SMA has lent itself as the scientific and research partner of many companies while at the same time becoming an excellent source of top-notch talent.

4) Strong alumni

Strong alumni bonds are one of the most powerful sources of support for a world-class university. The SMA Alumni has been firmly established and it is most heartening to witness the strong networking among SMA graduates from various parts of South East Asia and the SMA faculties. This would not have been possible without the strong support of the Singapore MIT Club.

SMA has had a very good head start. This momentum will be upheld and further strengthened in years ahead.

Professor Andrew Nee Yeh Ching
Co-Director (Singapore)

Co-Director's (MIT) Message

"They said SMA could not be done. But it can be done. And it has been done. And it is the SMA students who did it."

When SMA was first proposed, there were many doubters at MIT, including many of us involved in SMA today.

They, in fact we, said that Singapore was very far away from MIT. And They were very right.

They said that distance-education technology is not yet (and may never be) perfect, and will on occasion prove intrusive or inadequate. And They were right.

They said that face-to-face interactions will always be necessary, even in a predominantly distance-education program. And They were right.

They said that meaningful research collaborations can not be developed overnight, in particular at 12,000 miles. And They were right.

But also...

They said that SMA would benefit only a few at MIT. There are those that would disagree: 71% of the MIT students in Cambridge who take MIT SMA courses have MIT advisors that are *not* associated with SMA.

They said that distance education would distract and detract from the MIT residential experience. There are those that would disagree: 89% of the MIT students in Cambridge who take MIT SMA courses find these MIT SMA courses as good as, or better than, their MIT *non*-SMA courses.

They said that distance education would be less interactive, a poor replica of MIT's residential model of high-contact, highly interactive, student-faculty exchange. There are those that would disagree: 70% of the SMA students who have attended both MIT classes at a distance (in Singapore) *and* MIT classes in Cambridge find that posing in-class questions to their MIT professor is *as easy* at a distance as face-to-face.

They said that MIT courses at a distance would simply be not as good as MIT courses on the MIT campus. There are those that would disagree: 90% of the SMA students who have attended both MIT classes at a distance *and* MIT classes in Cambridge state that they learned the material *just as well* at a distance.

It *is* true that students enjoyed the MIT classes in Cambridge more than the MIT classes at a distance; and it *is* true that there is much more to the residential experience than just classwork; and it *is* true that only very limited data on distance-mediated research is currently available – with no obvious conclusions. Furthermore, it *is* true that the statistics quoted above are based on small samples, and that cause and effect are not yet entirely understood. In short, we can certainly not conclude that all that MIT stands for, and insists upon, can be preserved at a distance.

But one thing *is* clear.

They said SMA could not be done. But it can be done. And it has been done. And it is the SMA students who did it.

Professor Anthony T. Patera
Co-Director (MIT)

History

1. Massachusetts Institute of Technology
2. National University of Singapore
3. Nanyang Technological University
4. The Signing Ceremony of the MOU between MIT, NUS and NTU in 1998

An important chapter of SMA's history was marked with the signing of the Memorandum of Understanding between the Massachusetts Institute of Technology (MIT), the National University of Singapore (NUS) and Nanyang Technological University (NTU) on 3 November 1998.

SMA is MIT's unprecedented effort to collaborate with universities beyond the United States. It was established with the aim to promote global science and engineering education and research. Drawing the combined resources of the three premier academic institutions, SMA is the world's largest interactive distance education initiative, offering its students access to vastly rich faculty expertise and world-class research facilities.

The teaching programmes were launched in stages. The programmes in Advanced Materials for Micro- and Nano-Systems (AMM&NS) and the High Performance Computation for Engineered Systems (HPCES) were launched in July 1999, followed by the Innovation in Manufacturing Systems and Technology (IMST) programme in July 2000 and both the Molecular Engineering of Biological and Chemical Systems (MEBCS) and Computer Science (CS) in July 2001.

SMA had its first enrolment of 63 students, both local and from around Asia in July 1999. This increased to 69 in July 2000 and 149 in July 2001. From the total of 281 students enrolled, 248 students have graduated, 26 students are on the direct research track while the remaining students have decided to do their Doctor of Philosophy (Ph.D.) after receiving their Professional Master's (S.M.) degree.

Programmes
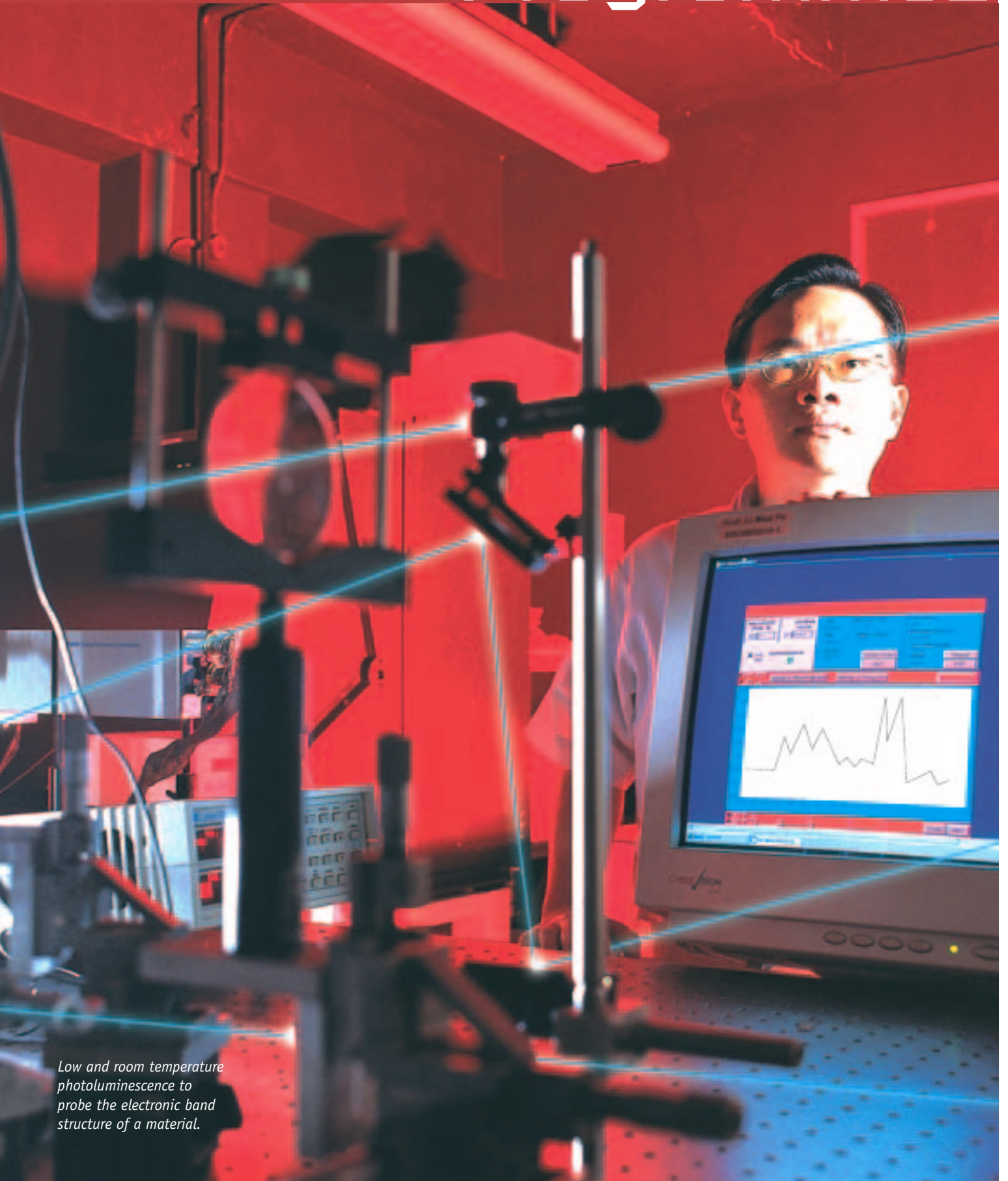
Low and room temperature photoluminescence to probe the electronic band structure of a material.

*Students using the
30-litre Microbial
Fermentor.*

SMA offers a total of five full-time programmes in:

- *Advanced Materials for Micro- and Nano-Systems (AMM&NS)*

- *High Performance Computation for Engineered Systems (HPCES)*

- *Innovation in Manufacturing Systems and Technology (IMST)*

- *Molecular Engineering of Biological and Chemical Systems (MEBCS)*

- *Computer Science (CS)*

Descriptions

Advanced Materials for Micro- and Nano-Systems (AMM&NS)

The Future of Modern Technologies >

The AMM&NS degree programme offers a comprehensive and intensive approach to a field of study that is rapidly defining the frontier of modern technologies. Students are exposed to the broad foundations of advanced materials that encompass processing, microstructure, properties and performance, with a particular emphasis on microelectronics applications. The preparation, characterisation and optimisation of materials comprise the core of this multi-disciplinary coursework, which prepares students for the challenges of a variety of advanced industrial problems. The AMM&NS degree programme also promotes concepts that are widely linked to critical advances in the science and engineering of materials.

The coursework provides an exceptional opportunity for research collaboration between SMA students, world-renowned faculties and industry experts. Students interact with scientists and engineers at a number of research institutes such as the Institute of Materials Research and Engineering (IMRE) and the Institute of Microelectronics (IME).

High Performance Computation for Engineered Systems (HPCES)

New Frontiers in High Performance Computation >

The HPCES degree programme is the most technologically advanced and critically acclaimed computational engineering coursework available in the world today. Through a powerful combination of state-of-the-art interactive distance learning technology and premier academic collaboration, the HPCES programme is graduating the very best, high performance computation professionals.

High performance computation for engineered systems is a crucial component in the modelling, simulation, design, optimisation, control and visualisation of engineered systems in a wide range of technology and service industries. HPCES courses promote creativity as well as hands-on experience in an effort to study the improvement of both product and systems design. The programme's unified approach combines engineering science and systems optimisation:

Engineering Science

A keen focus on modelling and simulating physical phenomena and product behaviour helps students to uncover shorter design cycles and improve functionality. Such virtual testing allows industries to design innovative, quality products with a minimum number of costly physical prototypes.

Systems Optimisation

Careful attention to modelling and designing complex systems allows students to identify optimal configurations for maximum operational performance. The study of efficient process automation and integration is also emphasised. Such virtual design tools are widely used by industries to construct innovative solutions to complex tactical and strategic decisions.

The SMA academic programmes are also unique in their close affiliation with the Institute of High Performance Computing (IHPC), a premier research institute in Singapore's Science Park. The IHPC specialises in research involving simulation and visualisation using advanced computational techniques. The Institute maintains close ties with the academia to undertake upstream research for the development of new technology and at the same time, supports local companies in industry-inspired research to enhance their capabilities and productivity.

Innovation in Manufacturing Systems and Technology (IMST)

Strategic Tools for Manufacturing Innovation >

The IMST degree programme offers highly competitive courses of study that explore the many facets of manufacturing technology. Challenging coursework integrates the process, product, system and business aspects of this vibrant industry while focusing on the core of manufacturing systems - the operational flow problems of the factory environment.

While staying firmly grounded in the engineering sciences, the advanced coursework exposes students to innovative theories and methodology as well as a rigorous investigation of financial, strategic and global aspects of technology innovation and new business generation.

Molecular Engineering of Biological and Chemical Systems (MEBCS)

A Unique Perspective on Molecular Engineering >

The MEBCS degree programme offers an exciting and innovative curriculum in the field of molecular engineering. Its innovative courses of study integrate a molecular-level understanding of biological and chemical phenomena with advances in process engineering for the life sciences and fine chemical industries. Coursework presents advanced engineering concepts that unite multiple length scales "molecular, microscopic and macroscopic" through a close coupling of biological and chemical sciences. Students are exposed to state-of-the-art concepts in structured fluids, surface functionalisation, microstructure tailoring and materials design in relation to fine chemicals and pharmaceutical synthesis. Students also study the molecular and cellular aspects of biotechnology, genomics, bioinformatics, proteomics, drug design and delivery that underlie advanced bioengineering.

MEBCS coursework provides a unique curriculum and a companion research programme that emphasises molecular engineering as it pertains to advanced materials synthesis and biotechnology. Classes and research are conducted collaboratively with the MIT faculty and SMA students will also have the opportunity to interact with scientists and engineers at a number of leading research institutes and centres such as the Institute of Molecular and Cell Biology (IMCB), Institute of Materials Research and Engineering (IMRE) and Bioprocessing Technology Centre (BTC), all of which are internationally renowned for their basic and applied R&D programmes.

Manufacturing of injection moulded parts for verification with simulation.

Computer Science (CS)

New Advances in a Thriving Discipline >

The CS degree programme offers an in-depth understanding of and appreciation for the rapidly growing field of computer science. The primary goal of the CS programme is to train students to discover and develop new technology with immediate economic impact while providing a solid foundation to enable adaptation. Students are exposed to the broad foundations of computer science, encompassing computer architecture, software systems, algorithms and advanced applications. Through a challenging and rigorous course of study and diverse interaction with industry leaders as well as young entrepreneurs, graduates will closely examine advanced developments in web applications and infrastructure, embedded systems and computational biology.

Professional Master (S.M.)

The S.M. degree programme takes one year to complete and combines coursework with project. The graduates provide industry with a pool of highly trained manpower quickly. The projects undertaken in the S.M. programme are of a collaborative and multi-disciplinary nature.

Doctor of Philosophy (Ph.D.)

The Ph.D. Degree takes between three to four years to complete and combines research with coursework. Their research topics are formulated through discussions with the Singapore and MIT Fellows. Each of the Ph.D. research projects is co-supervised by MIT and Singapore Fellows. The projects are worked out jointly and undertaken for their topical relevance and potential impact to industry in Singapore and the region.

SMA students interact with their MIT professors and counterparts in real time via videoconferencing.

Lecture in Singapore which was also beamed to MIT.

Teaching and Supervision

Approximately 50 professors from MIT and another 50 from NUS, NTU and the national research institutes (NRIs) are involved. They conduct courses and co-supervise the students in their research. Besides classes conducted in the usual face-to-face setting, SMA students attend lectures conducted through Internet2, enabled by state-of-the-art interactive distance learning technology, delivered by lecturers at MIT in real time. In addition, MIT Fellows spend up to a semester in Singapore each year.

MIT Fellows' visits to Singapore for teaching and research interaction during the period stated.

	AMM&NS Programme	*IMST Programme*	*MEBCS Programme*
Yr 2001 Summer/ Fall Terms	Assoc Prof Craig Carter Prof Gerbrand Ceder Prof Joel P. Clark Prof Eugene A. Fitzgerald	Prof Chun Jung-Hoon Prof Stephen Graves Prof Lawrence Wein Prof Kamal Youcef-Toumi	Prof Kenneth A. Smith Prof T. Alan Hatton
Yr 2002 Spring Term	Prof Clifton G. Fonstad	Prof David E. Hardt	Prof Gregory N. Stephanopoulos Prof Daniel I. C. Wang Prof Jackie Y. Ying

A CS recitation conducted via beaming.

