Vision & Mission

Our Vision
A leading bioengineering department advancing knowledge and nurturing talent.

Our Mission
To provide quality bioengineering education through integration of engineering with the biomedical sciences.

To foster new knowledge and achieve leadership in bioengineering research through the development of novel technologies and innovative applications.

Message from the Head

Our beginning 10 years ago was characterised by passion and dedication. It was a group of dedicated staff from various disciplines with a strong passion for Bioengineering meeting regularly to conceive the formation of the Division of Bioengineering. It is heartening to note that we still operate in that same mindset.

With passion and dedication we aim to nurture bioengineers with a strong foundation in engineering, science and technology capable of contributing to biomedicine through innovation, enterprise and leadership. Our educational program has a strong emphasis on science and engineering fundamentals with a high degree of flexibility which can provide a wide diversity of educational experiences. We strive to graduate versatile bioengineers that are equipped to lead and be an integral part of the biomedical engineering industry now and in the future.

The Bioengineering undergraduate program has been accredited for the period 2007-2013 by the Engineering Accreditation Board, Singapore which is a signatory to the Washington Accord. In consultation with our industry partners, we ensure that the curriculum is relevant. The accreditation is an assurance of quality curriculum and recognition of the program by the industry.

Bioengineering is profoundly changing the world of biomedicine through novel research and technological breakthroughs that revolutionise health and medical care. As such our Faculty members are research-active and heavily involved in interdisciplinary, interdepartmental and interfaculty research collaboration, particularly with the Yong Loo Lin School of Medicine. The Department has developed four strong platform technologies, they are: biomaterials & tissue engineering, bioimaging & biosignals processing, biomechanics & computational bioengineering, bionanotechnology & mechanobiology. We are committed to active participation in the faculty-wide development of the “Engineering in Medicine” research theme with its thrusts in Neuroengineering, Therapeutics Delivery Systems, Point-of-Care Medical Devices and Medical Robotics. Our research has attracted large grant funding and also yielded fruits in high impact publications, patents and spin-off companies.

Bioengineering at NUS will continue to innovate and re-invent itself to stay relevant to our stakeholders; students and industry alike. We will endeavour to be ahead of the pack, leading in effective learning tools and pioneering cutting edge research for many years to come.

I am delighted to report that as of 1st October 2011, the Division of Bioengineering has been re-designated as the Department of Bioengineering.

James Goh
Head and Professor
Department of Bioengineering
Faculty of Engineering
National University of Singapore
My heartiest congratulations to the Department of Bioengineering, Faculty of Engineering, as it celebrates its 10th Anniversary!

The Department has certainly come a long way since its inception in 2002. Among its many achievements, the Department has made several breakthroughs in the areas of research and education. It has served as an effective multi-disciplinary platform for researchers from NUS, and their collaborators from local hospitals, research institutes as well as overseas universities. It has also make important contributions to both undergraduate and PhD education.

As we mark the 10th Anniversary of the Department, we also celebrate the achievements of the individual faculty, staff and students of the Department. As you go through this Commemorative Book, I hope you share my pride in the excellent progress that it has made, as well as the excitement of its future, which is full of promise and potential.

Professor Tan Chorh Chuan
President
National University of Singapore
A multi-disciplinary and integrative approach to research and education

It is with great pleasure that I join the Bioengineering Department of the NUS’s Faculty of Engineering in celebrating its 10th anniversary.

The establishment of the Bioengineering Division in 2002 was in tandem with the decisive push by the Singapore Government to develop the biomedical sector in the early 2000s. By adopting a multi-disciplinary and integrative approach to bioengineering research and education, the Bioengineering Department has grown from strength to strength since inception. It has contributed significantly to Singapore’s bid to become a leading international bio-cluster in Asia by building up intellectual and human capital over the last decade.

Today, global trends of rapid urbanisation, ageing population, rising affluence and improvement in health care have given rise to new significant demand for biomedical solutions. True to its raison d’etre, NUS’s talented academic staff with varied background in engineering, life sciences and medicine has recognized these trends and carry out exciting cutting-edge translational research that improve the living standards of the community at large. For instance, the development of a CTC Microfluidic filtration Biochip (CTChip) by Prof Lim Chwee Teck, scored as one of the world’s first in being able to isolate whole rare and viable CTCs from patient’s blood without having to fix the cells or using antibodies as compared to current techniques. By using cell mechanics principles to develop this microfluidic biochip to physically filter, isolate and retrieve the larger and stiffer cancer cells from the softer blood cells via semi-circular microtraps without the need for biomarkers, Prof Lim’s technique is innovative and more importantly translational. Another success story is embodied in a novel, ultra-low powered electrocardiogram (ECG) chip developed by Prof Lian Yong. By commercializing this medical device, NUS’s spinoff called Clearbridge VitalSigns is poised to enter the global cardiac healthcare market worth some US$8 billion.

I am confident that the multi-disciplinary and integrative approach to research and education adopted by the Bioengineering Department will continue to inspire and spur many more exciting bioengineering possibilities in the years ahead!

Professor Tan Eng Chye
Deputy President (Academic Affairs) & Provost
Office of the Provost
National University of Singapore
Dean of Medicine

My heartiest congratulations to the Division of Bioengineering on your 10th Anniversary!

The faculty and staff of the Yong Loo Lin School of Medicine and the Alice Lee Centre for Nursing Studies join me in celebrating this significant milestone.

Over the last ten years we have watched the Division grow into a world-class team of faculty and students. I am confident that the next decade will hold even greater promise given your multidisciplinary and integrative approach to research and education. You are already making a great impact in work such as the early detection of cancer and neurocognitive impairment. These are critically important issues as we face the challenges of an aging population.

We live in an exciting era where we can shape the future, and we are delighted to be one of your partners as we create a better place for Singapore and the community we live in.

Professor John Wong
Dean, Yong Loo Lin School of Medicine
National University of Singapore

Dean of Science

Greetings and congratulations to the Division of Bioengineering on its 10th Anniversary celebrations!

