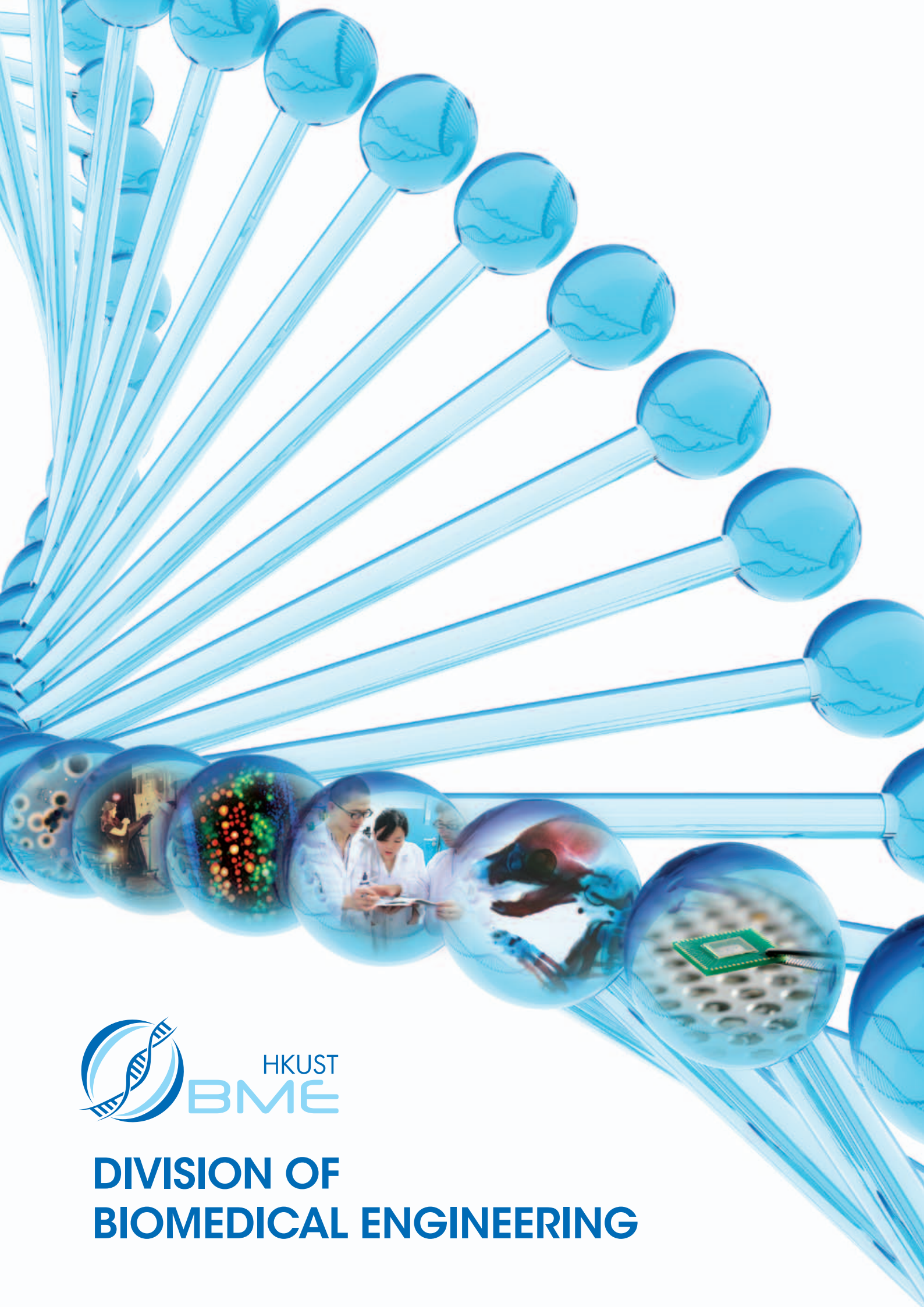


HKUST BME

DIVISION OF BIOMEDICAL ENGINEERING

Interdisciplinarity

Collaboration

Excellence

ABOUT BME

Division of Biomedical Engineering (BME) was established since July, 2011.

The Division coordinates and promotes faculty collaboration in teaching and research in biomedical engineering.

Photo by Prof. Wei Shyy

Contents

About HKUST

HKUST - A dynamic, international research university, in relentless pursuit of excellence, leading the advance of science and technology, and educating the new generation of front-runners for Asia and the world.

Since its official opening in October 1991, the Hong Kong University of Science and Technology has established itself as an intellectual powerhouse, energizing the community's transformation into a knowledge-based society, and securing a place on the academic world map in record-breaking time.

An innovator in research and teaching, HKUST is the only science and technology research university in Hong Kong, and the only one to offer an all-PhD faculty. Its groundbreaking work is successfully pushing back the boundaries of the information age. Such advances are assisted by the University's top-class facilities.

In a short two decades, the University has advanced into a leading international university with outstanding world-class faculty, developed globally recognized strengths, educated cohorts of entrepreneurial and innovative graduates, and produced research contributions with significant societal impact in many areas. It is consistently ranked amongst the top institutions worldwide, and its "miracle" of achieving such impact and international standing in a short period of time has been widely acknowledged in Asia and globally.

Mission & Vision

Mission

To advance learning and knowledge through teaching and research, particularly:

(i) in science, technology, engineering, management and business studies; and
(ii) at the postgraduate level;

and to assist in the economic and social development of Hong Kong.

Vision

To be a leading university with significant international impact and strong local commitment.

- Global -
To be a world-class university at the cutting edge internationally in all targeted fields of pursuit.

- National -
To contribute to the economic and social development of the nation as a leading university in China.

- Local -
To play a key role, in partnership with government, business, and industry, in the development of Hong Kong as a knowledge-based society.

Head's Message

On behalf of our students and faculty members in the Division of Biomedical Engineering, we present you this brochure that highlights some of our recent developments.

The Hong Kong University of Science and Technology was established in 1991. Over the past twenty years, our University has been recognized internationally as a leading research university in the Pacific Rim. Internationalization and interdisciplinary research and education are strategic emphasis of our institution. As we are prepared for the next twenty years' excellence, the University has established the Division of Biomedical Engineering (BME) in July 2011.

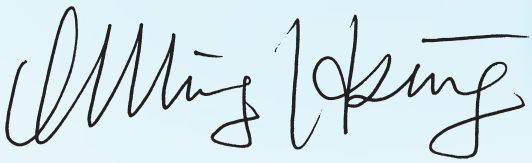
BME Division coordinates and promotes faculty collaboration in teaching and research in biomedical engineering. In addition, the Division hosts the bioengineering postgraduate program, and works closely with Schools of Science (SSCI) and Engineering (SENG) to support the planning and development of a set of biomedical foundation courses to enhance undergraduate programs in biotechnology and bioengineering sponsored by SSCI and SENG, respectively.

The Division also fosters interdisciplinary research in areas of biomedical engineering in collaboration with the Schools and industry. The setup of this new Division reflects HKUST's strong interests and commitments in interdisciplinary biomedical engineering education and research.