Interactive Distance Education

The use of the Internet and computers for communication, web-based learning and net meetings for research interaction all form an important part of the learning environment at SMA.

SMA utilises state-of-the-art synchronous and asynchronous facilities to achieve seamless interaction between Singapore and MIT. Nine distance education facilities, as well as eight rooms equipped for research interaction, are established at MIT, NUS and NTU. Web-based experiments are part of the innovative efforts spearheaded at SMA whereby students in Singapore are able to manipulate electronic equipment and characterisation tools at MIT, through the Internet.

The Academic Media Production Services (AMPS) at MIT, the Centre for Educational Development (CED) at NTU, the Centre for Instructional Technology (CIT), the Centre for IT & Application (CITA) at the Faculty of Engineering and the School of Computing at NUS take on the role of providing technical assistance to ensure that the lectures are successfully beamed and delivered. Members from these departments constitute a joint technical committee, which is responsible for overseeing the interactive distance education technology.

Synchronous Platform

Lectures are delivered through Internet2, backed up with Integrated Services Digital Network (ISDN), together with state-of-the-art videoconferencing facilities. Internet2 is a high-speed broadband network platform that supports users from academic institutions, research organisations and industry, with the aim of facilitating research and development and advanced technology development.

The videoconferencing facilities, which have been specially designed to enhance the learning and teaching experience, include:

- Dual-Screen projection that allows the user at the foreign site (lecturer/student) to be viewed continuously on one screen and the lecturer's teaching materials on the other; and

- An audio system with auto-tracking camera that enables interactive verbal communication, allowing the lecturers and students to interact as they would like in a normal classroom setting. The voices and video images of the students at a remote end (at NUS, for example) are automatically sent to the lecturers at the other end at MIT.

These facilities enable SMA Fellows and students from MIT, NUS and NTU to conduct and participate in highly interactive settings without having to be physically present in one single location. Research interactivity rooms, which help to make the students' and lecturers' group discussions through videoconferencing possible, are also available.

Synchronous Delivery
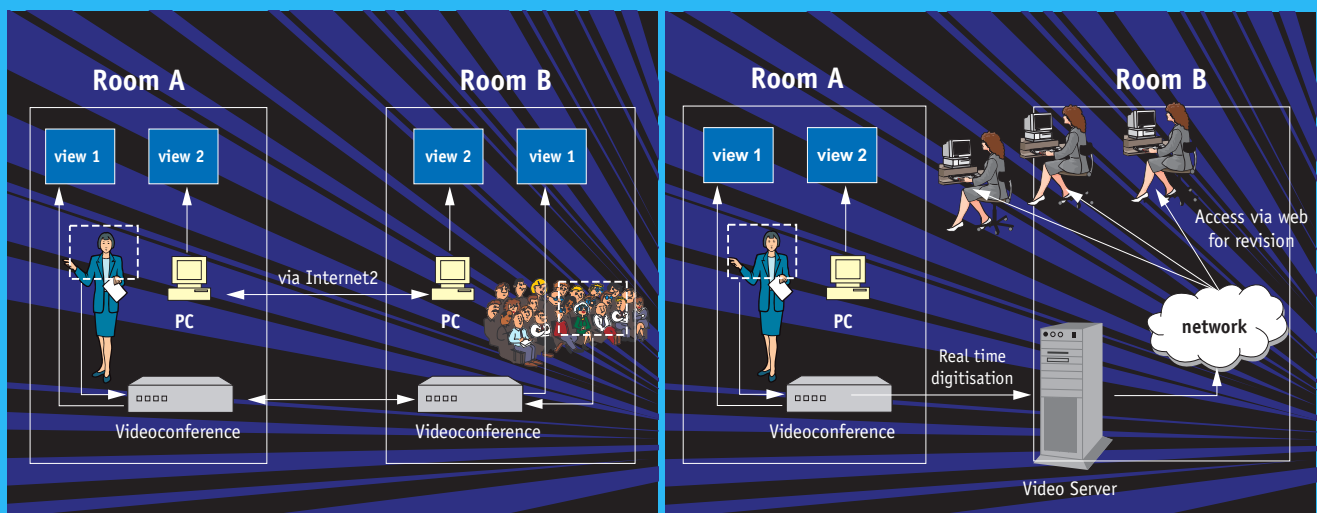
Asynchronous Platform

Asynchronous delivery is achieved via an E-learning system called Stellar. The web-based application includes a back-end database server that is designed to allow easy access, control, and organisation of contents. Course videos, for example, are digitised from the daily videoconferencing lectures and stored, together with course materials such as lecture notes, assignments and solutions. All these can be easily accessed by the lecturers and students via the Internet.

Student viewing archived course video from the SMA website at her own pace.

Conferencing Facilities

- NUS CIT Auditorium (*60)
- NUS CIT Smart Classroom (*35)
- NTU CED Smart Classroom (*50)
- NUS Eng Smart Classroom (*39)
- NUS SOC Conference Room (*50)
- MIT Room 1-390 Bechtel (*69)
- MIT Room 3-370 (*58)
- MIT Room 8-404 (*25)
- MIT Room 9-057 LINC (*45)

*** seating capacity**

Research Collaboration

As part of its goal in achieving excellence in research through collaboration with MIT, SMA students and faculty are in constant touch with the professors and students at MIT through the use of sophisticated and user-friendly videoconferencing tools. This enables communication to take place from anywhere, at any time.

The frequent and almost effortless interaction and discussions facilitate the exchange of innovative ideas and cutting-edge technology while helping to foster closer relationships with the MIT professors at the same time.

In this way, SMA hopes to inculcate the culture of engaging in research collaboration through videoconferencing.

*Research collaboration using videoconferencing tools.*

The MIT Experience

All SMA students spend two and a half weeks at MIT for the Summer Conference, which comprises a series of entrepreneurship seminars, delivered by Chief Executive Officers and founders of start-up companies, followed by intensive discussion sessions held on the MIT's campus.

The speakers, who have achieved prominence on the entrepreneurial scene, are invited to share their own experiences on starting up their companies, the importance of having effective teams for their companies and how to sell business models to venture capitalists. The students are given opportunities to discuss case histories and business trends with the speakers. This sets the tenor for intensive lectures and self-study expected of a world-class university.

The topics that were presented at the Summer Conference Entrepreneurship session at MIT in 2001 included:

- High Tech Entrepreneurship at MIT - What's Hot and What's Not
- The OmniGuide Fibre: From Basic Science to the Marketplace
- Personal Experiences in a Technology Start-up
- Great Technology! - Great Business?
- Advances in Drug Delivery and Tissue Engineering
- Confessions of an Academic Entrepreneur
- On the Road to Commercialisation of a Materials Technology
- Mind over Matter: The Intellectual Capital Revolution in Communication Systems Design
- Towards a Manufacturing Equipment Infrastructure for the Optical Communication Industry
- Down in the Trenches
- Being an Entrepreneur
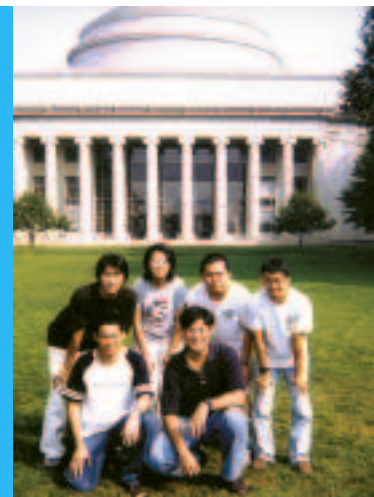
Students at MIT for Summer Conference.

Student Resources

SMA students are each allocated a computer in the Student Atheneum. Through these terminals, they can interact and videoconference with MIT professors and engage in net meetings as well as obtain access to web-based lecture materials and homework assignments. The Atheneum houses about 220 computers, located at both NUS and NTU.

The Student Atheneum provides a conducive environment and ample interaction opportunities for SMA students, through which the students get to foster bonds with their peers and build networks that will help them as they advance in their careers.

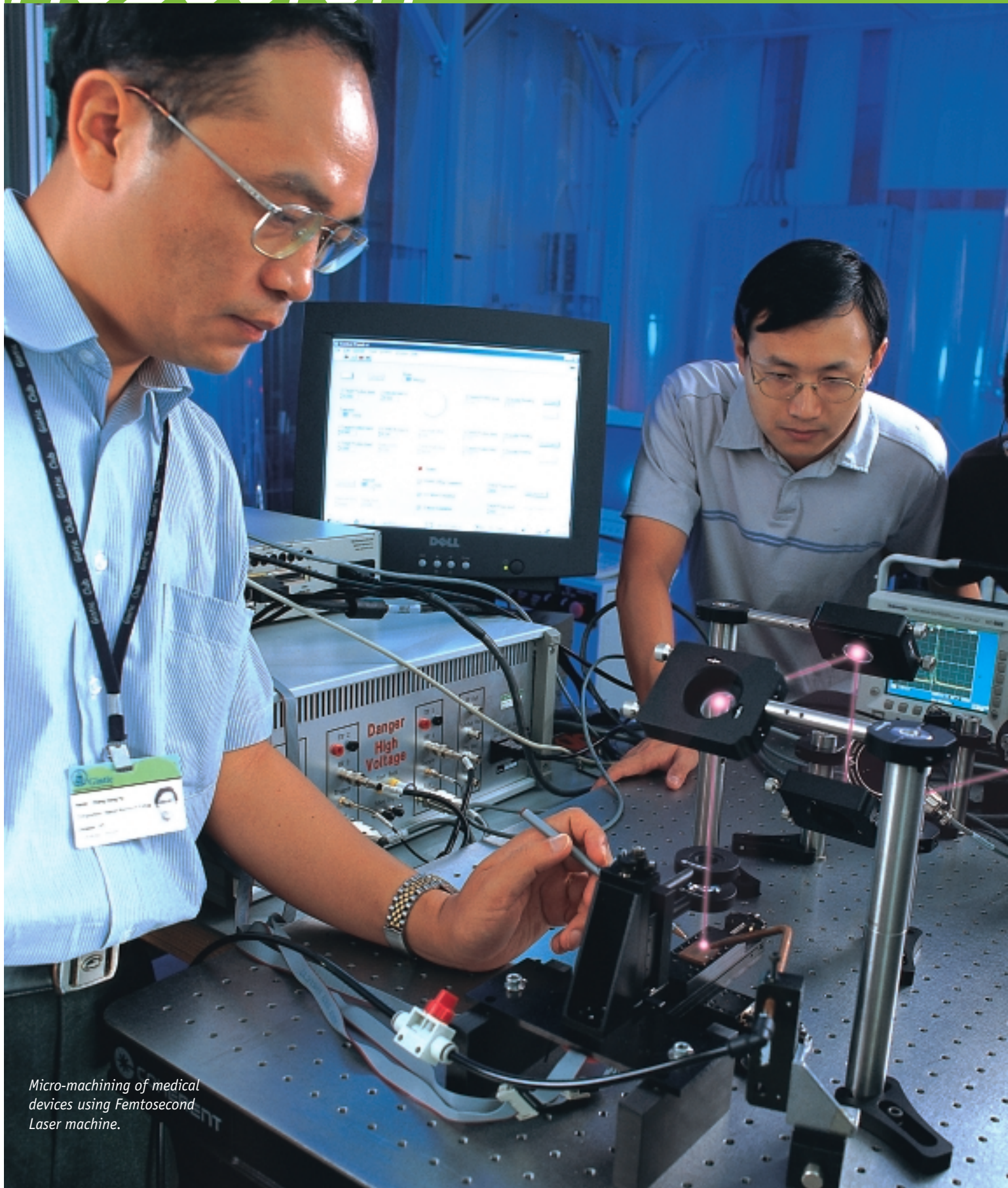*SMA Atheneum at Faculty of Engineering, NUS.*

SMA Atheneum in NTU.
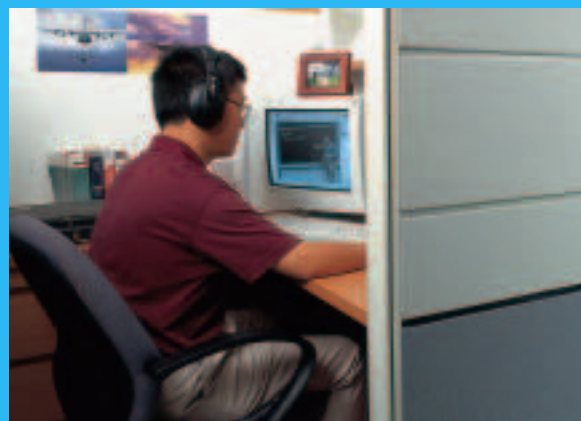
SMA Atheneum at School of Computing, NUS.

Research

Micro-machining of medical
devices using Femtosecond
Laser machine.

At SMA, students get to adopt the longstanding tradition among MIT's graduate students, that is, to take on central roles in bringing about scientific breakthroughs and technological advances. SMA students have the opportunity to undertake research work that will have direct and long-term economic influences on the global engineering industry.

The research projects undertaken in SMA are collaborative and multi-disciplinary in nature. They offer the students the opportunity to work with pioneers in the academic and research fields, both at MIT as well as from industry.

SMA students have the access to research facilities at MIT, NUS, NTU as well as those at the NRIs. In the SMA programme, the NRIs play multiple roles of initiating cutting-edge research, co-supervising students' research and allowing the students access to world-class facilities that are not usually available at universities.

The Institute of Microelectronics (IME) and the Institute of Materials Research and Engineering (IMRE) are involved in the AMM&NS programme. The two NRIs are dedicated to adding value to their partners through strategic and innovative applications in their respective fields.

The Institute of High Performance Computing (IHPC) participates in the HPCES programme to undertake upstream research for the development of new computational techniques and methodologies. It also supports local companies in industry-initiated research to enhance their capability and productivity.

Singapore Institute of Manufacturing Technology (SIMTech) is involved in the IMST programme. It seeks to complement the expertise in manufacturing capabilities that are currently available at NTU. One of SIMTech's focuses is the development and application of new and advanced manufacturing processes and technology in and to the existing local industry.

By advancing the capacity and depth of the existing research, SMA hopes to conquer even greater research frontiers and revolutionise industrial mindsets. Through establishing a foothold in tomorrow's science and technology, SMA hopes to help boost Singapore's ability to compete in the global economy.