Bioengineering integrates physical, chemical, mathematical sciences and engineering principles for the study of biology, medicine or health. It creates new knowledge from the molecular to the organ systems levels, and seeks to develop innovative solutions for the prevention, diagnosis and treatment of disease. It inherently integrates the sciences with engineering, and I am pleased that the Faculty of Science has had the privilege of contributing to the development of BIE through research collaboration and joint appointments.

The Faculty of Science also offers more than 10 science modules at both undergraduate and post-graduate levels, in Life Sciences, Chemistry, Mathematics and Physics. These fundamental modules lay the foundations that BIE students may equip themselves with, as they develop progressively to be a full-fledged bioengineer.

As it launches itself into a new decade, BIE is eminently poised to promote and facilitate cross-fertilization of ideas and multi-disciplinary teaching and research. I wish the Division the very best, and look forward to our continuing relationship both in the teaching and research domains.

Professor Andrew Wee
Dean, Faculty of Science
National University of Singapore
Congratulations to the Division of BioEngineering on your 10th Anniversary!

This Division can be proud of its achievements within a short span of 10 years. It has gained international recognition for the work carried in the Division.

The Faculty of Dentistry has enjoyed good collaboration with the Division of BioEngineering in research and teaching, since the department started in 2001. We have worked on joint research projects, seminars and joint supervision of graduates students. The Division had extended our Faculty tremendous support in sharing their expertise and resources.

We look forward to many more years of working together, tapping on our strengths and synergizing our efforts to scale greater heights.

Associate Professor Grace Ong
Dean, Faculty of Dentistry
National University of Singapore

My heartfelt congratulations to the NUS Division of Bioengineering for reaching a successful 10 years milestone! From the transformation of the initial NUS Bioengineering Initiative more than 10 years ago, you have accomplished much more than I could have envisioned when we set out to develop this pioneering multidisciplinary field in Asia. This milestone shows that Bioengineering truly has a strong foothold in Singapore not just as an educational degree, where your graduates are now number over the hundreds, but also that it is a significant industrial and economic contributor to the nation. I hope that my early contributions to the Initiative and subsequently to the Discipline, both as the Founding Director of NUS Bioengineering Initiative and then Dean of NUS Faculty of Engineering, has been of service to bring you to where it is now. I wish you all the success for your next 10 years and onwards, in research, education and service to our nation!

Professor Seeram Ramakrishna
Former Dean of Engineering
National University of Singapore

I am delighted to write a short message on this special occasion of the 10th Anniversary Celebration of the Division of Bioengineering as Past-President of the Biomedical Engineering Society (Singapore) - BES.

The biomedical engineering activities at NUS started in 1983 when a group of researchers from the Faculty of Engineering and Faculty of Medicine got together to organize the 1st Symposium on Biomedical Engineering to discuss about common interest. The first three symposia were organised mainly as a university’s conference to create a platform for the exchange of knowledge. It gradually grew to become an important international conference since 1987 attracting participants from all over the world. The 14th International Conference on Biomedical Engineering (ICBME), held in conjunction with the World Congress of Biomechanics, attracted more than 1600 participants from over 42 countries last year. The 15th ICBME will be organised in 2013 and this series of international conference has anchored NUS strongly in the international bio-medical engineering scene. It provides an international forum for our local researchers to showcase their work and interact with prominent researchers from all over the world.

The Biomedical Engineering Society was established in 1991 by the same group of staff e.g. Kamal Bose, Lee Eng Hin, James Goh from the Department of Orthopaedic Surgery, Teoh Swee Hin, Toh Siew Lok, Low Hong Tong and myself from the Department of Mechanical Engineering, who had been active in organising the series of ICBME. One of the main objectives is to promote biomedical engineering research in Singapore. It pre-dated the Singapore government’s drive towards biomedical engineering as a key high value-added industry contributing to Singapore’s economy.

In response to the call for more biomedical engineers to support the economy, the Division of Bioengineering was formed in 2001 mainly by staff spinning off from the Department of Mechanical Engineering and Faculty of Medicine. The Division has grown from strength to strength and is now having a yearly intake close to 100. I am glad that the Division is now under the capable leadership of Prof. James Goh who has been involved in the development of biomedical engineering since 1980s. I believe he is the first fully-trained biomedical engineer that we have at NUS. I hope your Division will continue to work closely together to achieve new heights.

It now remains an occasion to celebrate what you have achieved and I wish you all the best in your future endeavours.

Professor Chew Yong Tian
Past President
Biomedical Engineering Society (Singapore)
My heartiest congratulations to the Division of Bioengineering, NUS on its 10th birthday! It seems not that long ago that the division was established. My own experience with bioengineering takes me back to the 1980’s when I just returned from Canada and started my career in NUS in Orthopaedic Surgery. I remember meeting Dr James Goh who had also just returned from his doctoral studies in Strathclyde University and both of us worked closely together on many biomechanical projects and ran the Gait Analysis Laboratory. I also remember attending the first Symposium on Biomedical Engineering in the Faculty of Engineering building in the mid-1980’s. This conference has now become one of the most important international biomedical engineering conferences (ICBME) and is held in Singapore every two years. The close relationship between the Faculties of Medicine and Engineering in NUS has contributed immensely to the growth of bioengineering in Singapore. In fact our NUS Tissue Engineering Programme (NUSTEP) is a prime example of this close collaboration. Today, it is a commonly held belief that new breakthroughs will come from the interphase between different fields such as biomedicine and the physical sciences and engineering. I wish the Division of Bioengineering every success for the future and look forward to continuing our close relationship to scale greater heights and contribute to the health and well-being of our people in the next decade.

Professor Lee Eng Hin  
Executive Director  
Biomedical Research Council  
Agency for Science, Technology and Research (A*STAR)

Dear James and Colleagues of the Division of Bioengineering, Congratulations on your 10th Anniversary, and many more successes in the next 10 years. IBN looks forward to more interactions with you and your students.