The Division is established to fulfill the following mission:

- To pursue excellence in biomedical engineering research to attain the highest academic standard possible;
- To lead and develop interdisciplinary educational activities of direct interest to biomedical engineering;
- To develop and lead biomedical engineering research projects relevant to the local community that attracts partnerships and sponsorship from local industries and the community.

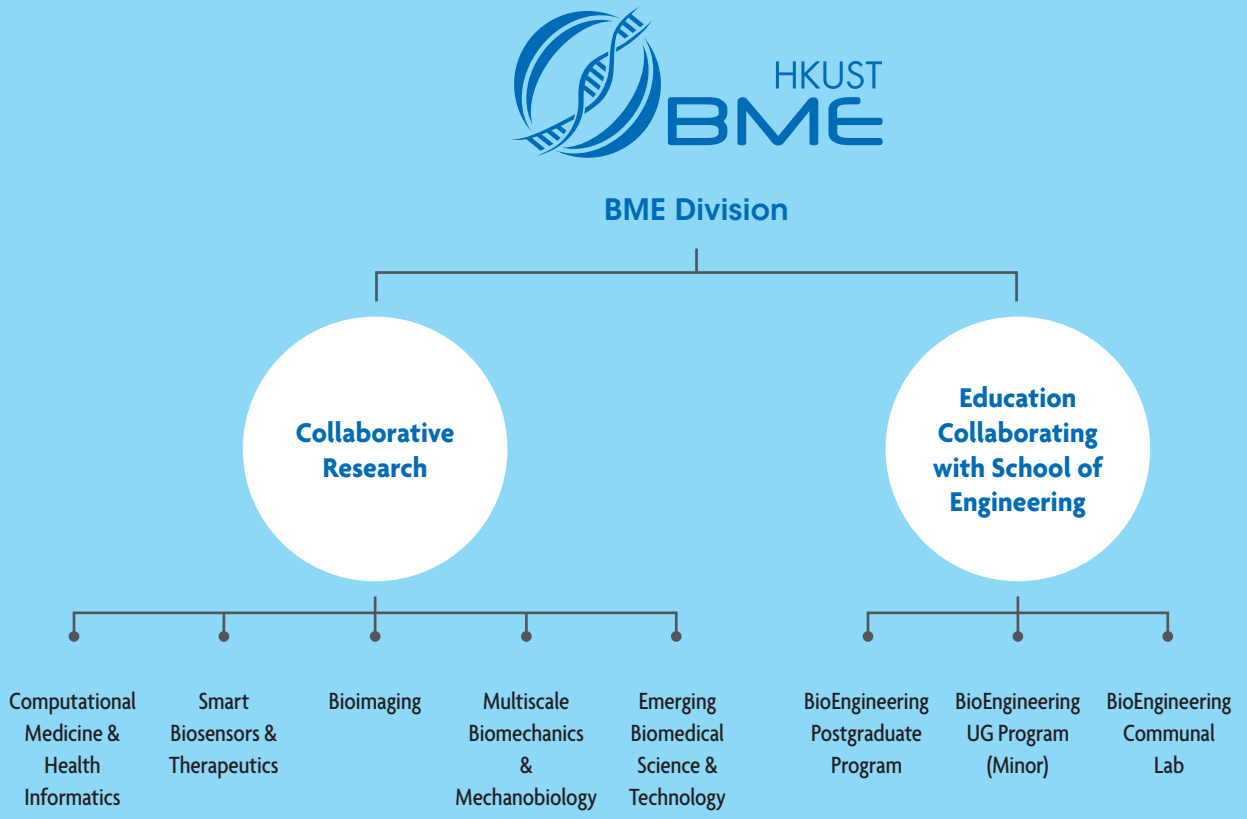
Our students, our colleagues and I are very much excited about our Division. We will keep you regularly updated on our development.