Publications

AMM&NS programme

Collaborative Research Projects with SMA-MIT Fellows

Bulk Metallic Glasses and their Mechanical Properties

Conference Publication

Tan H., Zhang Y., & Li Y., "La-Al-Cu-Ni Bulk Metallic Glass Composite", Bulk Metallic Glasses (Bulk Amorphous Alloys) II Conference, Keelung, Taiwan, 22-30 March 2002.

Copper Reliability

Journal Publication

Gan C. L., Thompson C. V., Pey K. L., Choi W. K., Tay H. L., Yu B. & Radhakrishnan M. K., "Effect of Current Direction on the Lifetime of Different Levels of Cu Dual-Damascene Metallization", Applied Physics Letters, Vol. 79, pp. 4592 (2001).

Conference Publications

1. Gan C. L., Thompson C. V., Pey K. L., Choi W. K., Wei F., Yu B. & Hau-Riege S. P., "Experimental Characterization of the Reliability of 3-Terminal Dual-Damascene Copper Interconnect Tress", to be published in the Proceedings of MRS Spring 2002 Meeting.

2. Wei F., Gan C. L., Thompson C. V., Clement J. J., Hau-Riege S. P., Pey K. L., Choi W. K., Tay H. L., Yu B. & Radhakrishnan M. K., "Length Effects on the Reliability of Dual-Damascene Cu Interconnects", to be published in the Proceedings of MRS Spring 2002 Meeting.

3. Gan C. L., Wei F., Thompson C. V., Pey K. L., Choi W. K. & Yu B., "Consequence of Preferential Void Formation at the Cu/Si_3N_4 Interface on the Multiple Failure Mechanisms of Cu Dual-Damascene Metallization", to be presented at IPFA2002.

Germanium Nanocrystal Growth and its Applications in Electronic Devices

Journal Publication

Choi W. K., Chim W. K., Heng C. L., Teo L. W., Ho V., Ng V., Antoniadis D. A. & Fitzgerald E. A., "Observation of Memory Effect in Germanium Nanocrystals Embedded in an Amorphous Silicon Oxide Matrix of a Metal-Insulator-Semiconductor Structure", Applied Physics Letters, Vol. 80, No. 11, pp. 2014 (2002).

Conference Publication

Teo L. W., Heng C. L., Ho V., Tay M., Choi W. K., Chim W. K., Antoniadis D. A. & Fitzgerald E. A., "Manipulation of Germanium Nanocrystals in a Tri-Layer Insulator Structure of a Metal-Insulator-Semiconductor Memory Device", to be published in the Proceedings of MRS Spring 2002 Meeting.

Related Publications
Conference Publications

1. Heng C. L., Teo L. W., Ho V., Tay M. S., Lei Y., Choi W. K. & Chim W. K., "Effects of Rapid Thermal Annealing Time and Ambient Temperature on the Charge Storage Capability of SiO_2/pure Ge/Rapid Thermal Oxide Memory Structure", to be presented in NANO 2002, Florida, USA, June 2002.

2. Ho V., Tay M. S., Moey C. H., Teo L. W., Choi W. K., Chim W. K., Heng C. L. & Lei Y., "Electrical Characterization of a Trilayer Germanium Nanocrystals Memory Devices", to be presented in the 8th International Conference on Electronics Materials, Xian, China, June 2002.

3. Choi W. K., Pey K. L. & Zhao H. B., "Nickel Silicidation on Polycrystalline Silicon Germanium Films", 8th International Conference on Electronics Materials, Xian, China, 10-15 June 2002.

4. Choi W. K., Leoy C. C., Arianto J., Kan E. W. H., Wee A. T. S. & Liu Y. J., "Oxidation Study and Formation of Ge Nanocrystals in RF Sputtered Polycrystalline Silicon Germanium Films", 8th International Conference on Electronics Materials, Xian, China, 10-15 June 2002.

Oxidation and Silicidation of Epitaxial SiGe films

Journal Publications

1. Tan C. S., Choi W. K., Bera L. K., Pey K. L., Antoniadis D. A. & Fitzgerald E. A., "N_2O Oxidation of Strained Si/Relaxed SiGe Heterostructure Grown by UHVCVD", Solid State Electronics, Vol. 45, pp. 1945 (2001).

2. Zhao H. B., Pey K. L., Choi W. K., Chattopadhyay S., Fitzgerald E. A. & Antoniadis D. A., "Interfacial Reactions of Ni on $Si_{1-x}Ge_x$ (x=0.2, 0.3) at Low Temperature by Rapid Thermal Annealing", accepted for publication in Journal of Applied Physics.

Conference Publication

Sanatan C., Pey K. L., Choi W. K., Chi D. Z., Antoniadis D. A. & Fitzgerald E. A., "Identification of Deep Traps in a Compositionally Graded n-$Si_{0.75}Ge_{0.25}$ Alloy using Ti Schottky Diode", presented in the International Conference on Communications, Computer & Devices, IIT Kharagpur, India, 14-16 December 2000.

SiGe Optical Communication Component

Journal Publication

Li B. J., Chua S. J., Leitz C. W. & Fitzgerald E. A., "1x2 optical Waveguide Filters based on Multi-Mode Interference for 1.3- and 1.55- µm Operation", Opt. Eng., Vol. 3, No. 3, pp. 723-727 (2002).

Related Publications
Journal Publications

1. Li B. J. & Chua S. J, "High Carrier Injection Optical Switch based on Two-Mode Interference in SiGe Alloy", Applied Physics Letters, Vol. 80, No. 2, pp. 180-183 (2002).

2. Li B. J. & Chua S. J., "Reflection-Type Optical Waveguide Switch with Bow-Tie Electrode", Journal of Lightwave Technology, Vol. 20, No. 1, pp. 65-70 (January 2002).

Thin Film Microbatteries for Integration with Microelectronics

Journal Publication

Zhao J., Lu L., Thompson C. V., Lu Y. F. & Song W. D., "Preparation of (001)-Oriented PZT Thin Films on Silicon Wafers using Pulsed Laser Deposition", Journal of Crystal Growth, Vol. 225, pp. 173 (2001).

Conference Publication

Zhao J., Lu L., Thompson C. V., Lu Y. F. & Song W. D. "Growth of (001)-Oriented PZT Thin Films on Amorphous SiO_2 by Pulsed Laser Deposition", presented in the 2nd International Symposium on laser precision microfabrication, Singapore, 2001.

Other SMA Research Projects

Cooling of Electronic Components

Conference Publication

Tay A. O. A, "Cooling Electronic Components with Free Jet Impingement Boiling", ITherm 2002 - Eight Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems, San Diego, USA, 29 May - 1 June 2002.

Nanostructured Materials

Conference Publication

Lu L. & Lai M. O., "Formation of Nanostructured Magnesium Alloy via Mechanical Alloying", Conference on High Performance Powder Metallurgy Components, Coimbra, Portugal, 28 April - 3 May 2002.

Reliability of Electronics Packaging

Conference Publication

Tay A. O. A, "A Numerical Study of the Effect of Die, Die Pad and Die Attach Thickness on Thin Plastic Packages", 52nd Electronic Components & Technology Conference, San Diego, USA, 28-31 May 2002.

HPCES programme

Collaborative Research Projects with SMA-MIT Fellows

A Posteriori Error and Output Bounds for PDEs using Approximate Hybrid Flux

Conference Publication

Ali S., Damodaran M. & Patera A. T., "Regularization and Reduced Order Modeling for the Parametric Estimation of Systems Governed by Elliptic Partial Differential Equations", presented at the 1st Singapore-MIT Alliance (SMA) Annual Symposium, Singapore, 16-17 January 2001.

Evolutionary Computing for Complex Engineering and Bio-Science System

Journal Publications

1. Yang Z. L., Lee J. H., Liu G. R., Patera A. T. & Lam K. Y., "Inverse Identification of Boundary Constants for Electronic Packages Using Modified Micro-Genetic Algorithm and Reduced-basis Method", Adaptive Computing in Design and Manufacture V, I. C. Parmee (ed), pp. 143 (2002).

2. Yang Z. L., Lee J. H., Liu G. R., Patera A. T. & Lam K. Y., "Inverse Identification of Thermal Parameters for Microelectronic Packages Using Reduced-Basis Method", Computer Methods in Applied Mechanics and Engineering (CMAME) (2001).

Conference Publications

1. Yang Z. L., Lee J. H., Liu G. R., Patera A. T. & Lam K. Y., "Identification of Convection Constants for Electronic Packages Using Modified Genetic Algorithm and Reduced-Basis Method", in Proceedings of the 2nd Singapore-MIT Alliance (SMA) Annual Symposium, 14-16 January 2002, section C.

2. Yang Z. L., Lee J. H., Liu G. R., Patera A. T. & Lam K. Y., "Coefficients Identification for Microelectronic Packages Using Inverse Analysis and Reduced-Basis Method", the 2nd Singapore-MIT Alliance (SMA) Annual Symposium, Singapore, 14-16 January 2002.

Related Publications
Journal Publications

1. Yang Z. L., Liu G. R., Venkatasubramanian S. H. & Lam K. Y., "Inverse Identfication of Dynamic Parameters of PCB and Components using an Improved μGA" (2001).

2. Yang Z. L., Liu G. R. & Lam K. Y., "An Inverse Procedure for Crack Detection using Integral Strain Measured by Optical Fibers", Smart mater. Struct. 11, pp. 72-78 (2002).

Conference Publications

1. Yang Z. L., Liu G. R. & Lam K. Y., "Flaw Detection using an Inverse Procedure and an Integral Strain measured by an Optic Fiber", the 1st Singapore-MIT Alliance (SMA) Annual Symposium, Singapore, 16 January 2001.

2. Yang Z. L., Liu G. R., Xu Y. G. & Lam K. Y., "A Local Optimized Genetic Algorithm and Its Application to Inverse Detection of Delamination in Laminates", in Proceedings of the Asia-Pacific Vibration Conference, pp. 1155-1159, Hangzhou, China, 28 October - 1 November 2001.

Parametric Model Order Reduction

Conference Publication

Daniel L., Ong C. S., C. L., Low S. C., Lee K. H. and White J., "Geometrically Parameterized Interconnect Performance Models for Interconnect Synthesis", in Proceedings of International Symposium on Physical Design ISPD 02, San Diego, USA, 7-10 April 2002.

Robust Optimization in Logistics and Finance

Journal Publication

Teo C. P. & Bertsimas D., "Multistage Lot Sizing via Randomized Rounding", Operations Research, Vol. 49(4), pp. 599-608 (July-August 2001).

Conference Publication

Bertsimas D., Karthik N. & Teo C. P., "Applications of Semidefinite Optimization in Stochastic Project Scheduling", in Proceedings of the 2nd Singapore-MIT Alliance (SMA) Annual Symposium, 14-16 January 2002, section D.

Simulation of Bubble Dynamics

Related Publications
Journal Publications

1. Zhang Y. L., Yeo K. S., Khoo B. C. & Wang C., "Three-Dimensional Jet Impact and Toroidal Bubbles", J. Comp. Phys., Vol. 166, pp. 336-360 (2001).

2. Zhang Y. L., Yeo K. S., Khoo B. C., Chong W. K., "Simulation of Three-Dimensional Bubbles using De-Singularised Boundary Integral Method", Int. J. Num. Method in Fluids, Vol. 31, pp. 1311-1320 (1999).

The Enclosing Ball Problem

Related Publication
Journal Publication

Zhou G., Sun J. & Toh K., "An Efficient Algorithm for the Smallest Enclosing Ball Problem in High Dimensional Space", to appear in Novel Approaches to Hard Discrete Optimization, P. Pardalos and H. Wolkowicz eds., Fields Institute of Mathematics (2002).

Other SMA Research Projects

Aerodynamic Shape Optimization Using Computational Fluid Dynamics and Simultaneous Perturbation Stochastic Approximation Method

Journal Publication

Xing X. Q. & Damodaran M., "Assessment of Simultaneous Perturbation Stochastic Approximation Method for Wing Design Optimization", to appear in AIAA Journal of Aircraft, Vol. 39, No. 2 (March-April 2002).

Conference Publications

1. Damodaran M., "Leveraging Computational Fluid Dynamics Simulations and Optimization Methods for Optimal Aerodynamic Shape Design", presented at the 1st Singapore-MIT Alliance (SMA) Annual Symposium, Singapore, 16-17 January 2001.

2. Xing X. Q. & Damodaran M., "Optimal Design of Transonic Rotor Blade Leading Edge Shape Using CFD and Simultaneous Perturbation Stochastic Approximation Method", presented at the 2nd Singapore-MIT Alliance (SMA) Annual Symposium, Singapore, 14-16 January 2002.

3. Xing X. Q. & Damodaran M., "Comparison of Simultaneous Perturbation Stochastic Approximation and Simulated Annealing in Transonic Airfoil Design Optimization", to be presented at the 2nd International Conference on Computational Fluid Dynamics, ICCFD2, Sydney Australia, 15-17 July 2002.

4. Xing X. Q. & Damodaran M., "Application of the Simultaneous Perturbation Stochastic Approximation Method for Aerodynamic Shape Design Optimization", AIAA-2002-5653, to be presented at the 9th AIAA/ISSMO Symposium on Multidisciplinary Analysis and Optimization, Atlanta, GA, USA, 4-6 September 2002.

Atomistic Computer Simulation of Micro- and Nano-Systems

Journal Publications

1. Liu G. R., Xu Y. G. & Wu Z. P., "Total Solution for Structural Mechanics Problems", Computer Methods in Applied Mechanics and Engineering, Vol. 191 (8-10), pp. 989-1012 (2001).

2. Xu Y. G., Liu G. R., Wu Z. P. & Huang X. M., "Adaptive Multilayer Perceptron Networks for Detection of Cracks in Anisotropic Laminated Plates", International Journal of Solids and Structures, Vol. 38 (32-33), pp. 5625-5645 (2001).

3. Xu Y. G., Liu G. R. & Wu Z. P., "A Novel Hybrid Genetic Algorithm Using Local Optimizer Based on Heuristic Pattern Move", Applied Artificial Intelligence - An International Journal, Vol. 15(7), pp. 601-631 (2001).

4. Xu Y. G., Liu G. R. & Wu Z. P., "Damage Detection for Composite Plates Using Lamb Waves and Projection Genetic Algorithm", AIAA Journal, No. J-25481 (2002) (in press).

5. Liu G. R., Han X., Xu Y. G. & Lam K. Y., "Material Characterization of Functionally Graded Material Using Elastic Waves and a Progressive Learning Neural Network", Composites Science and Technology, Vol. 61(10), pp. 1401-1411 (2001).

6. Xu Y. G. & Liu G. R., "Detection of Flaws in Composite Materials From Scattered Elastic-wave Field Using Modified μGA and Gradient-based Optimizer", Computer Methods in Applied Mechanics and Engineering, MP/01/209 (2001).