Jackie Ying  
Executive Director  
Institute of Bioengineering and Nanotechnology  
Agency for Science, Technology and Research (A*STAR)

Bioengineering has pioneered science based education by training students in engineering principles for applications in biology and medicine. The ability to teach and train students in disciplines that traverse traditional departmental or divisional boundaries is the way education and research in other fields should try to emulate. As societal and economic problems become increasingly complex and require systems-level approaches to solutions; individuals trained in the breadth of multiple disciplines are highly valuable to modern society as they generate ideas and solve problems free of the confines narrow specialisations. I congratulate NUS’ Bioengineering Division for its pioneering efforts and its 10 years of training top quality graduates.

Dr. Raj. Thampuran  
Executive Director  
Science and Engineering Research Council  
Agency for Science, Technology and Research (A*STAR)

Congratulations as you celebrate the 10th Anniversary of Bioengineering at the National University of Singapore. It is amazing that in such a short period of time you have achieved such international prominence. The future looks very bright as you seek international partnerships in educational and research endeavors.

Professor Herbert F. Voigt  
President  
International Federation for Medical and Biological Engineering

On behalf of the IEEE Engineering in Medicine and Biology Society, I am writing to extend our warmest congratulations to the Division of Bioengineering of National University of Singapore on its 10th Anniversary. Over the last ten years, your division has had significant impact on the development of the bioengineering field. We are not only proud of the outstanding research accomplishments of your faculty and students but also greatly appreciate the important contributions that you and your colleagues have made to educating and training a new generation of biomedical engineers. I wish you and your colleagues greater success in the years ahead.

Professor Zhi-Pei Liang  
President  
IEEE Engineering in Medicine and Biology Society
I would like to congratulate the Division of Bioengineering, of the Faculty of Engineering at NUS for its 10th anniversary.

In the last 10 years, it is now increasingly recognized that the medicine cannot progress on its own without major paradigm shifts. One of this is the need to develop ideas and solutions to diagnose, prevent and treat diseases through an integrated, interdisciplinary approach in transitional research. In particular, the area of medical technology or MedTech has great potential and is the next frontier for personalized and diagnostic medicine. To achieve this, there is a greater need to have divisions and departments that span interface areas. The Division of Bioengineering is one such initiative without the Faculty of Engineering.

I have followed and seen the remarkable progress in this Division as it develops a world leading research programme in bioengineering through projects that addresses the needs of modern clinical medicine with the scientific rigor of engineering. Our clinicians and clinician scientists at the Department of Ophthalmology and the Singapore Eye Research Institute looks forward to further collaborative efforts in the next 10 years!

My congratulations again on this wonderful achievement.

Professor Wong Tien Yin
Head, Department of Ophthalmology
Director, Singapore Eye Research Institute
National University of Singapore & National University Hospital

On the 10th anniversary of the Division of Bioengineering, I would like to offer my heartfelt congratulations to Professor James Goh and staff on this happy occasion. The remarkable progress made by Bioengineering through several breakthrough projects by its talented academic staff with varying backgrounds in engineering, life sciences and medicine belies its short history of just ten years.

The Department of Orthopaedic Surgery is proud to be associated with Bioengineering through its present Head, Professor James Goh who brought bioengineering expertise to the Department and linked Bioengineering and Orthopaedics in collaborative research. Over the years, there has been a significant increase in cross faculty collaboration in musculoskeletal biomechanics, orthopaedic implants and devices, biomaterials, tissue engineering and repair.

The Department of Orthopaedic Surgery looks forward to continued close collaboration with Bioengineering and wishes you even greater success in years to come!

Professor Wong Hee Kit
Head, Department of Orthopaedic Surgery, National University of Singapore
Chair, University Orthopaedics, Hand and Reconstructive Surgery Cluster, National University Health System

As surgeons, we realize that operating on one patient at a time, there is a finite number of people we can help in our lifetime. This fact forms the basis for us to actively seek the collaboration for Bioengineers to develop medical Technologies and devices to benefit more patients in need of better therapies, to save lives and reduce sufferings. We are privileged to have on campus the Division of Bioengineering. The Division has a group of excellent, enthusiastic and top rate people who work closely with us towards making lives better. On behalf of the University Surgical Cluster I wish everyone good health. But if in the future some of us become unwell, the discoveries we jointly develop may save our own lives.

Congratulations on the 10th Anniversary and look forward to exciting work together.

Professor Lee Chuen Neng
Head of Surgery, National University of Singapore
Chair, University Surgical Cluster, National University Health System

It gives me great pleasure to congratulate the National University of Singapore's Bioengineering Department on their 10th Anniversary. As a sister Department, it is exciting to see the advances that NUS has made and continues to make in this important and exciting field. As I am sure you know, bioengineering is the one field of engineering where engineers directly work to make sure people are healthy; this will never “go out of fashion” and can only grow as technology drives ever-stronger links between engineering and medicine. Singapore’s remarkable investments in this area will certainly stand you in good stead in future years, and I look forward to further interaction between our Departments as they grow and develop.

Professor C.Ross Ethier
Head, Department of Bioengineering
Imperial College London

Professor Ethier is a well-respected bioengineer known for his contributions to the field, and his presence at the event signifies the international recognition and influence of NUS Bioengineering.

As the Division of Bioengineering continues to grow, it is evident that they are well-positioned to contribute significantly to the advancements in medical technology and personalized medicine. The collaborative efforts between departments and faculties highlight the interdisciplinary approach that is crucial for tackling complex health issues. The congratulations from esteemed figures in the medical and engineering fields underscore the impressive achievements of NUS Bioengineering over the past decade.
It is my pleasure to be invited to contribute these few comments on this momentous occasion. I have been honored to have numerous fruitful interactions with the Division through collaborative research projects with Professors CT Lim, Michael Raghunath and Dieter Trau, and in connection with GEM4 and SMART BioSystems and Micromechanics IRG. Also, I have enjoyed working with others in the Division, especially James Goh, in the World Council of Biomechanics. While my permanent home is at MIT in Mechanical Engineering and Biological Engineering, I have already begun to enjoy the benefits of my role as Adjunct Professor in the Division for this semester. I very much look forward to continued interactions during the coming semester and in subsequent years during which I am sure that my connections with your prestigious Division are certain to grow. Please accept my warmest congratulations on this special Anniversary, and my best wishes for continued success and growth.