Head, Division of Biomedical Engineering

Prof. I-Ming Hsing

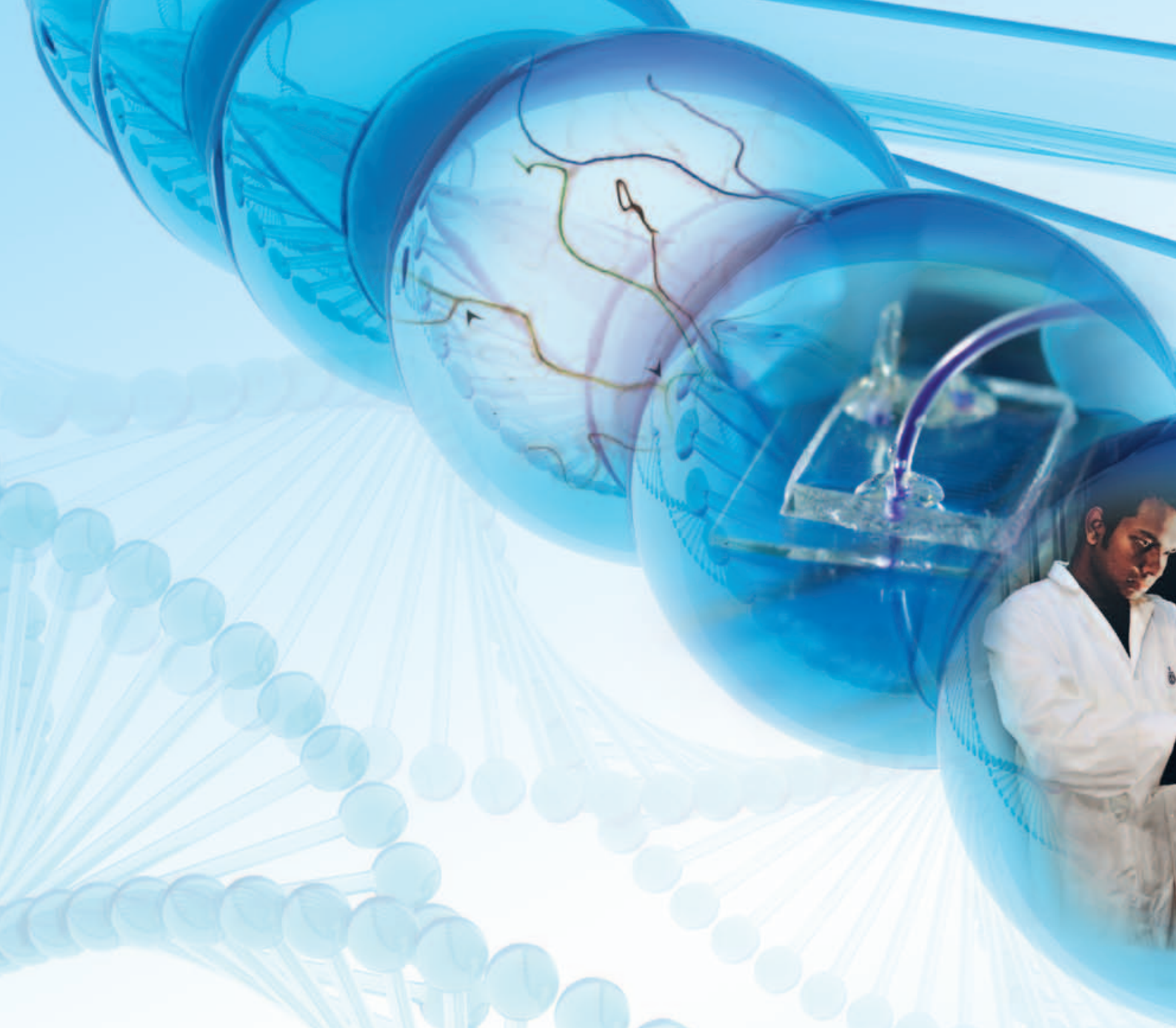
Structure Schematic of BME Division



BME Division serves as an academic platform that aims to pursue excellence in interdisciplinary research activities and education in biomedical engineering. In collaborations with the Schools of Science and Engineering, the Division develops strategies and implements action plans that would lead to large-scale, high-quality collaborative research in the thematic areas of biomedical engineering. These projects are expected to be translated into notable existence involving multiple PIs with external funding primarily from the Government institutions and industrial sectors. To enhance the Division's competitiveness and differentiate our core strength from other institutions, five thematic areas are identified;

- Computational Medicine & Health Informatics
- Smart Biosensors & Therapeutics
- Bioimaging
- Multiscale Biomechanics & Mechanobiology
- Emerging Biomedical Science & Technology

In collaboration with the School of Engineering, BME Division is hosting the University's bioengineering postgraduate program, manages undergraduate minor program in bioengineering, and maintains the operation of bioengineering communal laboratory. Research projects carried by the Division faculty members are multidisciplinary and research students are expected to be co-supervised by faculty members with complementary research expertise.



Thematic Research Group and **Faculty Profile**

Computational Medicine & Health Informatics

Computational medicine is a broad umbrella of research areas aimed at enhancing human health using computational methods. In HKUST Division of Biomedical Engineering, research in computational medicine has the following two themes:

Modeling and Simulating Living Systems

Living systems are extremely complex and are made up of networks of interconnecting parts. Modeling and computer simulations are often required to understand the dynamic and nonlinear behavior of such systems. Examples include simulating the conformational changes and interactions of proteins, or how our nervous system works.

Group Members

- Prof. Ravindra GOONETILLEKE - Human performance, Product design
- Prof. Bertram SHI - Neural engineering, Machine vision
- Prof. Richard SO - Vision, Hearing
- Prof. Xuhui HUANG - Protein and RNA folding, Molecular simulation

Omics and Bioinformatics

Biomedical research is being revolutionized by new technologies for generating high throughput data, commonly referred to as “omics” technologies. Nowadays thousands of biological signals can be measured simultaneously and accurately, across many samples, using rapidly maturing technologies such as DNA microarray (in the case of mRNA) and mass spectrometry (in the case of proteins and metabolites). These “high-throughput” experiments generate vast amount of data that demand sophisticated informatics tools to analyze and manage. Research in this area focuses on representing, analyzing and making sense of such rich information for learning about disease mechanisms and improving treatments. Examples include machine learning to extract hidden information from genome sequences, and statistical analysis to assign identification or quantification confidence to measured signals in various omics experiments.

Group Members

- Prof. Nevin ZHANG - Machine learning, Artificial intelligence
- Prof. Weichuan YU - Genomics, Proteomics, Biomedical signal processing
- Prof. Henry LAM - Proteomics, Metabolomics, Mass spectrometry

Prof. Ravindra S. GOONETILLEKE

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Primary Research Area

Human Factors/Ergonomics

Research Interests

- Area: Biomechanics, psych ophysics
- Modelling human performance in manual control environments and designing culture-friendly products.

Highlighted Publications

- Thibbotuwawa, N., Goonetilleke, R. S. and Hoffmann, E. R. "Constrained path tracking at varying angles in a mouse tracking task", Human Factors, 54(1) February, 137 - 149 (2012)
- Xiong, S. and Goonetilleke, R. S., Zuhua Jian, "Pressure thresholds of the human foot: measurement reliability and effects of stimulus characteristics ", Ergonomics Vol 54(3), March, 282-293 (2011)
- Weerasinghe, T. W., and Goonetilleke, R. S., "Getting to the bottom of footwear customization", Journal of Systems Science and Systems Engineering, 20(3), 310-322 (2011)

Prof. Bertram SHI

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Primary Research Area

Neuromorphic Engineering, Bio-inspired and Developmental Robotics,
Computational Vision, Computational Neuroscience,
Machine Learning, Neural Networks,
Brain Machine Interfaces

Research Interests

Research in my lab focuses on exploiting our expanding understanding about the brain, as gleaned from studies in neuroscience and psychology, to engineer interactive systems, which we define as agents that "intelligently" map information from sensors to actions in their environment. Examples include animals, robots and human computer interfaces. We pay particular attention to modeling the processing of visual information. Not only is vision a rich source of information about the environment, visual perception is also one of the most heavily studied topics in neuroscience and psychology. Thus, there is a wide range of experimental and modeling data from which we can draw in obtaining design insights.

Among the many areas where the design of interactive systems might benefit from an understanding of the mechanisms employed by the brain, we feel that the following two are the most promising at this time.

- Cue Integration – In interacting with the world, biological systems
  seamlessly integrate information from multiple cues. In vision, cues about the geometry of the world include orientation, stereo disparity and motion. We are interested in how the populations of units (e.g. neurons in the brain) can represent information from these cues efficiently and how this representation facilitates effective integration.
- Adaptability – As they mature, biological systems undergo large
  physical changes, yet performance generally improves. In contrast, the performance of robots typically degrades if their physical configuration changes with respect to their initial calibration. We are interested in how insights from the neural development of biological systems can be used to design interactive systems that can adapt to change.

Our method is synthetic. We build real time models of the neural representation of the world which take as input real binocular image sequences. We embed these models into robotic systems, which learn how to map the neural representations to actions. Our approach is empirical. We believe that the representation of sensory information in an interactive system should develop according to the degree to which it enables behavioral success.

Highlighted Publications

- Y. W. Wang and B. E. Shi, "Autonomous development of vergence control driven by disparity energy neuron populations," Neural Computation, 22, 730–751, (2010)
- Q. Y. Peng and B. E. Shi, "The changing disparity energy model," Vision Research, 50(2), 181-192, (2010)
- E. K. C. Tsang and B. E. Shi, "Disparity estimation by pooling evidence from energy neurons," IEEE Transactions on Neural Networks, 20(11), (2009)

Prof. Richard H.Y. SO

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Primary Research Area
Functional Brain Studies on Visual and Audio Perception,
Computational Ergonomics

Research Interests

Vision and hearing are the two main sensory channels for humans to perceive the world. My research teams are interested in studying the perception, interpretation, and responses to visual motion and directional binaural sounds. In particular, we are interested to examine how and why perception of visual motion and directional sounds can generate illusion of self-motion and symptoms of motion sickness (MS). Being a member of Commission Internationale de L'eclairage (CIE) Technical Committee TC1-67 on image safety and member of the expert panel for ISO working group on image safety, I am motivated to develop a biologically plausible model to predict and simulate perceived visual fatigue and MS for computer game users. We use brain imaging tools to examine the cortical interactions for generating MS and develop biological inspired computational models. Past Spin-offs from our research include customizable virtual surround sound algorithms and head mounted displays with adjustable focal lengths.