7. Xu Y. G., Liu G. R., Pan L. S., "Parameter Identification of Dynamic Flow-Pressure Characteristics in Valve-less Micropumps", Sensors and Actuators A: Physical (March 2002).

Conference Publications

1. Xu Y. G. & Liu G. R., "A Novel Inverse Algorithm for Parameter Identification Problems in MEMS", WCCM 2002.

2. Xu Y. G. & Liu G. R., "Improved Impedance Model of Piezoelectric Actuator-Sensors and Application to Debonding Detection", SEM Conference, USA, 8-12 June 2002.

3. Xu Y. G. & Liu G. R., "A Simple But Effective Hybrid Genetic Algorithm With Application to Inverse Problems in MEMS", Proc. of International Conference on Inverse Problems - Recent Development in Theories and Numerics, Hong Kong, 9-12 January 2002 (published by the World Scientific).

4. Xu Y. G. & Liu G. R., "A Novel Evolutionary Algorithm for Complicated Optimization Problems", Proc. of the 2nd Singapore-MIT Alliance (SMA) Annual Symposium, Singapore, 14-16 January 2002.

5. Xu Y. G. & Liu G. R., "A Novel Hybrid Genetic Algorithm for Damage Detection of Composite Laminates", Proc. of the 1st Singapore-MIT Alliance (SMA) Annual Symposium, Singapore, 15-17 January 2001.

6. Xu Y. G., Liu G. R. & Wu Z. P., "An Accelerated Genetic Algorithm Using Hooke-Jeeves Method For Local Searching", Proc. of the 1st Int. Conf. on Structural Stability and Dynamics, pp. 781-786, Taipei, Taiwan, 7-9 December 2000.

7. Xu Y. G. & Liu G. R., "A New Coupled Electro-Mechanical Dynamics Model of Piezoelectric Actuator-Sensors and Application", International Conference on Structural Stability and Dynamics, Singapore, 17-19 December 2002.

Convex Optimization

Journal Publications

1. Hegland M., Osborne M. & Sun J., "Parallel Interior Point Solution of Multistage Convex Programming", to appear in Annals of Operations Research.

2. Sun J. & Zhang L., "On the Log-exponential Trajectory of Linear Programming", to appear in Journal of Global Optimization.

Discrete Optimization

Journal Publication

Sun J. & Gu Y., "A Parametric Approach for a Nonlinear Discrete Location Problem", Journal of Combinatorial Optimization, Vol. 6, pp. 119-132 (2002).

Distribution Network Design Problem in Logistics

Journal Publication

Teo C. P., Ou J. & Goh Mark, "Impact On Inventory Cost With Consolidation of Distribution Centers", IIE Transactions, Vol. 33, Issue 2, pp. 99-110 (February 2001).

Micro- and Nano-Structure Simulation

Journal Publications

1. J. Cai & Wang J.-S., "Reconstruction of Si(001) and Adsorption of Si Adatoms and Ad-Dimers on the Surface: Many Body Potential Calculations", Phys. Rev. B. {64}, 035402 (2001).

2. J. Cai & Wang J.-S., "Reconstruction of Si(001): A Comparison Study of Many Body Potential Calculations", Phys. Stat. Sol. (b) {223}, 773 (2001).

3. J. Cai & Wang J.-S., "Adsorption and Difussion of Si on the Si(001): An Empherical Potential Calculation", International Journal of Modern Physics B, Vol. 16, No. 4, pp. 621-629 (2002).

4. J. Cai & Wang J.-S., "Friction between a Ge tip and the (001)-2x1 Surface: A Molecular-Dynamics Simulation", Phys. Rev. B {64}, 113313 (2001).

5. J. Cai & Wang J.-S., "Molecular Dynamics Study of the Friction Properties for a Ge Tip-Surface System", Surface Review Letters, {8}, 581 (2001).

6. J.Cai & Wang J.-S., "Friction between Si Tip and (001)-2x1 Surface: A Molecular Dynamics Simulation", to be published in the Computer Physics Communications.

7. J. Cai & Wang J. S., "Modeling Generalized Stacking Fault in Au using Tight-Binding Potential Combined with a Simulated Annealing Method", to be published in the European Physical Journal B.

Conference Publication

J. Cai & Wang J.-S., "Modeling Generalized Stacking Fault in Au Using Tight-Binding Potential Combined with a Simulated Annealing Method", presented at the 2nd Singapore-MIT Alliance (SMA) Annual Symposium, Singapore, 14-16 January 2002.

Nonlinear Optimization
Journal Publications

1. Chen X. & Sun J., "Global Convergence of a Two-parameter Family of Conjugate Gradient Methods without Line Search", to appear in Journal of Computational and Applied Mathematics.

2. Han J., Sun J. & Sun W., "Global Convergence of Nonmonotone Descent Methods for Unconstrained Optimization Problems", to appear in Journal of Computational and Applied Mathematics.

Numerical Simulation on Shock Waves in Bio-MEMS and Biological Systems
Journal Publications

1. Liu T. G., Khoo B. C., Yeo K. S., "The Simulation of Compressible Multi-Medium Flow. Part I: A New Methodology with Test Applications to 1D Gas-Gas and Gas-Water Cases", Comp. & Fluids, Vol. 30, pp. 291-314 (2001).

2. Liu T. G., Khoo B. C., Yeo K. S., "The Simulation of Compressible Multi-Medium Flows. Part II : Applications to 2D Underwater Shock Refraction", Comp. & Fluids, Vol. 30, pp. 315-337 (2001).

Semidefinite Programming and Matrix Equations
Journal Publications

1. Toh K., Zhao G. & Sun J., " A Multiple-Cut Analytic Cutting Plane Method for Semidefinite Feasibility Problems", to appear in SIAM Journal on Optimization.

2. Sun J., Toh K., & Zhao G., "An Analytic Cutting Plane Method for Semidefinite Feasibility Problems", to appear in Mathematics of Operations Research.

3. Sun D. & Sun J., "Semismooth Matrix Valued Functions", Mathematics of Operations Research, Vol. 27, pp. 150-169 (2002).

Simulation of Wave-Structure Interaction: Nonlinear Sea-Keeping
Conference Publication

Wang C. Z., Khoo B. C. & Wu G. X., "Numerical Study on Large Scale Amplitude Motions of a Floating Body", in Proceedings of the Int. Conf. On Port & Maritime R & D and Technology, pp. 751-758, 2001.

Stable Matching Problem
Journal Publications

1. Teo C. P., Sethuraman J. V. & Tan W. P., "Gale-Shapley Stable Marriage Problem Revisited: Strategic Issues and Applications", Management Science, Vol. 47, No. 9, pp. 1252-1267 (September 2001).

2. Sethuraman J. & Teo C. P., "A Polynomial Time Algorithm for Bistable Roommates Problem", Journal of Computer and System Sciences, pp. 498-508 (November 2001).

3. Qian L., Sethuraman J. & Teo C. P., "The Geometry of Stable Admission Polytope and Its Applications" Preprint.

Stochastic Optimization
Journal Publication

Liu X. & Sun J., "A New Decomposition Technique in Solving Multistage Stochastic Linear Programs by Infeasible Interior Point Methods", to appear in Journal of Global Optimization.

Web-based Simulator Engines and Tools for Numerical Simulation
Journal Publication

Kannan V., Damodaran M. & See C. W., "Developmment of a Web-Based Simulator Engine for Programmable Software Environments", in Advances in Automation, Multimedia and Video Systems and Modern Computer Science, Ed. Kluev, V. V., D'Attellis, C. E. and Mastorakis, N. E., pp. 274-278, WSES Press (ISBN: 960-8052-44-0) (October 2001).

IMST programme

Collaborative Research Projects with SMA-MIT Fellows

Data-Mining in Product Development Process (PDP)

Related Publications
Conference Publications

1. Loh H. T., Koh W. L., Menon R. & Leong C. K., "A Study of Service Center Records Using Data Mining", the 2nd Singapore-MIT Alliance (SMA) Annual Symposium, Singapore, 14-16 January 2002.

2. Loh H. T., Menon R. & Leong C. K., "Mining of Text in the Product Development Process", the 2nd Singapore-MIT Alliance (SMA) Annual Symposium, Singapore, 14-16 January 2002.

Development of Nitrogen-containing Group III-V Semiconductor Alloys for Optoelectronics and High Frequency Device Applications

Related Publications
Journal Publications

1. Loke W. K., Yoon S. F., Wang S. Z., Ng T. K. & Fan W. J., "Rapid Thermal Annealing of GaN_xAs_{1-x} grown by Radio Frequency Plasma Assisted Molecular Beam Epitaxy and its Effect on Photoluminescence", Journal of Applied Physics, Vol. 91, No. 7, pp. 1-5 (April 2002).

2. Ng T. K., Yoon S. F., Wang S. Z., Loke W. K. & Fan W. J., "Photoluminescence Characteristics of GaInNAs Quantum Wells Annealed at High Temperature", to be published in Journal of Vacuum Science & Technology (May/June 2002).

Conference Publications

1. Loke W. K., Yoon S. F., Ng T. K., Wang S. Z. & Fan W. J., "Effect of Rapid Thermal Annealing: Red and Blue Shift in Photoluminescence of GaAsN Grown by RF Plasma-Assisted Molecular Beam Epitaxy", Materials Research Society Fall Meeting, Boston, USA, October/November 2001.

2. Wang S. Z., Yoon S. F., Ng T. K., Loke W. K. & Fan W. J., "Ga(In)AsN Grown by Plasma-Assisted Molecular Beam Epitaxy Towards 1.31µm and 1.55µm", 14th Indium Phosphide and Related Materials Conference, Stockholm, Sweden, 12-16 May 2002.

3. Ng T. K., Yoon S. F., Wang S. Z., Loke W. K., Fan W. J., Yew K. C. & Sun Z. Z., "Photoluminescence Behavior of GaInNAs Quantum Wells Annealed at High Temperature", 14th Indium Phosphide and Related Materials Conference, Stockholm, Sweden, 12-16 May 2002.

4. Yew K. C., Yoon S. F., Sun Z. Z., Ng T. K., Loke W. K., Wang S. Z. & Fan W. J., "Studies of In and N Composition Effects on the Optical Properties and Surface Morphology of GaInNAs Quantum Dots Grown by RF-Plasma Assisted MBE", 14th Indium Phosphide and Related Materials Conference, Stockholm, Sweden, 12-16 May 2002.

Improved Supply Chain Coordination through Information Sharing

Related Publications
Journal Publication

Bhatnagar R. & Viswanathan S., "Analysis of Warehouse Location Decisions in Urban FMCG Distribution Systems", Revisions submitted to International Journal of Physical Distribution and Logistics Management (2002).

Conference Publication

Si L., Bhatnagar R. & Sivakumar A. I., "Impact of Distribution Network Configuration on Supply Chain Cost: An e-Business Perspective", Proceedings of the LOGISTICS 2001 Conference, pp. 43-50, Singapore, August 2001.

Network Configuration for Supply Chain Design

Related Publication
Journal Publication

Bhatnagar R., Jayaram J. & Phua Y. C., "The Impact of Plant Location Factors on Competitiveness of Supply Chains", Journal of Business Logistics, USA (2002).

One Step Transfer of Diffractive Structure from Designed Pattern to Replica with Hybrid Sol-gel film

Related Publications
Journal Publications

1. Fu Y. & Ngoi K. A. B., "One Step Transfer of Diffractive Structure from Designed Pattern to Replica with Hybrid Sol-Gel Film", Optics Express, Vol. 10, No. 10, pp. 436-442 (20 May 2002).

2. Fu Y. & Ngoi K. A. B., "Investigation of Hybrid Microlens Integration with Vertical-Cavity Surface-Emitting Lasers for Free-Space Optical Link", Optics Express, Vol. 10, No. 9, pp. 413-418 (May 2002).

Conference Publication

Fu Y. & Ngoi K. A. B., "One-Step Fabrication of Hybrid Micro-Diffractive-Refractive Lens with Continuous Relief using Focused Ion Beam Milling", OSA Technical Digest, Diffractive Optics and Micro-Optics, pp. 87-89, Tucson, USA, 3-7 June 2002.

Optimization of Planning and Scheduling of Advanced Manufacturing Systems and Supply Chains

Related Publications
Conference Publications

1. Wang J. G., Wong Y. S., Lee K. S., Huang X. G., Liao Q., Loh H. T. & Liu Z. J., "Domain-Specific Portal for the Manufacturing Industry in Singapore - Implementation Issues", IMLF-2002 International Manufacturing Leaders Forum 2002 - Leadership of the future in Manufacturing, Adelaide, Australia, 8-10 February 2002.

2. Zhang Y. F., Loh H. T., Fuh J. Y. H. & Wang G. J., "Agent-Based Manufacturing Resource Planning", IMLF-2002 International Manufacturing Leaders Forum 2002 - Leadership of the future in Manufacturing, Adelaide, Australia, 8-10 February 2002.

3. Rajagopalan A., Bhatnagar R. & Sivakumar A. I., "Optimal Labor Induction in Personal Computer Supply Chain", Proceedings of the LOGISTICS 2001 Conference, pp. 153-160, Singapore, August 2001.

4. Srivastava V., Sivakumar A.I. & Bhatnagar R., "Quantification of Bull Whip Effect in a global computer manufacturer's supply chain", Proceedings of the LOGISTICS 2001 Conference, pp. 137-143, Singapore, August. 2001.

Simulation and Control of Femto-laser Micro-machining

Related Publications
Journal Publication

Lam Y. C., Chen X., Tan K. W., Jan M., Tam K. C. & Yu S. C. M., "Experimental Measurements And Simulation Of Particle Migration In A Pressure-Driven Tube Flow: Applications To Flow In Runners", accepted by Journal of Injection Technology.

Conference Publication

Chen X., Lam Y. C., Tan K. W., Jan M., Tam K. C. & Yu S. C. M., "Shear-Induced Particle Migration In A Pressure-Driven Tube Flow", International Conference on Advanced Material Technology (ICMAT), Singapore, July 2001, accepted by Key Material Engineering.

Other SMA Research Projects

Advanced Manufacturing Processes

Conference Publications

1. Krishnan P. & Yue C. Y., "Interfacial Properties of Zylon AS/Epoxy Composites by the Multiple Fibre Pullout Technique-A Case Study", presented at ACUN-4, International Conference on Composites, July 2002.

2. Yue C. Y., Lam Y. C., Yang Y. X., Joshi S. C., Tam K. C. & Hu X., "Factors Governing In-Situ Fibre Formation in LCP/PC Blends", presented at ACUN-4, International Conference on Composites, July 2002.

Autonomous Robotic Manipulation

Conference Publication

Xie M. & Yuan M. L., "A Developmental Principle for Robotic Hand-Eye Coordination Skill", IEEE International Conference on Development and Learning, MIT, 12-15 June 2002.