Professor Roger Kamm
Massachusetts Institute of Technology & National University of Singapore

On the behalf of Department of Biomedical Engineering, Zhejiang University, I send my heartfelt congratulations to you on this momentous celebration. During the past decade, Division of Bioengineering, NUS, grew fast with fruitful success in academic research and education. With a young and proud history, it has been internationally recognized as an important institution in the field of bioengineering and has shown vital role in international activities. Being partners, in the recent years we have conducted marked achievements in cooperation, from student exchange to joint summer course program. The great contribution of your side in these events is highly admired and the association with your colleagues has left numerous cherished memories. I am confident that in next decade with creative efforts and wisdom your division will reach greater heights and wish you every success.

Professor Gangmin Ning
Chair, Dept. of Biomedical Engineering
Zhejiang University

It is with a mixed sense of honours, nostalgia and exhilaration that I wrote these forewords on the occasion of the tenth anniversary of the BioEngineering Division – from my perspectives as the first Head of Division.

It was in the midst of the strong support and commitment from the government, to the tune of 4B USD, for strengthening up the research infrastructure in biomedical sciences and engineering, in the midst of other equally important developments designed to further the road to the research-oriented university that has now become NUS (most notably SMA, Duke, and John Hopkins initiatives), a group of us, called the Core Group in BioEngineering, met for the 1st time on Aug 25, 2000, to prepare a submission to EDB on the Faculty position on an NUS BioEngineering Initiative. This core group met at least 15 more times, punchually on every Friday, involving key persons from various Faculties, until early Jan 2001 to chart the way for BioEngineering Education, Research and future directions. By Oct 19, 2000, in the 1st BioEngineering Steering Committee meeting, in which all major Faculties were presented, together with the then Provost Prof Chong Chi Tat approval, that the initiative was formally called NUS BioEngineering Initiative, to be driven by Engineering, hosted by the Department of Mechanical Engineering, enjoying full support of the Office of Life Sciences (OLS), a University-wide body just setup in early 2000 to champion NUS as a prominent key player in Biomedical Sciences & Engineering, and all the participating Faculties. A minor BioEngineering programme was up and running in Jan 2001, with a major and graduate programmes approved in Nov 2001. Under OLS and the Faculty of Engineering (FoE) support, an active recruiting was in full swing, and by Feb 2001, it was clear that we had the concentration of relevant people to become an academic body. With a presentation to the FoE and the Registrar in Mar 2001, our NUS BioEngineering Initiative became the Division of BioEngineering in Oct 2001, an academic body with a Department status reporting to the FoE – together with this, the BioEngineering Corridor, a joint-lab concept was on the way, opening in July 2002. This feat is the collective effort of several individuals, with the strong unwavering support of senior administrators in the University and Government, and it is better left for the current Head to acknowledge them. Initially, the term “Division” was chosen deliberately (not the customary “Department”), to emphasize the multi-disciplinary nature of BioEngineering; “Division” may also be taken as a de-mountable programme, should the need ever arised! From what I have seen, BioEngineering is a vibrant, full of enthusiasm and is here to stay as a full-fledged Department, carrying its own share of the FoE’s burden and the responsibilities. Its future is well and truly in your hands.

Many congratulations, our academic baby is ten years old, and is matured!

Finally, may I congratulate us with a Chinese proverb “May we live through interesting and challenging time”, but add an important appendage to it, “and be profited by it”.

Professor Nhan Phan-Thien
Founding Head of Department
2001:
A “Minor in Bioengineering” was offered by the Faculty of Engineering

2001:
The Division of Bioengineering received funding from the Office of Life Sciences (OLS), now the Life Science Institute (LSI), to develop the Bioengineering Research Programme

2002:
The Bioengineering Corridor (E3 level 5) was officially opened

2004:
The first batch of Bioengineering graduate students were enrolled

2003:
The first batch of undergraduate students were enrolled in the “Major in Bioengineering” programme

2005:
Space for the expansion of Bioengineering laboratories was allocated in E3A Level 7

2006:
Graduation of the first batch of Bioengineering Major undergraduate students

2008:
Accreditation from the Engineering Accreditation Board for the Bachelor of Engineering (Bioengineering) undergraduate programme

2010:
Two spin-off companies founded: Clearbridge Nanomedics and Ayoxxa Living Health Technologies

2011:
10th anniversary of the Division of Bioengineering

2008:
Opening of the new Bioengineering laboratories in E3A level 7

2004:
The first batch of Bioengineering graduate students were enrolled
I feel very fortunate in having served as Head of Division of Bioengineering from 2004-2010. This was an enjoyable period during which the Division expanded and matured. I recognize the support and companionship of my colleagues during this journey. The Division has performed admirably in all respects. Research is world class. The curriculum is well-designed, and the students, undergraduate and graduate, keen and highly-performing.

The Division was started in response to the establishment of the Biomedical Sciences Initiative in Singapore. The continuation of this programme to 2015 has recently been announced. The target is $25B output by 2015. Over the next 5 years the thrust is “Integration of knowledge and capabilities across disciplines”, so an interdisciplinary area like bioengineering becomes even more relevant. A $36M push to develop the medical technology industry was announced in 2009. There are now 18000 people employed in the biomedical sciences area, in manufacturing and research, and biomedical sciences now contributes 10% to total manufacturing output and 21% to value added.

Bioengineering looks set for a bright future.

Professor Colin Sheppard
Head 2004-2010, Division of Bioengineering
National University of Singapore
The Department Today

Our Management

Head of Department
Dr James Goh, Professor
Ph.D. (Bioengineering), University of Strathclyde, U.K.
My research interests are in the field of biomechanics of the musculoskeletal system and the design & development of orthopaedic devices (including biologics, prosthetics and orthotics). I have had research experiences in biomechanics of the knee and spine, human locomotor control systems and musculoskeletal tissue engineering.

Deputy Head (Education and Student Affairs)
Dr Toh Siew Lok, Associate Professor
Ph.D. (Mechanical Engineering), University of Strathclyde, U.K.
The Tissue Repair Lab focuses on regeneration of ligament/tendon, cartilage and bone using various tissue engineering.