Highlighted Publications

- So, R.H.Y., Wong, W.S., Yip, R., Lam, A., and Ting, P., "Benefits of Matching Accommodative Demands to Vergence Demands in a Binocular Head-Hounted Display: A Study on Stereo Fusion Times", PRESENCE, 20 (6) (2011)
- So, R.H.Y., Leung, N.M., Horner, A., Braasch, J. and Leung, K.L., "Effects of spectral manipulation on non-individualized head-related transfer functions (HRTFs) ", Human Factors, 53(3), pp.271-283 (2011)
- Ji, T.Y., So, R.H.Y. and Cheung, R.T.F., "Isolating the Effects of Vection and Optokinetic Nystagmus on Optokinetic Rotation-Induced Motion Sickness", Human Factors, 51(5), pp.739-751 (2009)

Prof. Nevin L. ZHANG

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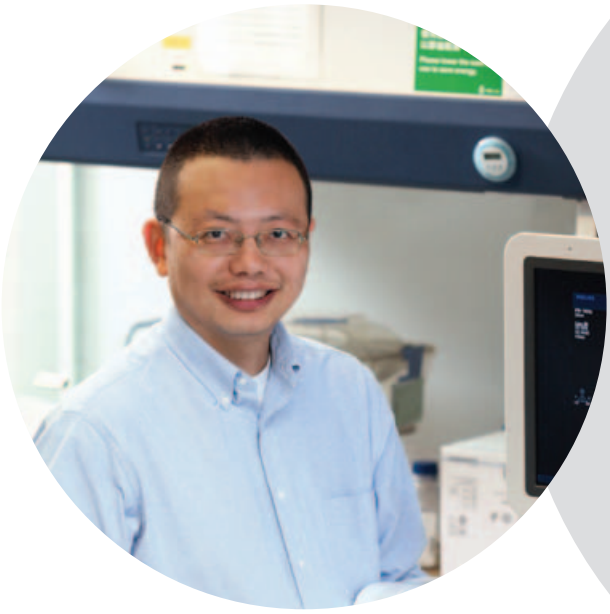
Primary Research Area
Latent Variable Models and Applications, Multidimensional Clustering, Applications in Traditional Chinese Medicine

Research Interests

- Current Focus: Latent Variable Models and Applications, Multidimensional Clustering, Applications in Traditional Chinese Medicine.
- General: Artificial Intelligence, Machine Learning, Model-Based Clustering, Probabilistic Graphical Models, Reasoning and Decision under Uncertainty.

Highlighted Publications

- T. Chen, N. L. Zhang, T. F. Liu, Y. Wang, L. K. M. Poon, "Model-based multidimensional clustering of categorical data.", Artificial Intelligence, 176(1), 2246-2269 (2011)
- N. L. Zhang, S. H. Yuan, T. Chen and Y. Wang, "Latent tree models and diagnosis in traditional Chinese medicine.", Artificial Intelligence in Medicine, 42: 229-245 (2008)
- N. L. Zhang, S. H. Yuan, T. Chen and Y. Wang, "Statistical Validation of TCM Theories", Journal of Alternative and Complementary Medicine, 14(5), 583-7 (2008)



Prof. Weichuan YU

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Primary Research Area
Bioinformatics, Ultrasound Image Analysis

Research Interests

My laboratory is interested in computational analysis problems with biological and medical applications. My long term goal is to develop mathematical, computational, and statistical methods to address challenges in biological and medical data analysis. Currently, my research focuses on the following three topics in bioinformatics and biomedical signal processing: Genome-Wide Single-Nucleotide Polymorphism (SNP) Data Analysis, Mass Spectrometry (MS) Data Analysis, and ultrasound image analysis.

Highlighted Publications

- X. Wan, C. Yang, Q. Yang, H. Xue, X. Fan, N. Tang, and W. Yu, "BOOST: A Boolean Representation-based Method for Detecting SNP-SNP Interactions in Genome-wide Association Studies", The American Journal of Human Genetics, 87:325-340, (2010)
- Ch. Yang, C. Yang, and W. Yu, "A Regularized Regression Method for Peptide Quantification", Journal of Proteome Research, 9:2705-2712, (2010)
- C. Yang, X. Zhou, X. Wan, Q. Yang, H. Xue, and W. Yu, "Identifying Disease-associated SNP Clusters via Contiguous Outlier Detection", Bioinformatics, 27:2578-2585, (2011)

Prof. Xuhui HUANG

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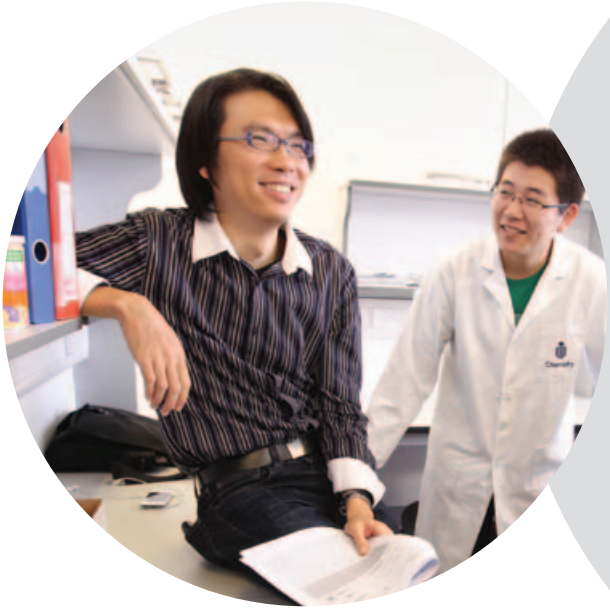
Primary Research Area
Computational Biology

Research Interests

The current research of my lab focuses on understanding and manipulates fundamental biological processes associated with conformational changes by developing and applying novel computational tools which bridge the gap between experiments and simulations. In general, we are interested in RNA folding, protein misfolding/aggregation, conformational changes in key cellular machinery, and the development of Markov State Models for long timescale dynamics. Ongoing research projects in the lab include: developing new algorithms based on statistical mechanics for conformational dynamics; elucidating mechanisms of conformational changes during gene transcription; understanding mechanisms of molecular recognition; and understanding hydrophobic interactions and aggregations.