Customer Demand Fulfilment Under Limited Capacity

Journal Publication

Xiong M., Tor S. B., Khoo L. P. & Chen C. - H., "A Web-enhanced Dynamic BOM-based Available-To-Promise System", International Journal of Production Economics (accepted for publication) (2002).

Dynamic Scheduling

Conference Publication

Gupta A. K. & Sivakumar A. I., "Approaches to Multiobjective Scheduling in Semiconductor Manufacturing", Proceedings of the International Conference on Modeling and Analysis of Semiconductor Manufacturing, pp. 223-228, Arizona, USA, March 2002.

Feature-based Design

Conference Publication

Deng Y. M., Britton G. A., Lam Y. C., Tor S. B. & Ma Y. S., "A Feature-Based CAD-CAE Integration Model for Injection Molded Product Design", 16th International Conference on Production Research, pp. 1-18, Prague, Czech Republic, 2001.

Functional Design of Mechanical Systems

Journal Publications

1. Britton G. A., Tor S. B., Lam Y. C. & Deng Y. M., "Modeling Functional Design Information for Injection Mold Design", International Journal of Production Research, Vol. 39, No. 12, pp. 2501-2515 (2001).

2. Tor S. B., Britton G. A., Zhang W. Y. & Deng Y. M., "Guiding Functional Design of Mechanical Products through Rule-Based Causal Behavioral Reasoning", International Journal of Production Research, Vol. 40, No. 3, pp. 667-682 (2002).

Humanoid Robot

Conference Publication

Xie M., Yuan M. L. & Yin X. M., "Vision Functions for Humanoid Robot", IEEE-RAS International Conference on Humanoid Robots", Tokyo, Japan, 22-24 November 2001.

Knowledge-Based System and Functional Design Research

Conference Publication

Zhang W. Y., Tor S. B. & Britton G. A., "A Knowledge-Based Functional Reasoning Strategy to the Conceptual Design of Mechanical Products", 13th International Conference on Engineering Design, ICED 01, pp. 291-298, Glasgow, Scotland, U.K., 21-23 August 2001, ICED 01-C586/658.

Mental and Physical Development of Robotic Systems

Conference Publication

Yin X. M. & Xie M., "Finger Identification in Hand Gesture Based Human Robot Interaction", IEEE/RAS International Conference on Humanoid Robots, MIT, Cambridge, 7-8 September 2000.

Smart and Mechatronics Products

Conference Publication

Yuan M. L. & Xie M., "An Incremental Representation of Conceptual Symbols Using RCE Neural Networks", IEEE International Conference on Development and Learning, MIT, 12-15 June 2002.

Unmanned Factory

Conference Publication

Yuan M. L., Xie M. & Yin X. M., "Robust Cooperative Strategy for Contour Matching Using Epipolar Geometry", Asian Conference on Computer Vision, Melbourne, Australia, 23-25 January 2002.

MEBCS programme

Collaborative Research Project with SMA-MIT Fellows

Stimuli Sensitive Polymers for Protein Separation, Protein Recognition and Enhanced Drug Release Applications

Conference Publication

Tam K. C. Micheal, Dai S., Bromberg L. & Hatton A. T., "Rheological and Thermodynamic Properties of PEO-PPO-PEO and PAA-g-PEO-PPO-PEO Systems", to be presented at Eurheo2002, Germany, September 2002.

Other SMA Research Project

Nanomaterials for Electrochemical Energy Conversions

Journal Publication

Chen W. X., Lee J. Y. & Liu Z. L. (IMRE), "Electrochemical Lithiation and De-Lithiation of Carbon Nanotube-Sn_2Sb Nanocomposites", Electrochemistry Communications 4, pp. 260-265 (2002).

Conference Publication

Lee J. Y., Chen W. X. & Liu Z. L. (IMRE), "Carbon Nanotube Composites of Sb, Sn_2Sb and Sn_2Co Alloys as Li-ion Battery Anodes", presented at the 201st meeting of the electrochemical society, Philadelphia, USA, 11-17 May 2002.

Research Activities

Research Progress

Advanced Materials for Micro- and Nano-Systems (AMM&NS) programme

*Deposition of Silicon-Germanium thin film using an Argon Plasma RF Sputterer.*

In the AMM&NS programme, the emphasis is on developing an understanding of the selection, processing and property-optimisation of a wide array of materials and material combinations. The new materials and technologies will facilitate the development of micro- and nano-systems of ultra-high performance, consisting of electronic and optoelectronic devices for application in information transmission, processing, storage and electromechanical actuation.

Currently, the AMM&NS programme has fourteen Ph.D. students and has graduated six M.Eng. students. The research topics include the use of heteroepitaxial SiGe films on Si substrates for fabrication of multi-mode interference optical filters. The application of strained Si films on SiGe substrates are also under investigation for the fabrication of CMOS devices. Silicidation processes of Ni on SiGe films have been examined for future metallisation on devices fabricated on such substrates. Research is being carried out on circuit-level assessments of the reliability of advanced metallisation technology for 0.1 and 0.18micron technologies, including Cu-based metallurgies and low-k dielectric materials. The development of processes for the growth of piezoelectric (PZT) films on Si microelectromechanical devices to serve as "active" materials for actuation is also under investigation. Metallic glasses obtained through rapid quenching from melt, as well as their applications in high frequency cores in electronics and as the electrolyte medium and electrodes for high power and energy density rechargeable micro-batteries, are also being studied. New projects on the role of graded InGaN buffers for strain relaxation in InGaN/GaN epilayers, the growth of germanium nano-crystals and their applications in electronic devices, dislocations and their effects on the electroluminescence and photoluminescence emissions of III-Nitrides and in micro-cavity LEDs and lasers and the structural evolution of growth of III-nitrides on silicon are currently underway.

Over the last three years, the programme has acquired three major pieces of equipment that have enhanced the research capability significantly, namely, a scanning near-field optical microscopy for the characterisation of optical properties of nano-size structures, a laser ablation system for the deposition of PZT films, and an electromigration test system for the copper reliability work. Discussions on a major project have been initiated for the fabrication of an autonomous sensor, involving the integration of energy sources, micro-batteries, MEMS and GaN LEDs on silicon electronics. This project calls for the expertise from IME, IMRE, the staff of microfabrication facility at MIT and the SMA Fellows in the programme.

High Performance Computation for Engineered Systems (HPCES) programme
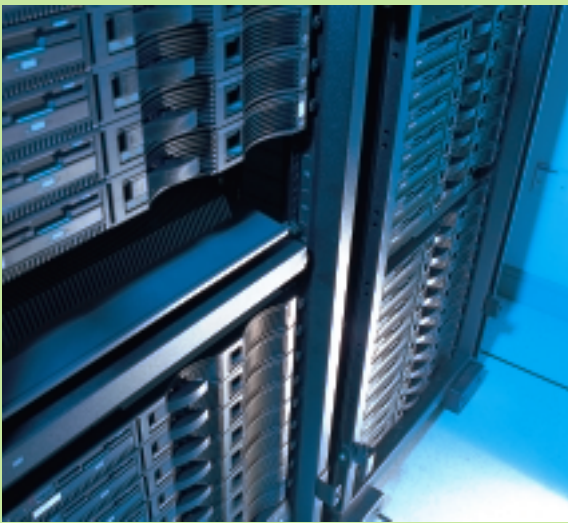
IBM X-Series 330 cluster

The research themes in the HPCES programme are simulation and optimisation. The emphasis is on the new and effective numerical techniques and methodologies for large-scale engineering/engineered systems that utilise HPC (High Performance Computing) technology like cluster and grid computing. One of the major research areas is the marrying up of simulation and optimisation for such diverse applications ranging from the use of fast multipole methods and model order reduction techniques for micro-arrays in MEMS (Micro-Electro Mechanical Systems) to traffic network flow and port management. A major thrust is in Bio-MEMS where HPC is becoming an increasingly important tool for simulation and optimisation.

Currently, the HPCES programme has seven Ph.D. students. The computing facilities available for research and teaching include a 72-node cluster of Pentium III computers for distributed computing. Another 60 nodes of Mckinley processors of the Itanium-family (IA-64) will be added for the researchers within SMA and related organisations. The researchers and students at the SMA-HPCES Programme also have access to the newly installed IBM-family Regattas at the IHPC (Institute of High Performance Computing). A large research project proposal based on Bio-MEMS with participation of staff from other programmes and non-SMA faculties is being worked out.

Innovation in Manufacturing Systems and Technology (IMST) programme

Design of injection moulded parts using the latest simulation software.

The IMST programme takes cognisance of the fact that a modern enterprise is a complex network comprising suppliers, manufacturers, warehouses, retail stores and customers, in which merchandise must be produced and distributed in such a way as to minimise overall costs and provide services of standard. The research objective is therefore to propose models and efficient solution methodologies for a variety of frequently occurring supply chain management scenarios, using a broad set of mathematical approaches. Various manufacturing processes are also investigated and optimised, in particular in the context of global competitiveness.

Some of the Theme Projects undertaken by S.M. students, which are jointly supervised by staff of participating companies, MIT and Singapore SMA Fellows, have flourished to become full-scale research projects for more in-depth investigation. Currently, the research activities in Manufacturing Systems are gathering momentum and research initiatives on Manufacturing Physics in optoelectronics, micro-machining and fabrication have started.

Currently, the IMST programme has seven Ph.D. students. The research topics have relevance from both global as well as Singapore perspectives.

Molecular Engineering for Biological and Chemical Systems (MEBCS) programme

Handling of an Electronic Pipettor in a Biosafety Cabinet.

The MEBCS programme aims to let its students have a fundamental understanding of biological and chemical sciences as well as the engineering and design aspects of products and processes. Research encompasses areas such as structured fluids, surface functionalisation, microstructure tailoring and materials design in relation to fine chemical and pharmaceutical syntheses as well as the molecular and cellular aspects of biotechnology and bioprocess engineering. Two proposals have been prepared for potential funding: "DNA-Guided Synthesis of Materials" and "Signalling Biochips and Microarrays". They represent the collaborative efforts that bring together the research expertise of various MEBCS faculties.

Currently, the MEBCS programme has three Ph.D. students (all of whom are graduates of NUS) who are top students in their coursework. They passed their qualifying examinations in January 2002 and have just embarked on their theses (April 2002). With a much larger pool of applicants for the 2002/2003 intake, 19 out of the 40 students who have enrolled indicate interest to pursue Ph.D. and the number is set to rise.

Computer Science (CS) programme

A CS student working on his computer.

The CS Fellows are experts in artificial intelligence, compilers, databases, embedded systems, machine learning and parallel and distributed processing. The joint supervision of Ph.D. students will begin in July 2002 and more collaboration is expected to take place when the research theme is settled.

The research theme is likely to be centred round the use of computing technologies in order to boost the productivity of human endeavours. The aim is to take advantage of the exponentially decreasing costs for disk storage, memory, processing power and camera arrays to capture and store records of human activities such as classroom lectures, engineering discussions and corporate meetings. Research in the areas such as graphics, media, artificial intelligence, databases and parallel processing technologies will allow these records to be indexed, organised and stored with minimum hassle. Search technologies allow the appropriate material to be found when required, while graphics and media technologies allow the knowledge to be absorbed quickly by allowing playback at higher speeds, skipping of irrelevant material and viewing of the reconstructed scenes from the best vantage point. The use of 3-D reconstruction technology, together with the advantage of being able to review the material and play back the appropriate sections at the appropriate speeds, should make the experience of using the material comparable to, or better than, actually being present at the event. The technologies created can be used in applications such as e-learning, global collaboration and knowledge management in organisations. Currently, the CS programme has one Ph.D. student.

S.M. Projects (2001/2002)

Project abstracts can be viewed online on the SMA website (http://www.sma.nus.edu.sg).

AMM&NS programme

High Performance and High Yield MIM Capacitor

Student : Arun Sreeranganathan
SMA Supervisor : Assoc Prof Choi Wee Kiong
Company Supervisor : Mr My The Doan

Growth, Characterization and Development of Ultra-Thin (1-2nm) Gate Dielectrics Using Combination of Nitrous Oxide and Oxygen

Student : Au Yin Kheng
SMA Supervisor : Assoc Prof Choi Wee Kiong
Company Supervisor : Dr Bera Lakshmi Kanta

Photodectors Based on lll-V Materials

Student : Cheow Lei Kun
SMA Supervisor : Prof Chua Soo Jin
Company Supervisor : Dr Ramam Akkipeddi

Shrink 0.13nm Backend Structure Using Resolution Enhancement Lithography Assisted by Chemical Shrink (RELACS) Process

Student : Foong Yee Mei
SMA Supervisor : Prof Chua Soo Jin
Company Supervisor : Ms Moitreyee Mukherjee-Roy

Polycrystalline Silicon Germanium as a Gate Material in CMOS

Student : Ganapathi Subrahmanyam
SMA Supervisor : Assoc Prof Choi Wee Kiong
Company Supervisor : Mr Simon Chan

Growth and Characterization of Ta and Ta Nitride as a Diffusion Barrier in Cu/SiO2 Structure

Student : Gong Zheng
SMA Supervisor : Assoc Prof Pey Kin Leong
Company Supervisor : Dr Pan Jisheng

The Impact of CMOS Processes on Negative Bias Temperature Instability

Student : Irwan Bin Karim
SMA Supervisor : Assoc Prof Choi Wee Kiong
Company Supervisor : Dr Ang Chew Hoe

Study of Nickel Silicidation Process on Device Performance

Student : Kan Shidong
SMA Supervisor : Assoc Prof Pey Kin Leong
Company Supervisor : Dr Chi Dongzhi

Nickel Metal Gate for CMOS Devices

Student : Kuang Weiwei
SMA Supervisor : Prof Chua Soo Jin
Company Supervisor : Dr Chi Dongzhi

Vertical Profile Control in High Aspect Ration Low-K Dielectric Contact Hole

Student : Lan Peiyuan
SMA Supervisor : Assoc Prof Choi Wee Kiong
Company Supervisor : Dr Vladimir N. Bliznetsov

Silicidation on Poly-SiGe Gate Stacks

Student : Li Yisuo
SMA Supervisor : Assoc Prof Pey Kin Leong
Company Supervisor : Dr Lee Pooi See

Triple Gate Oxide Integration for System-Ou-A chip

Student : Liu Xiaohong
SMA Supervisor : Assoc Prof Chim Wai Kin
Company Supervisor : Mr Simon Chan

Corrosive Effect of Trace Contaminants on Metal Surface

Student : Ng Soon Sing
SMA Supervisor : Prof Andrew Tay Ah Ong
Company Supervisor : Dr Thomas Liew

Study on the Reduction of Leakage Current of CMOS for N-Channel MOS Field-Effect Transistor