Deputy Head (Research and Enterprise)
Dr Zhang Yong, Associate Professor
Ph.D. (Materials Science & Engineering), Zhejiang University, China.
In the Cellular and Molecular Bioengineering Laboratory we develop new nanomaterials and microdevices for disease diagnostics and treatment.

Deputy Head (Admin and Communications)
Dr Tong Yen Wah, Associate Professor
Ph.D. (Chemical Engineering), University of Toronto, Canada.
Our Polymers for BioApplications Laboratory works on applying polymers in various biological and biomedical fields, through synthesis, modification and device fabrication. These include tissue engineering, drug delivery and biopharmaceutical processes.
Dr Martin Buist, Assistant Professor  
Ph.D. (Engineering Science), The University of Auckland, New Zealand.  
Computational Bioengineering Laboratory: We are interested in developing mathematical and computer models to answer questions and provide insights into human physiology.

Dr Casey K. Chan, Adjunct Professor  
M.A.Sc (Aerospace), MD University of Toronto, Canada  
Interested in medical device design and stem cell interaction with nanotextured materials.

Dr Nanguang Chen, Associate Professor  
Ph.D. Tsinghua University, China.  
My lab work on novel imaging methods for biomedical applications, such as breast cancer detection and brain function study.

Dr Chong Yok Rue, Desmond, Lecturer  
Ph.D. (Biomechanics), Imperial College London, UK  
Through the understanding of the mechanics of human movement, we aim to develop medical devices and healthcare solutions for the elderly, sports and rehabilitation.

Dr Andre Choo, Adjunct Assistant Professor  
Ph.D., University of Technology, Sydney, Australia  
The Stem Cell group at the Biotechnology Processing Institute (BTI) focuses on characterizing hESCs and establishing scalable cell expansion technologies for regenerative medicine.

Dr Alberto Corrias, Lecturer  
Ph.D. National University of Singapore  
My research interest is in computational models of human cells and organs, aimed at quantitatively addressing questions relevant to specific physiological processes in health and disease. Primary focus is on the heart and the gastrointestinal tract.

Dr Dieter Trau, Assistant Professor  
Ph.D. (Chemistry), Hong Kong University of Science & Technology, Hong Kong SAR  
In the NanoBioAnalytics lab we combine microfabrication, surface chemistry and molecular biology to create novel devices using biomolecules (DNA or proteins) for analytical purposes.

Dr Feng Si-Shen, Professor  
Ph.D. (Bioengineering), Columbia, USA  
Chemotherapeutic Engineering is the application and further development of chemical engineering principles to solve problems in chemotherapy of cancer and other diseases such as cardiovascular restenosis and AIDS.

Dr Han Mingyong, Assistant Professor  
Ph.D. (Chemistry), Jilin University, China  
My research addresses problems at the interfaces of nanoscience, nanotechnology and biotechnology/optoelectronics.

Dr Huang Zhiwei, Assistant Professor  
Ph.D. (Biophysics), Nanyang Technological University, Singapore  
In the Optical Bioimaging Laboratory we develop novel optical spectroscopy and endoscopic imaging, and multimodal nonlinear optical microscopy imaging techniques without labeling to address compelling problems highly related to human health and disease.

Dr Roger Kamm, Adjunct Professor  
Ph.D. (Mechanical Engineering), Massachusetts Institute of Technology, USA  
Our research has recently focused on two new areas, the molecular mechanisms of cellular force sensation, cell population dynamics, and the development of new microfluidic platforms for the study of cell-cell and cell-matrix interactions.

Dr Sangho Kim, Assistant Professor  
Ph.D. (Mechanical Engineering), Drexel University, Philadelphia, USA  
In the Microhemodynamics laboratory, we investigate blood flows in microcirculatory vessels (arterioles, capillaries, and venules) under physiological and pathophysiological conditions. We also develop computational models for aggregation of red blood cells and transport of nitric oxide and oxygen in the microcirculation. In addition, we are interested in development of new medical devices based on hemodynamics.
Dr Taeyong Lee, Assistant Professor  
Ph.D. (Biomedical Engineering), Univ. of Wisconsin-Madison, USA  
In the Laboratory of Biomedical Mechanics & Materials (LBMM), we have focused on understanding the material and structural properties of hard tissues, both in their normal and diseased states. We are currently working on the biomechanics of foot and ankle joint as well as the sport performance of smart shoes.

Dr Leo Hwa Liang, Assistant Professor  
Ph.D. (Bioengineering) Georgia Institute of Technology, USA  
I am interested in the understanding of cardiovascular diseases such as heart valve diseases, aortic dissection, aneurysms, and development of medical devices such as artificial heart valves, endovascular stents to treat these diseases. Other research focus include development of drug screening platform/bioreactors and bio-artificial liver.

Dr Jun Li, Associate Professor  
Ph.D. (Macromolecular Science), Osaka University, Japan  
In the Supramolecular Biomaterials Laboratory we develop biodegradable polymers, hydrogels, and nano-structured materials to be used in drug/gene delivery, tissue engineering, biosensors and medical devices for therapeutic and diagnostic applications.

Dr Li Xiaoping, Professor  
Ph.D. (Mechanical Engineering), University of New South Wales, Australia  
In the NeuroEngineering lab we develop novel sensors and analysis tools for investigating the human brain and monitoring human performance.

Dr Lim Chwee Teck, Professor  
Ph.D. Cambridge University, UK  
Habilitation (Ph.D.), University of Muenster, Germany  
Professor Lim heads the Nano Biomechanics Lab which conducts basic and applied research on the mechanobiology of human diseases such as malaria and cancer as well as the development of mechanics based microfluidic devices for disease detection and diagnosis. He has co-founded 3 start-up companies that exploit inventions that he has developed in his lab.

Dr Low Hong Tong, Associate Professor  
Ph.D., McGill University, Canada  
Our Biofluids lab investigates fluid dynamics and mass transport processes occurring in biological systems.