Highlighted Publications

- Da, L., Wang, D., Huang, X., "Dynamics of Pyrophosphate Ion Release and Its Coupled Trigger Loop Motion from Closed to Open State in RNA Polymerase II", J. Am. Chem. Soc., 134 (4), 2399, (2012)
- Huang X., Wang D., Weiss D.H., Bushnell D. A., Westover K. D., Kornberg R. D., and Levitt M., "RNA Polymerase II Trigger Loop Residues Stabilize and Position the Incoming NTP in Transcription", Proc. Nat. Acad. Sci. U.S.A., 107, 15745-15750, (2010)
- Huang, X., Bowman, G. R., Bacallado, S., and Pande, V. S. , "Rapid Equilibrium Sampling Initiated from Non-equilibrium Data", Proc. Nat. Acad. Sci. U.S.A., 106, 19765-19769, (2009)



Prof. Henry H N LAM

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Primary Research Area
Proteomics, Mass Spectrometry

Research Interests

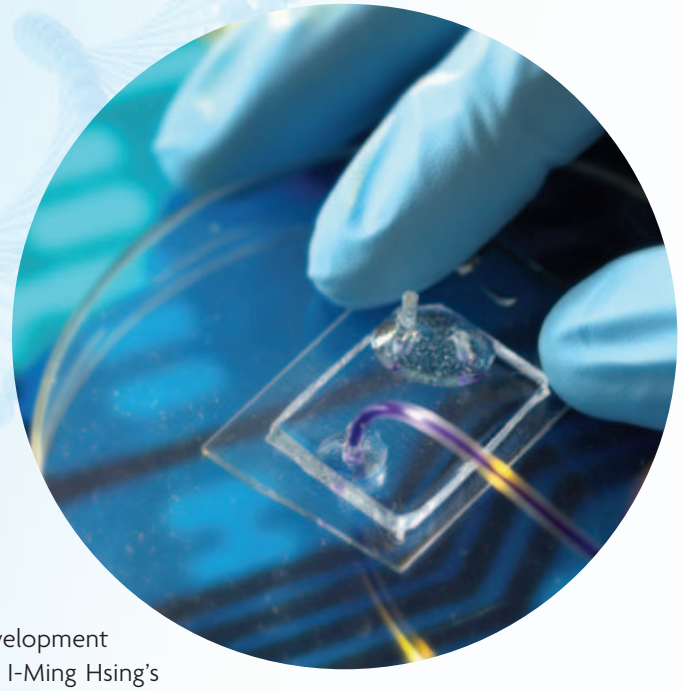
Proteomics, Metabolomics, Mass Spectrometry, Computational and Systems Biology, Surfactant Systems .

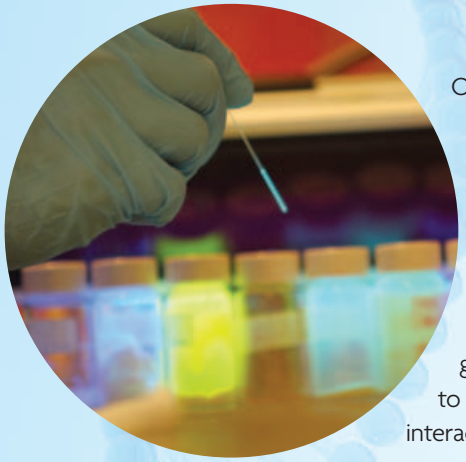
Highlighted Publications

- Y. Hu, Y. Li, H. Lam, "A semi-empirical approach to predict unobserved peptide MS/MS spectra from spectral libraries", Proteomics 11, 4702-4711 (2011)
- H. Lam, "Spectral archives: a vision for future proteomics data repositories", Nature Methods 8, 546-548 (2011)
- X. Zhang, Y. Li, W. Shao, H. Lam, "Understanding the improved sensitivity of spectral library searching over sequence database searching in proteomics data analysis", Proteomics 11, 1075-1085 (2011)

Smart Biosensors and Therapeutics

Mutidisciplinary approaches are used at HKUST to invent new tools to probe the biological systems, engineer carriers to deliver therapeutics, and develop diagnostics with attractive properties. The expertise ranges from material science, microfluidics, nanotechnology, synthetic biology to wireless networking.





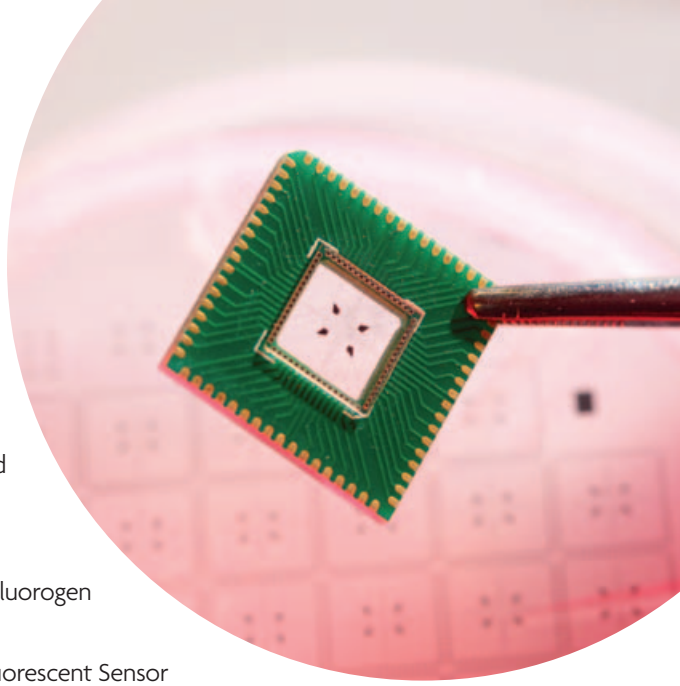
One major theme is the development of novel biomaterials. Prof. I-Ming Hsing's team is using synthetic biology to engineer microorganisms as novel biosensors. Prof. Benzhong Tang's group has pioneered the synthesis of fluorogenic molecules with aggregation-induced emission properties. These are promising biosensors with high sensitivity and specificity. Prof. Ying Chau's group develops hydrogel and nano-drug carriers with polymers and peptides. Her group is interested in delivering therapeutics to the eye and targeting to cancer cells. She is also interested in understanding the cell-biomaterial interactions and especially how they pertain to medical applications.

Another major theme is the development of new devices. Prof. Hsing's team is developing point-of-care diagnostic applications using electrochemistry-based real time PCR. Prof. Hongkai Wu's laboratory focuses on the development of new biosensing tools with microfluidics and surface chemistry. His group is particularly interested in single-cell analysis. Prof. Shuhuai Yao's team is using the expertise in bioMEMS to develop new mixers and reactors for biological assays, kinetic measurements, and micro/nanoparticle synthesis.

Prof. Qian Zhang's group is interested in using wireless technology in health care management and sensor networking.