Student : Ng Wei Beng
SMA Supervisor : Assoc Prof Chim Wai Kin
Company Supervisor : Mr Dhruva Kant Shukla

Junction Leakage Characterization in Silicide Junctions

Student : Nikholas Gerochi Toledo
SMA Supervisor : Assoc Prof Pey Kin Leong
Company Supervisor : Dr Lee Pooi See

Characterization of HF Aluminate as a Gate Dielectric

Student : Pan Manyi
SMA Supervisor : Assoc Prof Chim Wai Kin
Company Supervisor : Dr Ang Chew Hoe

Atomic Layer Deposition of Low Dimensional Structures on HOPG Surfaces

Student : Poon Siew Wai
SMA Supervisor : Assoc Prof Chim Wai Kin
Company Supervisor : Dr Pan Jisheng

Process Improvement in 0.25 Micron CMOS Logic Process to Have Better Hot Carrier Reliability

Student : Rajivakshan Ramanathan
SMA Supervisor : Assoc Prof Chim Wai Kin
Company Supervisor : Mr Dhruva Kant Shukla

Design, Simulation, Fabrication and Test of Microfluidic Silicon-Based Bio MEMS Devices with Patterned Self-Assembled Monolayer Surface Modification

Student : Shu Wenmiao
SMA Supervisor : Prof Andrew Tay Ah Ong
Company Supervisor : Dr Victor D. Samper

Design and Simulations of Spring and Hinge Mechanism for MEMS Micro-Mirror Devices

Student : Sohini Bose
SMA Supervisor : Prof Andrew Tay Ah Ong
Company Supervisor : Dr Janak Singh

Simulation and Modeling of Nanometer Scale Magnetic Devices

Student : Steby Rodriguez
SMA Supervisor : Prof Chua Soo Jin
Company Supervisor : Dr Wu Yihong

Microstructural and Mechanical Behavior of Lead-Free Solder Joints

Student   : Su Chun Wei
SMA Supervisor   : Prof Andrew Tay Ah Ong
Company Supervisor : Dr Yang Qianjin

Fabrication and Characterization of ERS2 Silicide Infrared Photodetector Application

Student   : Su Ning
SMA Supervisor   : Prof Chua Soo Jin
Company Supervisor : Dr Chi Dongzhi

To Study the Effect of Oxidation of AlGaAs on the Quality of the Upper GaAs Layer

Student   : Vernon Goh Tat Boon
SMA Supervisor   : Prof Chua Soo Jin
Company Supervisor : Mr Jason Tan

Correlation Between the Post Copper ECP Anneal and The Microstructure in Copper Metal Lines & The Effect of Microstructure on Copper Metal Lines Properties

Student   : Vikas Jindal
SMA Supervisor   : Assoc Prof Pey Kin Leong
Company Supervisor : Mr Alex See

Applications of Laser Scanning Microscopy to Integrated Circuits Failure Analysis

Student   : Wang Jianwei
SMA Supervisor   : Assoc Prof Chim Wai Kin
Company Supervisor : Dr Ong Soon Huat

Photodetectors Based on lll-V Materials

Student   : Wang Kejia
SMA Supervisor   : Prof Chua Soo Jin
Company Supervisor : Dr Ramam Akkipeddi

Design and Simulation of Thermal Bimorph Actuator and XY Micro Stage for Applications in Optical Communications Network

Student   : Yong Mee Lee
SMA Supervisor   : Prof Andrew Tay Ah Ong
Company Supervisor : Dr Janak Singh

Surface Modification and Characterization of Low-K Dielectric Films

Student   : Zhou Xing
SMA Supervisor   : Assoc Prof Choi Wee Kiong
Company Supervisor : Dr Pan Jisheng

HPCES programme

Transiet Fluid-Structure Interaction in 2D

Student   : Ajaykumar Rajasekharan
SMA Supervisor   : Assoc Prof Khoo Boo Cheong
Company Supervisor : Dr Kantharaj Murali

Scattering from the Interior Surface of Air Inlet

Student   : Chien Tze How
SMA Supervisor   : Assoc Prof Li Le-Wei
Company Supervisors : Dr Gan Yeow Beng, Dr Wang Chao-Fu

Virtual Prototyping Development of Head-Actuator Hard Disk Drive

Student   : Ding Fei
SMA Supervisor   : Assoc Prof Liu Guirong
Company Supervisor : Dr Yang Jiaping

Simulation of Air Flow Structure in a Near – HDD Configuration

Students   : Dong Peng, For Chee Wei
SMA Supervisor   : Assoc Prof Lee Kwok Hong
Company Supervisor : Dr Ong Eng Hong

Automatic Crane Sequencing

Student   : Duong Hong Duc
SMA Supervisor   : Asst Prof Toh Kim Chuan
Company Supervisor : Dr Tan Kok Choon

Combining HW/SW Partitioning and Chip Planning for System-on-Chip (SOC) Design

Student   : Guan Li
SMA Supervisor   : Assoc Prof Li Le-Wei
Company Supervisor : Dr Olivier Peyran

Timetable Scheduler for ITM (Integrated Training Manager)

Students   : Ho Liang Yoong, Keh Chin Chai,
                      Teo Soo Kng
SMA Supervisor   : Assoc Prof Teo Chung Piaw
Company Supervisor : Mr Yeo Jan Chee

Treating Framework for LP/MIP Programmes

Student   : Kalyana Chakravarthy
SMA Supervisor   : Assoc Prof Huang Huei Chuen
Company Supervisor : Mr Gosselin Vincent

Multiobjective Flight Control System Design

Student   : Lam Wooi Fun
SMA Supervisor   : Assoc Prof Murali Damodaran
Company Supervisor : Dr Yang Guang Hong

Simulation of Cavitating Flows

Student   : Lee Kien Leng, Lawrence
SMA Supervisor   : Assoc Prof Khoo Boo Cheong
Company Supervisor : Dr Tsai Her Mann

Reliability of Multiprocessor Embedded Systems

Student   : Liu Shudong
SMA Supervisor   : Assoc Prof Li Le-Wei
Company Supervisor : Dr Rajendra Patrikar

Modeling and Optimization of a Micro Comb Driven Fiber Optic Switches

Students   : Liu Xiaoxing, Xu Jianfeng
SMA Supervisor   : Assoc Prof Lee Kwok Hong
Company Supervisor : Mr Wang Zhiping

Real Time Crane Deployment

Student   : Mayank Gupta
SMA Supervisor   : Prof Sun Jie
Company Supervisor : Dr Tan Kok Choon

Single and Multiobjective Wing Platform and Airfoil Shape Optimization using Swarm Algorithm

Student   : Ng Kuan Ying
SMA Supervisor   : Asst Prof Tai Kang
Company Supervisors : Dr Tsai Her Mann, Dr Tapabrata Ray

Chip Planning for FPGA IC Design

Student   : Ong Chen Guan
SMA Supervisor   : Assoc Prof Li Le-Wei
Company Supervisor : Dr Olivier Peyran

Optimization of Active Constrained Layer Damping Treatments for Sound Radiation Control of Cylindrical Shells

Student   : Pau Shu Heng, George
SMA Supervisor   : Assoc Prof Liu Guirong
Company Supervisor : Dr Zheng Hui

Development of Effective Constraint Handling Methods for Constrained Optimization Problems
Student   : Poan Choy Ling
SMA Supervisor   : Asst Prof Tai Kang
Company Supervisor: Dr Tapabrata Ray

Simulation of One Dimensional Detonation Waves using the Method of Conservation Element and Solution Element
Student   : Sandeep Somani
SMA Supervisor   : Assoc Prof Khoo Boo Cheong
Company Supervisor: Dr Tsai Her Mann

Back Solving Strike and Barrier for Option and Option Based Structure
Student   : Song Miao
SMA Supervisor   : Asst Prof Toh Kim Chuan
Company Supervisor: Mr Milind Kulkarni

Stochastic Search Algorithms for Airfoil Shape Optimization Problems
Student   : Tan Chee Meng
SMA Supervisor   : Asst Prof Tai Kang
Company Supervisors: Dr Tsai Her Mann, Dr Tapabrata Ray

Selection Model for Ship Selections
Student   : Tan May Ling
SMA Supervisors   : Assoc Prof Murali Damodaran,
                        Assoc Prof Teo Chung Piaw
Company Supervisor: Mr Mark Lim Yew Guan

Computational Fluid Dynamics Study of High Performance Liquid Chromotography
Student   : Tan Sock Ngin
SMA Supervisor   : Assoc Prof Khoo Boo Cheong
Company Supervisor: Dr Lim Chia Ni

Bender's Decomposition for Stochastic Programme
Student   : Ting Shang Kee
SMA Supervisor   : Assoc Prof Huang Huei Chuen
Company Supervisor: Mr Gosselin Vincent

Virtual Reality for Reverberation Chamber E Field Simulation
Student   : Wang Hailong
SMA Supervisor   : Assoc Prof Li Le-Wei
Company Supervisor: Dr Zhang Daming

Numerical Investigation of the Performance of Fluid Film Journal Bearings
Student   : Wang Zhengyuan
SMA Supervisor   : Assoc Prof Murali Damodaran
Company Supervisor: Mr Zhang Qide

Single Carrier Prefix Assisted CDMA for High Speed Wireless Communication Systems
Student   : Yang Kai
SMA Supervisor   : Assoc Prof Li Le-Wei
Company Supervisor: Dr A S Madhukumar

Error Performance of a Multiple Access Based Ultra-Wide Band System
Student   : Zeng Huiwen
SMA Supervisor   : Assoc Prof Li Le-Wei
Company Supervisor: Dr Francois Chin

A Heuristic for Real-Time Container Load Sequencing
Student   : Zhang Changyong
SMA Supervisor   : Prof Sun Jie
Company Supervisor: Dr Tan Kok Choon

Method for a Bridge Topology of 3-Level IGBT Converters
Student   : Zhao Zhengyi
SMA Supervisor   : Assoc Prof Li Le-Wei
Company Supervisor: Dr Rajendra Patrikar

The S.M. project "What Determines the Outcome of Kidney Transplants?" of Tam Soh Khum, an S.M. student from the HPCES Programme (2000/2001) (Project Advisors: Assoc Prof Teo Chung Piaw, Prof Vladimir Bajic, and Dr Vladimir Brusic) has resulted in an article "Use of Artificial Neural Networks in Improving Renal Transplantation Outcomes". On 8 October 2001, it has been accepted for publication in Graft, Vol. 4, No. 8 (Dec 2001). The co-authors include Nikolai Petrovsky, Vladimir Brusic, Graeme Russ, Luis Socha and Vladimir B. Baijc.

IMST programme

Analysis, Appraisal and Improvement on Airbag Sensor Assembly Line
Students   : Cao Zhe, Keh Teng Yang, Xu Qing
SMA Supervisors   : Assoc Prof Bryan Ngoi Kok Ann
                        (Singapore),
                        Prof Kamal Youcef-Toumi (MIT)
Company Supervisor: Dr Teo Kiat Choon

Collaborative Product Commerce for the Product Life Cycle of Hard Disk Drive Industry
Students   : Chen Ke, Lee Sheng Yang, Tian Quan,
                        Wong Pei Lee
SMA Supervisors   : Assoc Prof Loh Han Tong (Singapore),
                        Prof David Hardt (MIT)
Company Supervisor: Dr Liu Zhejie

Multi-Agent System-Based Supply Chain Coordination
Students   : Cheong Lee Fong, Jeong Woo Sung,
                        Pallav Chhaochharia, Yin Zhijie
SMA Supervisors   : Asst Prof Rohit Bhatnagar (Singapore),
                        Dr Stanley Gershwin (MIT)
Company Supervisor: Mr Roland Lim

Building an Intelligent E-diagnostic System for Reducing Mean Time to Repair (MTTR) of Wire Bond Machines
Students   : Du Xian, Sunil Bhandari, Wang Xiaobo
SMA Supervisors   : Assoc Prof Appa Iyer Sivakumar (Singapore),
                        Prof Kamal Youcef-Toumi (MIT)
Company Supervisor: Mr Gary Chen

Issues and Development for an Automated Welding Station using Robotic Arm
Students   : Gu Jiayin, Pan Deng
SMA Supervisors   : Assoc Prof Xie Ming (Singapore),
                        Prof David Hardt (MIT)
Company Supervisor: Assoc Prof Xie Ming

Next Generation Manufacturing in Singapore
Students   : Ker Han Seah, Liu Ying, Lu Jinhan,
                        Ong Wee Leng, Tang Kum Cheong
SMA Supervisors   : Assoc Prof Bryan Ngoi Kok Ann (Singapore),
                        Prof Chun Jung-Hoon (MIT)
Company Supervisors: Mr Warren Wang, Dr Terence Loke

Micro-machining of Silicon and Metals using Femtosecond Laser

Students	: Koh Wee Leong, Wang Lei, Wong Thai Yuan, Zhang Yilei
SMA Supervisors	: Prof Lam Yee Cheong (Singapore), Prof Yue Chee Yoon (Singapore), Prof Lallit Anand (MIT)
Company Supervisor	: Dr Zheng Hongyu

Supply Chain Planning of Global Electronics Manufacturer for Short Life Cycle Products

Students	: Lee Kok Eng, Suruchi, Xing Xiaojun
SMA Supervisors	: Asst Prof Velusamy Subramaniam (Singapore), Assoc Prof Appa Iyer Sivakumar (Singapore), Prof Stephen Graves (MIT)
Company Supervisors	: Ms Sharon Leow, Mr Ramesh Nair

Tooling Cost Estimation Model for Injection Molding

Students	: Padmanaban Ranganathan, Tran Duc Vi, Wang Lan, Zhu Zhiqiang
SMA Supervisors	: Dr Lu Wen Feng (Singapore), Assoc Prof Tor Shu Beng (Singapore), Prof Steven Eppinger (MIT)
Company Supervisor	: Dr Ivan Lee

Issues in Manufacturing of Semiconductors for Wireless & Optoelectronics Applications

Students	: Subhro Bikash Chakraborty, Wang Shiren
SMA Supervisors	: Assoc Prof Yoon Soon Fatt (Singapore), Prof Chun Jung-Hoon (MIT)
Company Supervisor	: Dr Lap Chan

MEBCS programme

Term 1 (1 April – 10 May 2002)

Investigation of ID_FET Fuse Blowing Methods

Students	: Chen Yelin, Tan Kee Tung
Industrial Immersion Manager	: Dr Goh Lin-Tang
Company Supervisors	: Mr Andrew Yew, Mr Chou Sean Wei

Capacity Expansion Through Cycle-Time Reduction for a 2-Stage Bulk Drug Manufacturing Process