Dr Ong Sim Heng, Associate Professor  
Ph.D. The University of Sydney, Australia  
Works and teaches in the area of medical imaging, including the development of mathematical algorithms to examine and classify images for diagnostic and treatment purposes.

Dr Qiu Anqi, Assistant Professor  
Ph.D. (Electrical and Computer Engineering), Johns Hopkins University, USA  
Computational Functional Anatomy (CFA) is a new discipline in the medical image analysis that mathematically models the anatomy and functions of organs using multi-modality images. It aims at studying both anatomical and functional information in the structures of anatomical coordinates for identifying image biomarkers associated with diseases.

Dr Michael Raghunath, Associate Professor  
MD & Doctorate in Medicine, University of Mainz Medical School, Germany  
Habilitation (Ph.D.), University of Muenster, Germany  
Research in the Tissue Modulation lab spans the fields of extracellular matrix biology and pathobiochemistry, skin biology and wound repair, focusing on macromolecular crowding, scar wars, tissue glues, and epigenetics in regenerative medicine.

Dr Partha Roy, Assistant Professor  
Ph.D. (Chemical Engineering), State University of New York at Buffalo, USA  
In the Biofluids Lab, we study the movement and interactions of molecules and/or cells in natural and bioartificial systems.

Dr Bruce Russell, Adjunct Assistant Professor  
Ph.D. (Tropical Health), University of Queensland, Australia  
Our research focuses on the development and optimization of innovative tools and methodologies for the research and control of vector borne (malaria and dengue) and food borne disease in limited resource settings.

Dr Colin Sheppard, Professor  
Ph.D. (Engineering), University of Cambridge, UK  
D.Sc. (Physical Sciences), University of Oxford, UK  
As part of the Optical Biomaging Laboratory, my research is in the development of novel instruments and techniques for optical imaging, especially microscopy.
Dr Gerald Udolph, Adjunct Assistant Professor
Ph.D. (Developmental Neurobiology), Johannes Gutenberg-University, Mainz, Germany
The primary interests of our laboratory are to understand the molecular mechanisms involved in the specification of dopaminergic neurons and to utilize this knowledge for in vitro strategies to generate dopaminergic neurons from stem cells.

Dr Evelyn Yim, Assistant Professor
Ph.D. (Biomedical Engineering), USA
The Johns Hopkins University School of Medicine
In Regenerative Nanomedicine Laboratory, we are interested in studying stem cell interactions with nanotopography of the extracellular microenvironment, and to direct stem cell fate by controlling the biophysical environment for tissue engineering applications.

Dr Yu Haoyong, Assistant Professor
Ph.D. (Mechanical Engineering), USA
Massachusetts Institute of Technology
In Biomedical Robotics Lab we develop robotic devices for neurorehabilitation and assistive devices for the elderly.

Dr Zhong Shaoping, Instructor
Ph.D. National University of Singapore
In the Nanobiomechanics lab, I conduct some cooperative work on nanofibers and cellular biomechanics.

Dr Ronen Zaidel-Bar, Assistant Professor
Ph.D., Weizmann Institute of Science, Israel
In the Cell Adhesion lab we study the regulation of cell-cell adhesion during morphogenesis and cell migration. We use microscopy in cell cultures and in the model organism C. elegans to address basic questions about how cells connect to and sense their environment, be it a neighboring cell or the surrounding matrix. We are particularly interested in the role forces play in the regulation of cell adhesion and in the interplay between cell adhesion and the actin and microtubule cytoskeletons.

Administrative Staff
Ms Annie Koh
Ms Jacqueline Teo
Mr Matthew Tham
Ms Melinda Loo Shi
Ms Millie Chong
Ms Nirmal Kaur
Ms Nisha Shaik

Laboratory Staff
Mr Aneel Kumar Maheshwari
Ms Cheng Zi Yuan
Mr Hairul Nizam
Ms Lee Yee Wei
Mr Soon Hock Wei
Ms Tan Mei Yee, Dinah

Research Staff
Thulasisinga Sankar
Pipper Hans Juergen
Foad Kabinejadian
Chen Wenming
Saara Afzal
S M Mizandoor Rahman
Yang Xianfeng
Sergey Kushnarev
Zhong Jidan
Gan Swu Chyi
Annie Lee
Ang Lei Yin
Liu Jinhliang
Niagara Muhammad Idris
Li Zhengquan
Shashi Ranjan
William Chung Cheuk Wang
Yeong I Woo
Cho Seung Kwan
Zheng Wei
Rehman Shakil
Mads Sylvest Bergholt
Gao Guangjun
Shalin Mehta
Lin Kan
Gong Wei
Si Ke
Lin Kin
Marie Francene Arnobit
Cuthongco
Liu Xiao Hong
Wang Chunxia
Chen Zhen Cheng, Clarice
Peng Yanxian
Lim Sheng Jie, Natalie
See Yong Shun, Eugene
Sun Bingfeng

Consultative Committee
Mr Alok Mishra
Johnson & Johnson Medical South Asia
Ms Jacqueline Monteiro
Medtronic International Ltd
Mr Sandeep Chalke
GE Pacific Pte Ltd
Ms Sze Ling Lim
Economic Development Board
Mr Vincent Cheung
Applied Quality System Pte Ltd
Dr Glenn Vonk
Bioventure Centre Pte Ltd
The Division of Bioengineering was formed in 2002 as a department to provide engineering solutions to problems in the biomedical field. It involves a multidisciplinary team of talented individuals with various joint appointments from the Faculty of Engineering, Medicine, Science, Dentistry and Research Institutes. To date, the Division has set up a total of 17 research laboratories with 34 highly talented academic staff spear-heading research in four major research thrust, namely, Biomaterials/Tissue Engineering & Repair, Biomechanics and Computational Modelling, Bioimaging and Biosignal Processing, Nanobioengineering & Nanobiotechnology. There are also numerous joint research programmes with local universities and research institutes. Collaborative research work is being carried out with researchers from NUS Tissue Engineering Programme (NUSTEP), Mechanobiology Institute (MBI), National University Health System (NUHS), DSO National Laboratories and Life Sciences Institutes at Biopolis.