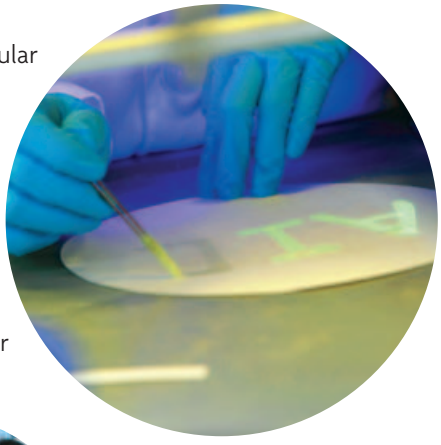
Group Members

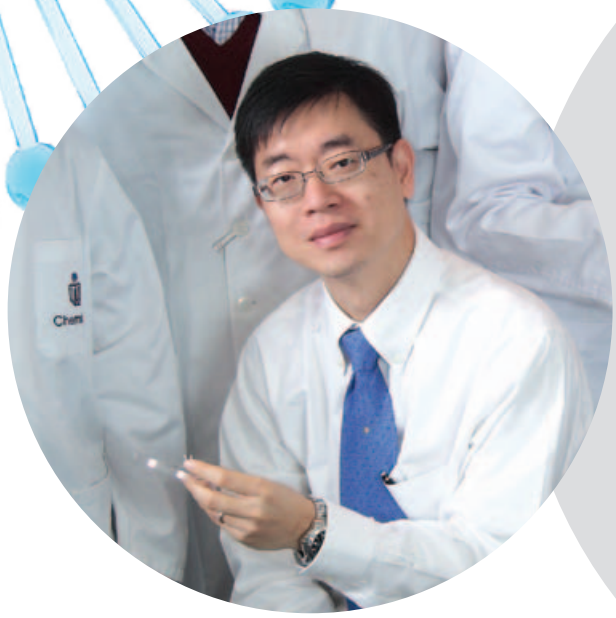
- Prof. I-Ming HSING
- Prof. Qian ZHANG
- Prof. Hongkai WU
- Prof. Benzhong TANG
- Prof. Ying CHAU
- Prof. Shuhuai YAO



Group Activities and Projects

1. Real time electrochemical monitoring of PCR amplicons using electroactive hydrolysis probe
2. Facile and rapid manipulation of DNA surface density on gold nanoparticles using mononucleotide-mediated conjugation
3. Electrochemical Real-Time Polymerase Chain Reaction
4. Monitoring and Inhibition of Insulin Fibrillation by a Small Organic Fluorogen with Aggregation-Induced Emission Characteristics
5. Specific Detection of D-Glucose by a Tetraphenylethene-Based Fluorescent Sensor
6. One-step click method for generating vinyl sulfone groups on hydroxyl-containing water soluble polymers
7. Self-Assembly Mediated Platform for Rapid and Facile Preparation of Peptide-Functionalized Nanoparticles with High Stability
8. Synthesis, characterization, and thermodynamic study of a polyvalent lytic peptide-polymer conjugate as novel anticancer agent
9. Whole Teflon Microfluidic Chips
10. Convenient Platform of Tunable Microlens Arrays for the Study of Cellular Responses to Mechanical Strains
11. Single-cell assays
12. Visualizing millisecond chaotic mixing dynamics in microdroplets: a direct comparison of experiment and simulation
13. Nanograssed micropyramidal architectures for continuous dropwise condensation
14. Improvements in mixing time and mixing uniformity in devices designed for studies of protein folding kinetics
15. 2G-RFID based E-healthcare System





Prof. I-Ming HSING

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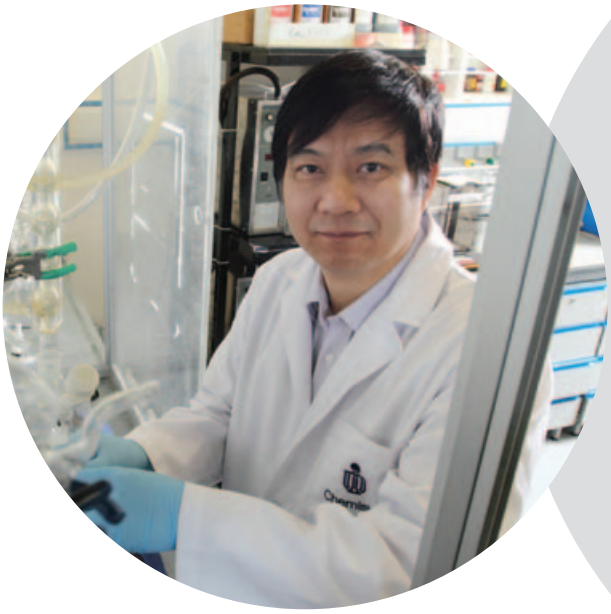
Primary Research Area
Biomicrosystems, Nanobiotechnology, Electrochemistry

Research Interests

Multidisciplinary researches are very exciting as often the best research opportunity lies within the indistinguishable borders of established fields and departments. By bringing together the knowledge of reaction engineering, life science, electrochemistry and microfabrication, my laboratory is interested in understanding as well as developing engineered biological and electrochemical microsystems. My bio-research group has interests in developing new DNA-based sensing technologies and integrated device platforms for point of care application. Our research in electrochemistry-based real time PCR technology has been widely recognized and this e-approach promises a new diagnostic product competing with existing fluorescence based counterparts. Our laboratory is also interested in microbial engineering. Using synthetic biology approach, microorganisms could be reengineered or re-assembled for interesting applications in bioenergy and bioassay.

Highlighted Publications

- F. Xuan, X. Luo, I-M. Hsing, "Ultrasensitive Solution-phase Electrochemical Molecular Beacon-based DNA Detection with Signal Amplification by Exonuclease III-assisted Target Recycling", Analytical Chemistry (Accelerated Article), 84, 5216-5229 (2012)
- W. Zhao and I-M. Hsing, "Facile and rapid manipulation of DNA surface density on gold nanoparticles using mononucleotide-mediated conjugation", Chem. Comm, 46, 1314-1316 (2010)
- S.W. Yeung, T.M.H. Lee, and I-M. Hsing, "Electrochemical Real-Time Polymerase Chain Reaction", Journal of the American Chemical Society, 128, 13374-13375 (2006)



Prof. Ben Zhong TANG

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Primary Research Area
Fluorescent Biosensors

Research Interests

Generation of new advanced materials with novel molecular structures and unique functional properties.

1. Synthesis of new fluorogenic molecules with aggregation-induced emission (AIE) characteristics and exploration of their technological, especially biological, applications.
2. Development of biocompatible AIE biosensors with high sensitivity and specificity.
3. Utilization of AIE bioprobes in monitoring important biological processes.

Highlighted Publications

- Y. Hong, L. Meng, S. Chen, C.W.T. Leung, L.T Da, M. Faisal, D.A. Silva, J. Liu, J.W.Y Lam, X. Huang, B.Z. Tang, "Monitoring and Inhibition of Insulin Fibrillation by a Small Organic Fluorogen with Aggregation-Induced Emission Characteristics", Journal of the American Chemical Society, 134, 1680 (2012).
- Y. Liu, C. Deng, L. Tang, A. Qin, R. Hu, J.Z. Sun, B.Z. Tang, "Specific Detection of D-Glucose by a Tetraphenylethene-Based Fluorescent Sensor", Journal of the American Chemical Society, 133, 660 (2011).
- Y. Hong, J.W.Y Lam, B.Z. Tang, "Aggregation-induced emission", Chemical Society Review, 40, 623 (2011).