Students	: Ho Hai Ting, Wong Yin Tiong
Industrial Immersion Manager	: Dr Victor Wong
Company Supervisor	: Dr S. Vijaya Kumar

Audit and Optimization of Plant-Wide Energy Utilization

Students	: Nivetha Murugesan, Zhang Lifeng
Industrial Immersion Manager	: Dr Goh Lin-Tang
Company Supervisor	: Mr Poh Kim Huat

Understanding the Mechanisms of the Contact Alloy Process for HP's Thermal Inkjet Products

Students	: Tai Du, Zhang Huoming
Industrial Immersion Manager	: Dr Goh Lin-Tang
Company Supervisors	: Mr Leslie Leong, Mr Chou Sean Wei

Review of Distillation/Reflux Process in the Reactor

Students	: Tan Chee Woi, Tian Yuan
Industrial Immersion Manager	: Dr Victor Wong
Company Supervisor	: Mr Goh Yong Keng

Term 2 (20 May – 28 June 2002)

Audit and Optimization of Plant-Wide Water Usage

Students	: Chen Yelin, Tai Du
Industrial Immersion Manager	: Dr Goh Lin-Tang
Company Supervisor	: Mr Poh Kim Huat

Capacity Expansion through Process Telescoping of a 2-Stage Bulk Drug Manufacturing Process

Students	: Ho Hai Ting, Wong Yin Tiong
Industrial Immersion Manager	: Dr Victor Wong
Company Supervisor	: Dr S. Vijaya Kumar

Feasibility Study of Laser-Assisted Etching in HP-TIJ Manufacturing Processes

Students	: Nivetha Murugesan, Tian Yuan
Industrial Immersion Manager	: Dr Goh Lin-Tang
Company Supervisor	: Dr Chia Wai Tuck

Investigation of Non-Uniform Sidewall Bevel and Residues Formation after Slope Metal Etching of Aluminium/Copper Layer

Students	: Tan Chee Woi, Zhang Lifeng
Industrial Immersion Manager	: Dr Goh Lin-Tang
Company Supervisors	: Ms Tan Ming Li, Mr Kevin Lai

Preliminary Study for the Installation of a New Hastelloy Crystallizer in Bay 2 of Steroids Building

Students	: Tan Kee Tung, Zhang Huoming
Industrial Immersion Manager	: Dr Victor Wong
Company Supervisor	: Mr Goh Yong Keng

CS programme

HyperSCSI Network Protocol Driver on Sun Solaris Platform for Network Storage

Students	: Aditya Kumar Gupta, Toni, Ou Hanyan, Zhao Qin
SMA Supervisor	: Asst Prof Lee Wee Sun
Company Supervisor	: Mr Patrick Khoo

Adaptive Update of Training Data for Gene Discovery System

Students	: Ameya Dileep Virkar, Ang Huey Ting, Li Guoliang, Kunal Agrawal
SMA Supervisor	: Assoc Prof Tan Kian Lee
Company Supervisor	: Prof Vladimir B Bajic

Mobile Learning – "Learning Anytime, Anyplace"

Students	: Anuradha, Shakun Mahajan, Wu Jie, Wu Yonghua
SMA Supervisor	: Assoc Prof Leong Tze Yun
Company Supervisor	: Dr Lam Win Hong

MPEG-7 Based Indexing and Summarization of Digital Media for Online Learning

Students	: Chen Yan, Low Wai Chong
SMA Supervisor	: Assoc Prof Wong Weng Fai
Company Supervisor	: Dr Edward Altman

Feasibility Studies in the Globus Toolkit

Students	: Edward Sim Joon, Qiu Long
SMA Supervisor	: Assoc Prof Teo Yong Meng
Company Supervisor	: Ms Tan Joo Geok

Computerized Assessment of Essays

Students : Gunjan Kathuria, Wu Wenjun
SMA Supervisor : Assoc Prof Wynne Hsu
Company Supervisor: Dr Looi Chee Kit

Sound Model Representation

Students : Ma Keng Teck, Zhan Xianfeng
SMA Supervisor : Prof Ooi Beng Chin
Company Supervisor: Dr Wyse Lonce

Diffserv Implementation Using IXP

Student : Qian Haichun
SMA Supervisor : Assoc Prof Wong Weng Fai
Company Supervisors: Dr Jit Biswas, Mr Teo Eng Hwa

A Very High Speed Traffic Aggregator

Student : Qiu Qiang
SMA Supervisor : Assoc Prof Wong Weng Fai
Company Supervisor: Dr Jit Biswas

Integrated Routing Algorithms for IP/DWDM Networks

Students : Yu Bei, Yu Jia
Project Supervisor : Asst Prof Lee Wee Sun
Company Supervisor: Dr Zhou Luying

Intelligent Internet Video Content Caching

Students : Zhang Sheng, Yu Xiaoxue
SMA Supervisor : Assoc Prof Leong Tze Yun
Company Supervisor: Mr Michael Sipusic

Ph.D. Projects (2001/2002)

Thesis abstracts can be viewed online on the SMA website (http://www.sma.nus.edu.sg).

AMM&NS programme

Optical Add/Drop Multiplexer

Student : Agam Prakash Vajpeyi
Thesis Advisor (Singapore) : Prof Chua Soo Jin
Thesis Advisor (MIT) : Prof Eugene A. Fitzgerald

Copper Reliability

Student : Chang Choon Wai
Thesis Advisors (Singapore) : Assoc Prof Choi Wee Kiong,
Assoc Prof Pey Kin Leong
Thesis Advisor (MIT) : Prof Carl V. Thompson

Ge Nanocrystal Growth in Epitaxial Silicon Germanium and its Applications

Student : Eric Kan Wing Hong
Thesis Advisors (Singapore) : Assoc Prof Choi Wee Kiong,
Assoc Prof Chim Wai Kin
Thesis Advisor (MIT) : Prof Eugene A. Fitzgerald

Ni-Silicidation on SiGe

Student : Jin Lijuan
Thesis Advisors (Singapore) : Assoc Prof Choi Wee Kiong,
Assoc Prof Pey Kin Leong
Thesis Advisors (MIT) : Prof Eugene A. Fitzgerald,
Prof Dimitri A. Antoniadis

Thin Film Microbatteries for Integration with Microelectronics

Student : Shi Zhifei
Thesis Advisor (Singapore) : Assoc Prof Lu Li
Thesis Advisor (MIT) : Prof Gerbrand Ceder

Dislocations and Their Effects on the EL/PL Emmissions of lll-Nitrides

Student : Wang Yadong
Thesis Advisor (Singapore) : Prof Chua Soo Jin
Thesis Advisor (MIT) : Prof Clifton G. Fonstad

Structure Evolution of Growth of lll-Nitrides on Silicon

Student : Zang Keyan
Thesis Advisor (Singapore) : Prof Chua Soo Jin
Thesis Advisor (MIT) : Prof Carl V. Thompson

HPCES programme

A Level Set Method for Biological Flows

Student : Le Duc Vinh
Thesis Advisors (Singapore) : Assoc Prof Khoo Boo Cheong,
Prof Nhan Phan-Thien
Thesis Advisor (MIT) : Prof Jaime Peraire

Research Fellows and Research Projects

Project abstracts can be viewed online on the SMA website (http://www.sma.nus.edu.sg).

AMM&NS programme

Dr Heng Chenglin

Expertise: Optoelectronic & microelectronic properties of Si-based nanoscale semiconductor materials & devices.

Optoelectronic Properties of some Si-based System comprised Semiconductor Nanocrystals

Project Advisors (Singapore) : Assoc Prof Choi Wee Kiong,
                               Assoc Prof Chim Wai Kin
Project Advisor (MIT)   : Prof Dimitri A. Antoniadis
Duration   : September 2000 to August 2002

Dr Lei Yong

Expertise: Highly ordered nanowire and nanotube arrays embedded in anodic porous alumina membranes & highly ordered nanoparticle arrays used in two dimensional nanodevices and their characterization by SCM, EFM and AFM.

Growth of Germanium Nanocrystals and Application In Memory Devices

Project Advisors (Singapore) : Assoc Prof Chim Wai Kin,
                               Assoc Prof Choi Wee Kiong
Duration   : October 2001 to October 2003

Dr Yao Linquan

Expertise: Computational mechanics of smart and (or) composite structures.

Finite Element Method for Piezoelectric Structures

Project Advisor (Singapore) : Assoc Prof Lu Li
Duration   : March 2001 to February 2003

Dr Zhang Yong

Expertise: Formation & properties of bulk metallic glasses, and bulk metallic glass-based composite.

Formation of La and Zr-based Bulk Metallic Glass and Bulk Metallic Glass Matrix Composite by Bridgman Solidification

Project Advisor (Singapore) : Assoc Prof Li Yi
Duration   : November 2000 to
                              November 2002

Dr Zhu Tiejun

Expertise: Pulsed laser deposition of ferroelectric thin films & thin micro-batteries.

Pulsed Laser Deposition of Oxide Thin Films of Si substrates

Project Advisor (Singapore) : Assoc Prof Lu Li
Project Advisor (MIT)   : Prof Carl V. Thompson
Duration   : January 2002 to January 2004

HCPES programme

Dr Chen Shuo

Expertise: Biomolecular suspension flow in microchannel using dissipative particle dynamics method.

Biomolecular Suspension Flow in Microchannel Using Dissipative Particle Dynamics Method

Project Advisors (Singapore) : Assoc Prof Khoo Boo Cheong,
                               Prof Nhan Phan-Thien
Project Advisor (MIT)   : Prof Robert A. Brown
Duration   : January 2002 to January 2004

Dr Chen Xiongda

Expertise: Smoothing Newton method and nonlinear network programming.

Semidefinite Programming, Theory, and Applications

Project Advisor (Singapore) : Prof Sun Jie
Duration   : April 2001 to August 2002

Dr Hu Xiangyu

Expertise: Numerical simulation of shock waves in bio-MEMS & biological systems.

Numerical Simulation on Shock Wave in Bio-MEMS and Biological Systems

Project Advisor (Singapore) : Assoc Prof Khoo Boo Cheong
Duration   : January 2002 to January 2004

Dr Li Jianying

Expertise: Analysis of electromagnetic scattering, radiation by using the fast multipole method (FMM) and multilevel fast multipole algorithm (MLFMA).

Electromagnetic Scattering by Conducting or Dielectric Objects: An Analysis Using the Fast Multipole Method (FMM) and Multilevel Fast Multipole Algorithm (MLFMA)

Project Advisor (Singapore) : Assoc Prof Li Le-Wei
Duration   : December 2001 to
                              December 2003

Dr Li Rongheng

Expertise: Complexity analysis for combinatorial problems & heuristic algorithms design and analysis for scheduling & network problems.

Complexity Analysis & Heuristic Algorithms Design and Analysis Combinatorial Problems

Project Advisor (Singapore) : Assoc Prof Huang Huei Chuen
Duration   : September 2000 to September 2002

Dr Liu Xin

Expertise: Computational mechanics, especially the research and application on meshless methods.

Research and Application of Meshless (Meshfree) Methods

Project Advisor (Singapore) : Assoc Prof Liu Guirong
Duration   : May 2002 to May 2004

Dr Liu Xinwei

Expertise: Algorithms and theory for constrained optimization and their applications.

Nonlinear Optimization

Project Advisors (Singapore) : Assoc Prof Khoo Boo Cheong,
                               Prof Sun Jie
Duration   : January 2002 to June 2002

Stochastic Optimization

Project Advisors (Singapore) : Assoc Prof Khoo Boo Cheong,
                               Prof Sun Jie
Duration   : January 2002 to June 2002

Traffic Problems

Project Advisors (Singapore) : Assoc Prof Khoo Boo Cheong,
Prof Sun Jie
Project Advisor (MIT) : Assoc Prof Georgia Perakis
Duration : January 2002 to June 2002

Dr Nie Xiaochun

Expertise: Analysis & design of EM scattering, radiation & MMIC by using the hybrid method & fast algorithm.

Electromagnetic Scattering by Open-ended Cavities: An Analysis using Precorrected-FFT Approach

Project Advisor (Singapore) : Assoc Prof Li Le-Wei
Project Advisor (MIT) : Prof Jacob K. White
Duration : September 2000 to August 2002

Fast Solutions to Electromagnetic Scattering Problems using Precorrected-FFT Method

Project Advisor (Singapore) : Assoc Prof Li Le-Wei
Project Advisor (MIT) : Prof Jacob K. White
Duration : September 2000 to August 2002

Mr Qian Liwen

Expertise: Sampling theory and its application to computation & discrete optimization.

Linear Programming and Stable Admission

Project Advisor (Singapore) : Assoc Prof Teo Chung Piaw
Duration : September 2001 to
September 2002

Mr Wang Shengyin

Expertise: GA-based topology optimization, morphological representation global optimization methods, compliant mechanism.

Topology and Shape Optimization of Structures by Evolutionary Algorithms

Project Advisor (Singapore) : Asst Prof Tai Kang
Duration : March 2002 to March 2004

Dr Xing Xiuqing

Expertise: Aerodynamic design, flow field simulation and numerical optimization's application in turbomachinery.

Optimization and Simulation of Aerodynamics Shapes Using Simultaneous Perturbation Stochastic Approximation and CFD

Project Advisor (Singapore) : Assoc Prof Murali Damodaran
Duration : April 2001 to April 2003

Dr Xu Yigui

Expertise: 1) Atomistic computer modeling of mechanical properties and failure behaviors of nanostructured materials and structures; 2) Neural networks techniques & generic algorithms with application to inverse problems - optimization, identification and detection; 3) Damage detection of composite materials & structures using techniques of modal analysis, elastic-wave scattering and PZT actuators/sensors; 4) Numerical modeling for structural & mechanical vibration and dynamics, fatigue and failure.

Atomistic Computer Simulation of Mechanical Properties and Failure Behaviors of Nanostructured Materials and Structures

Project Advisor (Singapore) : Assoc Prof Liu Guirong
Duration : November 2001 to
November 2002

Dr Xuan Zhaocheng

Expertise: Numerical methods for partial difference equations.

Output Bounds for Partial Differential Equations

Project Advisor (Singapore) : Assoc Prof Lee Kwok Hong
Project Advisor (MIT) : Prof Jaime Peraire
Duration : December 2000 to
December 2002

Dr Zhou Guanglu

Expertise: Computational methods in computational optimization and non-linear complementary & variational inequality problems.

Second Order Cone Programming

Project Advisor (Singapore) : Asst Prof Toh Kim Chuan
Project Advisor (MIT) : Prof Robert M. Freund
Duration : March 2001 to March 2003

IMST programme

Dr Chen Xing

Expertise: Computer aided design & engineering in plastic injection molding, and numerical simulation in powder injection molding.