Internationally, the Division collaborates with Kyoto Institute of Technology in Japan, Georgia Tech Institute of Technology, Massachusetts Institute of Technology, Johns Hopkins University, University of Michigan in the US, University of Toronto in Canada, Technion-Israel Institute of Technology in Israel, University of Auckland in New Zealand, Zhejiang University and Tongji University in China, University of Cologne and University of Freiburg in Germany and Cardiff University in the UK.

Our globally competitive research programmes aims to achieve international recognition for high quality research with clinical and industrial applications. Through multidisciplinary research, not only are we using the most advanced engineering technologies and concepts in our research, but we are moving the frontiers of engineering ahead by developing new technologies with diverse medical applications.

Professor Michael Raghunath imaging a sample as part of his ongoing efforts to control scar formation.
Research Focus

NUS Bioengineering is driven to excel in the following four research focus areas:

Biomaterials/Tissue Engineering & Repair
This area of focus applies principles and methods of engineering and life sciences toward the development of biological substitutes to restore, maintain or improve tissue function – this is known as tissue engineering. This research thrust has made various advances in tissue engineering using novel cell-sheet technology, state-of-the-art nanomaterials, novel-polymeric materials, controlling scar tissue growth via in-depth study of extra-cellular matrix (ECM) and developing next generation of biomaterials and medical implants.

Biomechanics and Computational Modelling
The Computational Bioengineering Laboratory develops computational models and simulations to characterize and understand biological functions. These processes to be studied can include ion channels, single cell movements to tissue or organ activity. It is through constant advancement in software development, solutions algorithms and numerical analysis, new data can surface on how our bodies function. The biomechanics laboratories were initiated from the study on how cells, organs, bone and body react to external mechanical stimuli which is also known as ‘mechanobiology’. Encompassing this study is the need to develop new mechanobiological tools for disease diagnosis and treatment besides understanding biomechanics fundamentals.

Bioimaging and Biosignal Processing
This area of research has been identified by BMRC (Biomedical Research Council) as a significant R&D platform to be developed in Singapore. The biomedial imaging group focuses on the development of micro/nano systems for medical diagnostic and treatment. Some of the notable advances in research include novel biocompatible fluorescent nanoparticles for biodetection and imaging, cancer cell detection and treatment in a microfluidic device, and rapid multiplexing capabilities in a bead-based detection system.

Nanobiology & Nanobiotechnology
This research group focuses on the development of micro/nano systems for medical diagnostic and treatment. Some of the notable advances in research include novel biocompatible fluorescent nanoparticles for biodetection and imaging, cancer cell detection and treatment in a microfluidic device, and rapid multiplexing capabilities in a bead-based detection system.

Research Highlights

In the past 10 years, Division of Bioengineering received numerous research grants from the government and many interesting research work were developed. We are pleased to present some research highlights from our department.

Circulating Tumor Cells (CTC) Chip – Prof Lim Chwee Teck
The team spear-headed by Prof Lim Chwee Teck developed a CTC Microfluidic filtration Biochip (CTChip) that was one of the world’s first in being able to isolate whole rare and most importantly viable CTCs from patient’s blood without having to fix the cells or using antibodies as compared to current techniques. The device development is paving its way to market through a spin-off company ‘Clearbridge Biomedics’. This technology was mentioned in a news article “New technologies aim to take cancer out of circulation” in the March 2011 issue of Nature Medicine.

Cell Sheet Technology – Prof. James Goh and A/P Toh Siew Lok
Porous scaffolds usually have a drawback of poor cell-seeding efficiency, and require a vehicle for cell-delivery. Many methods of generating tissues prove a failure because cells seeded on scaffolds fail to attach and proliferate on the various types of biodegradable polymers used as scaffolds. One promising approach is to form three-dimensional cell sheets first before attaching them to scaffolds to enhance tissue regeneration. Fibroblasts and bone marrow cells have been grown into 3-D cell-sheets and assembled with knitted scaffolds to engineer connective tissues, which possess favorable ECM production, histological and mechanical properties.

Upconversion Fluorescence Technology - A/P Zhang Yong
The up-conversion fluorescent nanoparticles can convert near infrared (NIR) light to visible light. Compared to conventional down-conversion fluorescent materials such as organic dyes and quantum dots, these nanoparticles have the following advantages: High light penetration depth in tissues; No photodamage to living organisms; Weak autofluorescence from cells or tissues; Low background light and high sensitivity for detection. These materials can bring new and unique capabilities to a variety of biomedical applications ranging from diagnosis of diseases to novel therapies. The potential of upconversion nanoparticles for use in clinical settings, such as photodynamic therapies against viruses and cancer, can possibly provide an alternative and better treatment modality to overcome the flaws of the existing ones. The work was featured by Nature Publishing Group (NPG) Asia Materials and Thomson Reuters ScienceWatch.
Research Highlights

Scar Wars – A/P Michael Raghunath
The Tissue Modulation Laboratory is leading the NMRC-funded National Group on Fibrovascular Disorders Programme (NFDP) to explore antifibrotic substances for the treatment of scarring conditions of several tissues. The group is developing strategies to overcome both bottlenecks by utilizing excellent deep expertise in collagen biochemistry and cell biology.

Time-resolved diffuse optical tomography (DOT) – A/P Chen Nanguang
DOT is a non-invasive imaging modality with a wide range of potential clinical applications. We have developed a new approach to measure the temporal point spread functions of diffusive photons. Near real time imaging acquisition and high image quality are among advantages of our system. Applications: Breast cancer detection and treatment planning, human brain function study, and small animal whole body imaging.

AyoxxA multiplexing protein analysis chip – Dr Dieter Trau
Unlike DNA assays, microarrays for protein analysis are not powerful yet. AyoxxA addresses this need of “multiplex” protein analysis with its platform technology of bead-based protein microarrays on a substrate biochip. These biochips are convenient to use, rapid and reliable. They will be a boon to biological research, pharmacological screening and medical diagnostics.