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Primary Research Area
Internet of Things on Healthcare, Wireless Sensor Networks, Wireless Communications and Networking

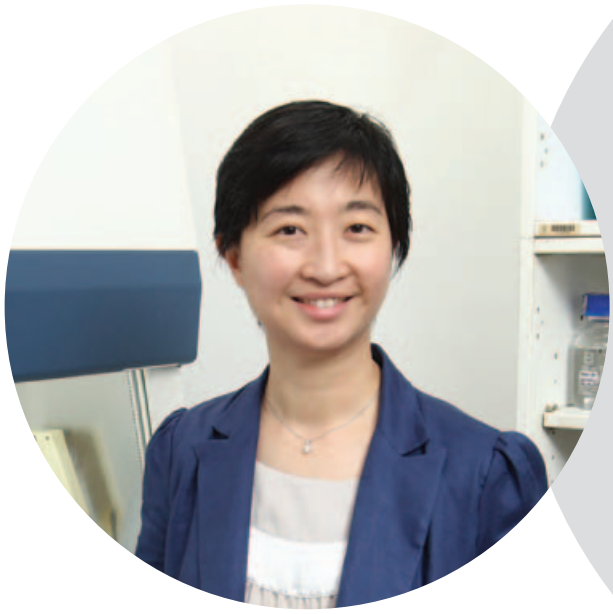
Research Interests

- Cognitive radio networks and dynamic spectrum management
- Cooperative communication and networking
- Wireless mesh and mobile ad hoc network
- Wireless sensor networks
- Internet of Healthcare Things and Digital Life
- Roaming/mobility across different types of wireless networks (WLAN, WPAN, WWAN, etc.)
- Multimedia delivery/distribution over p2p network
- Multimedia delivery over Internet, wireless, and wireless Internet
- Cloud Computing

Currently, I am working on cognitive and cooperative networking, sensor networking, as well as efficient media streaming over p2p overlay related projects.

Highlighted Publications

- Gabriel Y. Keung, B. Li and Q. Zhang, "The Intrusion Detection in Mobile Sensor Networks: Probabilistic Formulation, Energy Efficiency and a Distributed Algorithm", to appear in IEEE/ACM Transactions on Networking, (2011)
- J. Luo, D. Wang, and Q. Zhang, "On the Double Mobility Problem for Water Surface Coverage with Mobile Sensor Networks", in IEEE Trans. on Parallel and Distributed System, Issue 99, (2011)
- M. Chen, S. González, Q. Zhang, V. Leung, and M. Li, "2G-RFID based E-healthcare System", in IEEE Wireless Communications Magazine, special issue on wireless technologies for E-healthcare, Vol. 17, Issue 1, (2010)



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Primary Research Area

Biomedical Engineering; Drug Delivery; Cancer Targetting; Tissue Engineering; Biomaterial; Polymer and Peptide Design.

Research Interests

Use a multidisciplinary approach involving polymer synthesis, peptide design, cell biology, and engineering principles to develop new approaches and materials for drug delivery and regenerative medicines

Highlighted Publications

- Yu, Y. and Chau, Y., "One-step click method for generating vinyl sulfone groups on hydroxyl-containing water soluble polymers", Biomacromolecules, 13 (3): 937–942 (2012)
- Wang, W. and Chau, Y., "Self-Assembly Mediated Platform for Rapid and Facile Preparation of Peptide-Functionalized Nanoparticles with High Stability", Chemistry of Materials, 24 (5): 946–953 (2012)
- Li, Q., o Cheung, W.H., o Chow, K.L., o Ellis-Behnke, R.G., Chau, Y., "Factorial analysis of adaptable properties of self-assembling peptide matrix on cellular proliferation and neuronal differentiation of pluripotent embryonic carcinoma", Nanomedicine: Nanotechnology, Biology and Medicine, 8(5):748-56 (2012)
- Zhong, J. and Chau, Y., "Synthesis, characterization, and thermodynamic study of a polyvalent lytic peptide-polymer conjugate as novel anticancer agent", Bioconjugate Chemistry, 21:2055-2064 (2010)

Prof. Hongkai WU

Associate Professor, Division of BioMedical Engineering

Associate Professor, Department of Chemistry

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Primary Research Area

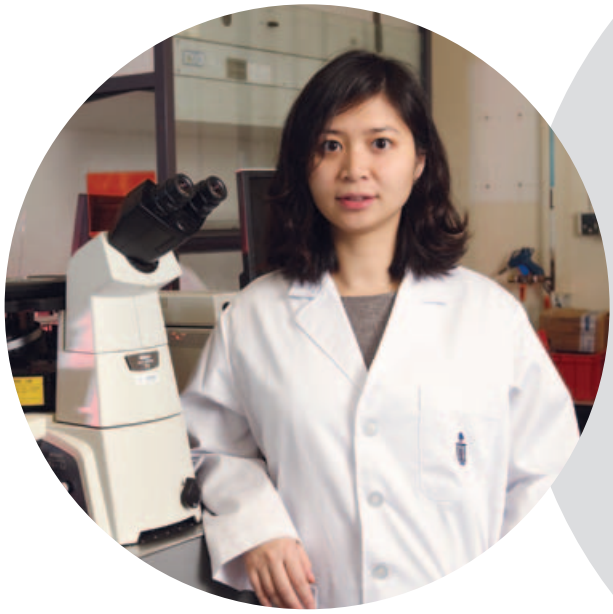
Biosensors, Microfluidics

Research Interests

My research focuses on the interdisciplinary frontiers of microfluidics, bioanalytical science and materials chemistry. We use the technologies in MEMS, microfluidics, soft lithography, and surface chemistry to design and provide new tools for the applications and understanding of fundamentals in materials and biological sciences, including microfluidic chemical reactors, high throughput single-cell analysis and chemical separations.

Highlighted Publications

- Declan Ryan, Kangning Ren, and Hongkai Wu, "Single-cell assays", Biomicrofluidics, 5, 021501 (2011) (Front cover article).
- Kangning Ren, Wen Dai, Jianhua Zhou, Jing Su, Hongkai Wu, "Whole Teflon Microfluidic Chips", Proc. Natl. Acad. Sci. USA, 108, 8162-8166 (2011)
- Yihua Zhao, Jianhua Zhou, Wen Dai, Yizhe Zheng, Hongkai Wu, A" Convenient Platform of Tunable Microlens Arrays for the Study of Cellular Responses to Mechanical Strains", Journal of Micromechanics and Microengineering, 21, 054017 (2011)



Prof. Shuhuai YAO

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Primary Research Area

Microfluidics and Nanofluidics, MEMS/BioMEMS ,
Nanobiotechnology

Research Interests

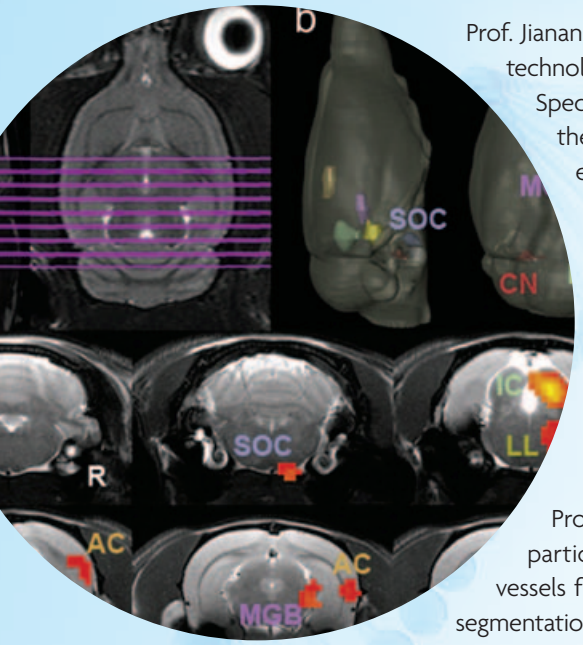
Our research effort have been focused on understanding the fundamentals of mass and heat transport phenomena, interfacial science at micro- and nano-scales, and integrating theoretical and experimental work to develop novel MEMS and bioMEMS devices. We are developing advanced nanomaterials using nanofabrication technologies and exploiting interfacial phenomena associated with phase change to create novel flow and sample delivery components for water harvesting, thermal management, and bio-sensing applications. We are also developing state of the art microfluidic mixers/reactors for micro/nano particle synthesis, biological assays, and ultrafast kinetic measurements. Utilizing nanobiotechnology and engineering toolbox in micro-/nano- fluidics, our long term goals are to achieve new functionalities in micro total analysis systems and to enable exciting discoveries in biomedical science.