Simulation of Particle Migration of Powder-Resin in Injection Molding

Project Advisor (Singapore) : Prof Lam Yee Cheong
Duration : July 2000 to May 2001

Dr Fu Yongqi

Expertise: Micro-optics, photonics, MOEMS, optical design, and microfabrication.

One Step Transfer of Diffractive Structure from Designed Pattern to Replica with Hybrid Sol-Gel Film

Project Advisor (Singapore) : Assoc Prof Ngoi Kok Ann, Bryan
Duration : January 2002 to June 2003

Dr Krishnan Padmanabhan

Expertise: Fracture & failure analysis of polymer matrix composites, advanced fibres & composites, micromechanics & interface, and dental composites & wear.

Macrostructural Properties of Fibre/Polymer Composites through the Mesomechanical Route; Micro-Injection Molding

Project Advisor (Singapore) : Prof Yue Chee Yoon
Duration : October 2000 to October 2002

Dr Muthu Mathirajan

Expertise: Applied operations research, heuristic optimization, modeling and scheduling in manufacturing, logistics & distributions management, and decision support systems.

Scheduling of Batch Processing Machines in Semiconductor Manufacturing

Project Advisor (Singapore) : Assoc Prof Appa Iyer Sivakumar
Project Advisors (MIT) : Dr Stanley B. Gershwin,
Prof Stephen Graves
Duration : May 2002 to December 2003

Dr Saddikuti Venkataramanaiah

Expertise: 1) Design and analysis of cellular manufacturing systems; 2) Manpower planning and allocation models; 3) Performance analysis of logistics systems; 4) Models for integrated lotsizing and scheduling in the semiconductor industry and ; 5) Inventory control models

Cellular Manufacturing

Project Advisor (Singapore) : Assoc Prof Rohit Bhatnagar
Duration : July 2002 to July 2004

Dr Wang Shanzhong

Expertise: MBE & CVD growth of semiconductor materials & its microstructures; characterization of semiconductor materials with different kinds of tools such as microscope, SEM, XRD, TEM, SEM, AFM, Raman, PL PLE, PR, MPR, transmittance, I-V, C-V, Hall & so on; and standard semiconductor processing for electronic and optical devices.

Development of Compound Semiconductor Device Fabrication and Growth Technology

Project Advisor (Singapore) : Prof Yoon Soon Fatt
Project Advisor (MIT) : Prof Clifton G. Fonstad
Duration : March 2001 to March 2003

Dr Xiong Mohua

Expertise: Complicated information systems analysis & modeling web-based supply chain management, and Decision Support Systems.

Customer Demand Fulfilment Approaches under Limited Capacity

Project Advisors (Singapore) : Assoc Prof Tor Shu Beng, Asst Prof Rohit Bhatnagar
Duration : October 2001 to October 2003

Dr Yuan Miaolong

Expertise: Visual inspection, image matching, 3D reconstruction, CAD, and spatial layout.

Development and Testing of the Advanced SQC and Vision Inspection Techniques

Project Advisor (Singapore) : Assoc Prof Xie Ming
Duration : September 2000 to September 2003

Mr Zhang Wenyu

Expertise: All in progressive die design automation.

Progressive Die Design Automation

Project Advisor (Singapore) : Assoc Prof Tor Shu Beng
Duration : March 2002 to March 2004

MEBCS programme

Dr Chen Weixiang

Expertise: Nanostructured materials for Li-ion batteries and fuel cell.

Inorganic Nanocomposites

Project Advisor (Singapore) : Assoc Prof Lee Jim Yang
Duration : July 2001 to July 2003

Dr Deng Rensheng

Expertise: Hydrodynamics and mixing behavior of fluidized beds; cracking and pyrolysis of heavy hydrocarbons; and instability analysis of flow in granular materials.

Instabilities in Flow of Granular Materials

Project Advisor (Singapore) : Asst Prof Wang Chi-Hwa
Duration : October 2001 to June 2002

Dr Palaniswamy Ravi

Expertise: Synthesis and characterization of novel stimuli responsive amphiphilic block copolymers for biomedical applications.

Synthesis and Characterization of Stimuli Responsive Amphiphilic Block Copolymers for Targeted Drug Delivery

Project Advisor (Singapore) : Assoc Prof Tam Kam Chiu, Michael
Duration : August 2001 to August 2003

Mr Parayil Kumaran Ajikumar

Expertise: Design, synthesis, and structure activity study of biologically interesting molecules such as peptides and peptido mimetic compounds, solid phase peptide synthesis, solid phase organic synthesis, and combinatorial chemistry.

Design of Novel Peptides as Building Blocks for Functional Materials

Project Advisor (Singapore) : Asst Prof Suresh Valiyaveettil
Duration : December 2001 to December 2003

Dr Ren Lei

Expertise: Surface modification of nano colloids with drug adsorption; hybrid nanocomposite interaction with cancer cells.

Nanomaterials for Drug Delivery

Project Advisor (Singapore) : Assoc Prof Chow Gan-Moog
Duration : July 2001 to June 2003

Dr Theivanayagam Chairman Deivaraj

Expertise: Carbon mono oxide resistant electrocatalysts for direct methanol fuel cells, and biomolecule guided nanoparticle synthesis.

Chemical and Biochemical Synthesis of Multi-Metallic Nanoclusters

Project Advisor (Singapore) : Assoc Prof Lee Jim Yang
Duration : April 2002 to April 2004

Dr Victor Wong Vai Tak

Expertise: Plant & mammalian cell cultivation for production of biotherapeutics.

Understanding the Effects of Media Supplements in Serum Free Media on Hybridoma Cells via Transcriptional Analysis

Project Advisor (Singapore) : Prof Miranda Yap G. S.
Project Advisor (MIT) : Prof Daniel Wang I. C.
Duration : May 2001 to April 2003

Dr Winnie Fung Kar Yee

Expertise: Signal transduction of GDNF and NTN receptors in mammalian cells.

Signal Transduction as a Means to Delineate the Functions of GDNF and NTN Receptors in Mammalian Cells

Project Advisor (Singapore) : Assoc Prof Too Heng-Phon
Project Advisor (MIT) : Prof Harvey F. Lodish
Duration : March 2002 to March 2004

Dr Xue Ying

Expertise: Development and application of computational methods in ligand-protein interaction.

Development of a Fast-Speed Method for Computing Molecular Descriptors used in Computer Aided Drug Design

Project Advisor (Singapore) : Assoc Prof Chen Yuzong
Duration : February 2002 to February 2004

Students have access to research facilities at NRIs.

Dr Yao Jia

Expertise: Property and structure of polyelectrolytes.

Thermodynamics and Physical Characteristics of Stimuli Responsive Amphiphilic Block Copolymers

Project Advisor (Singapore) : Assoc Prof Tam Kam Chiu, Michael
Duration : February 2002 to August 2003

Dr Yu Shi

Expertise: Design, synthesis, and physical study of magnetic nanostructured materials.

Designation and Development of Magnetic Nanoparticles for Drug Delivery

Project Advisor (Singapore) : Assoc Prof Chow Gan-Moog
Duration : April 2002 to September 2002

CS programme

Dr Fang Bin

Expertise: Computer vision, pattern recognition, image processing in biometrics, document processing, and medical image processing.

Tumor Cell Identification using Features Rules

Project Advisor (Singapore) : Assoc Prof Wynne Hsu
Duration : September 2001 to September 2002

Dr Zhang De

Expertise: Information retrieval, data mining, and machine learning.

Question Answering

Project Advisor (Singapore) : Asst Prof Lee Wee Sun
Duration : January 2002 to January 2004

Research Highlight (1)

Student   : **Gan Chee Lip (Ph.D. 1999/2000 intake - AMM&NS programme)**

Thesis Advisors   : **Prof Carl V. Thompson (MIT)**
                        Assoc Prof Choi Wee Kiong (NUS)
                        Assoc Prof Pey Kin Leong (NTU)

Research Title   : **Reliability Assessment Methodologies for Copper-Based**
                        Interconnects on Integrated Circuits

Research Outline

Aluminum metallization has been used as an interconnect material in every integrated circuit for the past few decades. However, as the dimensions of devices continue to shrink and the speed of circuits is increased with each generation of technology, copper metallization has emerged as a replacement for aluminum interconnects due to its higher electrical conductivity.

Several kilometers of metal interconnects are used to construct each single silicon-based high-performance integrated circuit. In each circuit, millions of metal segments exist and these elements are a great reliability concern due to electromigration-induced failures. Current design rules and practices usually attempt to be overly conservative to ensure that a circuit is immune to electromigration-induced failures. In order to optimize the performance for each generation of technology while maintaining a high overall reliability, new design and assessment methodologies are needed to more accurately account for the effects of circuit layout on the risk of generating electromigration-induced failure.

We have found that the direction of current flow in a copper interconnect of a multi-level metallization system affects its failure characteristics and reliability [1, 2]. Moreover, the reliability behavior of different lengths of copper lines is significantly different from the characteristics that were observed in aluminum interconnects [3]. Lastly, we have shown that the fundamental reliability unit of copper metallization is not a single straight segment as frequently assumed in circuit-level analyses [4].

[1] Gan C. L., Thompson C. V., Pey K. L., Choi W. K., Tay H. L., Yu B. & Radhakrishnan M. K., "Effect of current direction on the lifetime of different levels of Cu dual-damascene metallization," Appl. Phys. Lett., Vol. 79, pp. 4592 (2001).

[2] Gan C. L., Wei F., Thompson C. V., Pey K. L., Choi W. K., Hau-Riege S. P. & Yu B., "Contrasting failure characteristics of different levels of Cu dual-damascene metallization," IPFA 2002 Proceedings - 9th International Symposium on the Physical & Failure Analysis of Integrated Circuits (July 2002).

[3] Wei F., Gan C. L., Thompson C. V., Clement J. J., Hau-Riege S. P., Pey K. L., Choi W. K., Tay H. L, Yu B. & Radhakrishnan M. K., "Length effects on the reliability of dual-damascene Cu interconnects," Proceedings of the Symposium on Silicon Materials-Processing, Characterization, and Reliability, Spring 2002 Meeting of the Materials Research Society.

[4] Gan C. L., Thompson C. V., Pey K. L., Choi W. K., Wei F., Clement J. J., Hau-Riege S. P., Tay H. L., Yu B. and Radhakrishnan M. K., "Experimental characterization of the reliability of 3-terminal dual-damascene copper interconnect trees," Proceedings of the Symposium on Silicon Materials-Processing, Characterisation, and Reliability, Spring 2002 Meeting of the Materials Research Society.

*Reliability testing of
Copper interconnects
using Electromigration
Test System.*

Research Experience

My research experience under the Singapore-MIT Alliance has been truly enriching and exciting. Besides Assoc Prof Pey Kin Leong and Assoc Prof Choi Wee Kiong as my Singapore advisors, I also have Prof Carl V. Thompson, an MIT advisor, whom Assoc Prof Pey and Assoc Prof Choi had set up collaboration with before I started on my research project. Despite the 12-hour difference between Singapore and MIT, our research group holds weekly project discussions using the videoconferencing tools provided by SMA. These meetings provide a great stimulus of interesting ideas that help the progress of the research. At the same time, I have the chance to "meet" other MIT graduate students in Prof Thompson's research group and understand the work that they are doing.

In the SMA research project, I have the opportunity to work with many researchers and engineers both in Singapore and the United States of America. The collaboration established by my advisors allows me to conduct my research at the Institute of Microelectronics and Chartered Semiconductor Manufacturing in Singapore. At the same time, I have discussions with our collaborators from International Sematech, Intel Corp., and the Sandia National Laboratory in USA.

The SMA Annual Symposium is another great avenue for me to meet and interact with other MIT students. It allows me to present my research findings to the SMA community. In addition, the semester stay in MIT was another one of the unique parts of the SMA research experience. The time spent in Boston, immersed in the MIT culture and way of life was very memorable. Besides having daily discussions with the MIT students, I had the opportunity to experience a life away from Singapore. Conducting research under the SMA programme is indeed having the best of both worlds.

Gan Chee Lip

Research Highlight (2)

Student	:	**Karthik Natarajan (Ph.D. 1999/2000 intake – HPCES programme)**
Thesis Advisors	:	**Prof Dimitris J. Bertsimas (MIT)** **Assoc Prof Teo Chung Piaw (NUS)**
Research Title	:	**Robust Optimization In Stochastic Project Scheduling, Finance, And Queuing Theory**

Research Outline

A project consists of a set of activities that need to be performed in a specific order for it to be completed. Traditionally the Critical Path Method (CPM) is used to analyze projects with deterministic activity durations. The random nature of future activity durations however makes it necessary to develop models that can handle the uncertainties effectively. PERT techniques make use of the knowledge of complete probability distribution of activities to compute the expected completion time of the project. However, in practice, it is not reasonable to assume complete knowledge of probability distributions of activities. In this research project, we focus on computing bounds on expected completion time and expected project

tardiness (penalty of project continuing beyond a deadline date) given only partial information of the activity durations. We assume knowledge of the lower bounds on the activity durations along with first, second and cross moments among the various activities. The computation of these distribution free bounds on the parameters of interest is performed using techniques of semidefinite optimization. This optimization technique is currently a hot topic of research as it is a convex nonlinear problem that can be efficiently solved in practice. We provide an efficient solution technique to the problem in project management (not previously known), and perform comparisons both theoretical and computational with existing techniques.

The application of such techniques of semidefinite programming on problems of finance and queuing theory with partial moment information is currently being investigated. Finding robust bounds on parameters that describe the performance of such systems is of paramount importance in a stochastic setting and our research focuses on it.

[1] Bertsimas D., Natarajan K. & Teo C. P., "Applications of semidefinite optimization in stochastic project scheduling", to be presented in the 2nd Annual McMaster Optimization Conference, August 2002.

[2] Cheng Y. L., Sen H. C., Natarajan K., Teo C. P. & Tan K. C., "Dispatching Automated Guided Vehicles in a Container Terminal via Network Flow Methods", Working Paper 2002.

Research Experience

I have spent the last three years interacting with the faculties in MIT and Singapore, and found this to be a great experience. The courses that had to be taken in the first year at SMA provided me with the fundamentals of operations research and linear algebra that are a must for doing research in this area. This allowed me to have a taste of the various research avenues before deciding on what I wanted to pursue.

However, the trip to MIT gave me the real impetus to do research. It was exceedingly wonderful to be able to interact with the MIT students and faculty, and find out about the coursework and research opportunities. Being prepared, I spent the last year with all my energy focused on research.

I was also given the opportunity to take up other courses offered by other faculties in NUS and to take on the role of Teaching Assistant which I find to be useful and interesting. Finally, I must say that I owe this to both my supervisors, Prof Dimitris Bertsimas and Assoc Prof Teo Chung Piaw, without whose passion for research, my learning experience at SMA would not be a fulfilling one.

Karthik Natarajan