Achievements and Awards
Bioengineering have been at the forefront of research excellence and engineering innovation. As such, numerous outstanding achievements have been made throughout the years. Some of the achievements from our staffs and students include: NUS Young Investigator Award, Merlion Research Award, 1st Prize at “Best of Biotech 2010”, GlaxoSmithKline Research Award, National Research and Innovation 2010 Competition’s Best Award, etc.

Teaching & Learning

In 1969, a fully constituted Faculty of Engineering was established at the University of Singapore. The Faculty then comprised the Civil, Electrical and Mechanical Engineering Departments. The Division of Bioengineering was officially launched by the Faculty of Engineering and the Office of Life Sciences on 31 July 2002. The Division of Bioengineering was set up to promote bioengineering education and research programmes to help advance the development of biomedical sciences in Singapore. It was envisioned that these programmes would meet the manpower needs of the country’s efforts in building up the biomedical sciences industry and position NUS as an international player in the field of bioengineering. Teaching in the Division of Bioengineering started with a Minor in Bioengineering programme that has been offered since 2001.

Our Bachelor of Engineering (Bioengineering) programme is a four-year fulltime undergraduate degree programme. The curriculum incorporates fundamental ideas and approaches taken from the electrical, mechanical, chemical and materials engineering areas, and then applies them to biomedical problems. The curriculum also provides a solid foundation in science and engineering as well as develops powerful methods for understanding basic physiological processes. The first batch of students was admitted into Year 1 of study in the Academic Year (AY) 2002/03. In December 2005, three students from the first batch completed their studies in 3.5 years and were awarded the B.Eng. (Bioengineering) degree. In July 2006, a further 36 students were awarded the B.Eng. (Bioengineering) degree after four years of study. Over the following years, our intake has grown steadily.

Teaching Awards
Several of our staff members have been awarded Faculty teaching awards for their efforts in teaching our students. In addition, A/P Tong Yen Wah and Dr Martin Buist have been recipients of the University’s Annual Teaching Excellence Award (ATEA). A/P Tong has also been placed on the University’s Honour Roll for teaching.
Accreditation

Singapore, along with countries such as the United States, United Kingdom, Australia & Japan are signatories to the Washington Accord which is an international accreditation agreement for professional engineering academic degrees. The agreement recognizes that there is substantial equivalency of programs accredited by those signatories. Graduates of accredited programs in any of the signatory countries are recognized by the other signatory countries as having met the academic requirements for entry to the practice of engineering. Our B.Eng. (Bioengineering) has been accredited by The Institution of Engineers, Singapore, under the Washington Accord.

Our students

Our NUS Bioengineering students have achieved both national and international recognition for their excellence in bioengineering. A group of our BN3101 Biomedical Engineering Design students were ranked in the top three in the international IMechE 19th Annual Medical Engineering Student Project Competition with their BioHelix Meniscal Repair System.

An international team including our own Chrissy Phoong Yoke Xi and Chua Tsun Li were 2nd Prize Winners at the Cockrell School of Engineering Global Championship in the Idea to Product Global Competition held at the University of Texas at Austin. The team had taken a patented nanotube ingrained polymeric membrane and designed a water purification system around it.

Our Bioengineering graduates Eric Cher and Chua Zi Yong, his team won the Lee Kuan Yew Global Business Plan Competition with Chondromatrix, an implantable biomaterial that draws on stem cells to repair knee cartilage.

Jeffrey Tiong co-founded OrthoLab Technologies Inc, a spin-off from VascuLab Technologies in USA during his NUS Overseas College internship at BioValley in Philadelphia. His team was one of the 8 in the Wharton Business Plan Competition. He has since started his own company, PatSnap.

Bioengineering student Natalie Lim Sheng Jie made news when she became the only Singapore undergraduate and the only foreign participant in the National Research and Innovation Competition (NRIC) 2010 held in Universiti Sains Malaysia (USM). Natalie won the overall Best Project Award for her work on detecting early signs of cartilage damage.

After graduation

What do our students do after graduating? Here are a few of their occupations...

A*Star Researcher, Bioengineer, Biotech Patent Analyst, Business Support Executive, Chief Executive Officer, Civil Servant, Clinical Research Coordinator, Clinical Specialist, Engineer, Executive, Field & Application Engineer, Field Sales Engineer, Graduate medical student, HR Executive, Intellectual Patent Associate, Patent Engineer, Policy Analyst, Property Engineer, IT Specialist, Lab Officer, Manager, Market Research Analyst, Medical Device Engineer, Operations Executive, Process Engineer, Product Development, Product Specialist, Product Supply Manager, Project Engineer, Quality Assurance Executive, Quality engineer, R&D Engineer, Research Assistant, Research Engineer, Research Officer, Research Scholar, Senior Officer, Support Executive, Teacher, Technology Project Executive.
NUS BIOENGINEERING

Through the decade

[Images of faculty, students, and events from 2001-2011]

- Academic Staff circa 2003
- Transfer shuttle bus stop to the lab and back again
- Conducting by ensuring safety that have experienced SET to various universities across the world
- NUS-U undergraduate student club at the meeting
- Graduating Class, 2006
- Graduating Class, 2007
- Graduating Class, 2008
Graduating class, 2009

Graduating class, 2010

Graduating class, 2011

Professor James Goh delivering his opening address at the ICBME 2008 conference

Our first batch of graduates receive their degrees

Our second batch of graduates celebrate in 2007

Projecting a corporate image at the BN3101 presentations

Members of the first cohort of students at their graduation in 2006

Welcoming new graduate students in August 2006

All smiles after the tough questions are over, FYP 2007

Professors CT Lim, Colin Sheppard & Martin Buist celebrating graduation
Relaxing before the BN3101 presentations

BN3101 Biomedical Engineering Design Presentations, 2011

2011 final year project posters in the new Temasek Labs building

Farewell for Dr Corrias before his stint in Oxford

Discussions with representatives from industry and other stakeholder

Lunch after the 2011 final year project presentations

Graduate club BBQ at Marina Barrage, 2011

Our resident artists practicing for their graduation night debut

Dr. Martin Buist receiving a teaching excellence award from Provost Tan Eng Chye.