Highlighted Publications

- Jiang L., Zeng Y., Zhou H., Qu J.Y., and Yao S., "Visualizing millisecond chaotic mixing dynamics in microdroplets: a direct comparison of experiment and simulation", Biomicrofluidics, in press.
- Chen X, Wu J., Ma R., Hua M., Koratkar N., Yao S., and Wang Z., "Nanograssed micropyramidal architectures for continuous dropwise condensation", Advanced Functional Materials, 21, pp. 4617–4623, (2011) (Cover Article).
- Yao, S., and Bakajin, O., "Improvements in mixing time and mixing uniformity in devices designed for studies of protein folding kinetics", Analytical chemistry, 79, pp. 5753-5759, (2007)

Bioimaging

Bioimaging spans a broad range of physical scales and applications. At one end, light microscopy technologies such as stochastic optical reconstruction microscopy, confocal microscopy, and nonlinear microscopy image cellular and molecular targets. At the other end, medical imaging technologies such as magnetic resonance imaging (MRI), ultrasound imaging, and computed tomography image whole organs and systems.

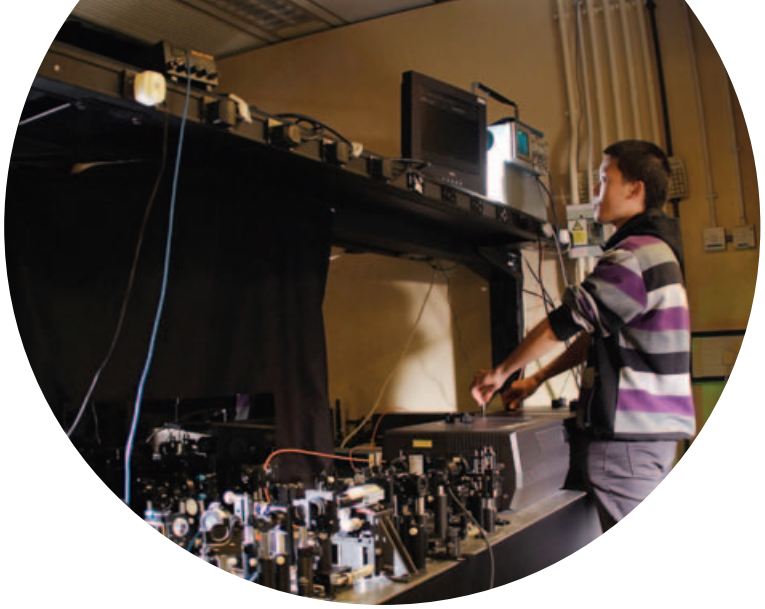


Prof. Jianan Qu's laboratory aims to develop advanced optical and photonics imaging technology for non-invasive imaging and sensing of important biological processes. Specifically, he develops label-free multi-modality nonlinear microscopes, one of the most exciting recent developments in biomedical imaging, for the study of early cancer progression and many other important biological problems. The miniaturization of the system based on micro-optics and MEMS technology will lead to clinical applications of the multimodality imaging technology for the non-invasive diagnosis of cancer and other diseases. The other on-going research projects focus on the discovery of new intrinsic biomarkers. He develops advanced imaging and spectroscopy systems to explore the optical signals in tissues and cells in spectral and time domains. The biological information extracted from the signals is used for non-invasive characterization of tissue pathology and diagnosis of diseases.

Prof. Albert Chung's laboratory pursues research in medical image analysis in particular analysis of brain images and computational reconstruction of blood vessels from angiograms. He is also interested in algorithmic development of image segmentation and registration methods.

Prof. Jun Xia's laboratory investigates the molecular mechanism of protein trafficking and its implication in brain disorder, diabetes, and infertility. He also investigates the molecular and cellular bases of learning and memory, organization of synapse, and regulation of synaptic transmission. His research also advances the use of fluorescent microscopes and imaging applications in life science.

Prof. Condon Lau's laboratory studies auditory and visual processing in animal models using functional MRI (fMRI). Recent studies have looked at motion processing in the subcortex using auditory and visual cues. Another set of studies examined intensity processing in the midbrain. He is currently developing a novel fMRI technique for tonotopic mapping using balanced steady state free precession imaging and acoustic frequency sweeping stimulation. This new technique improves frequency resolution and reduces image distortion compared to conventional fMRI. It can be readily applied to study tonotopy in the human auditory cortex. He is also developing simultaneous magnetic resonance and optical imaging technology (MROI). MROI offers higher effective spatial and temporal resolution than MRI, larger field of view than optical imaging, and multimodality imaging. It can potentially be used to direct endoscope placement during diagnostic examinations and conduct functional imaging with higher spatial resolution than existing neuroimaging technologies.

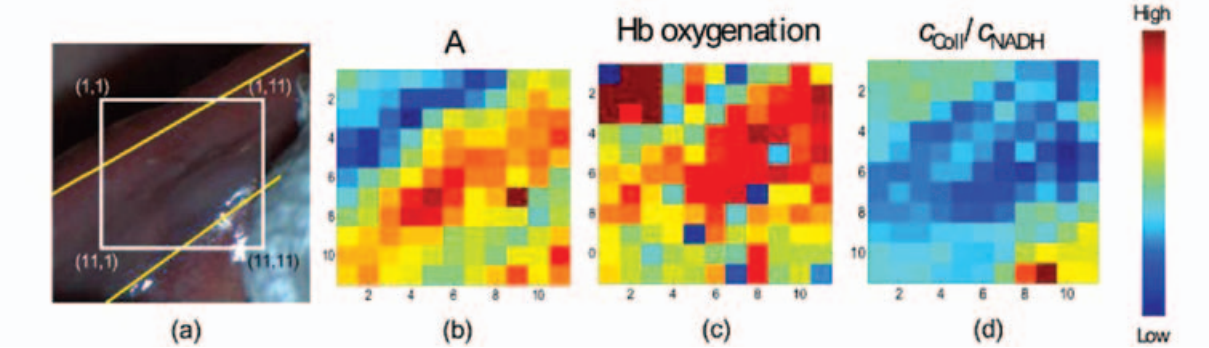


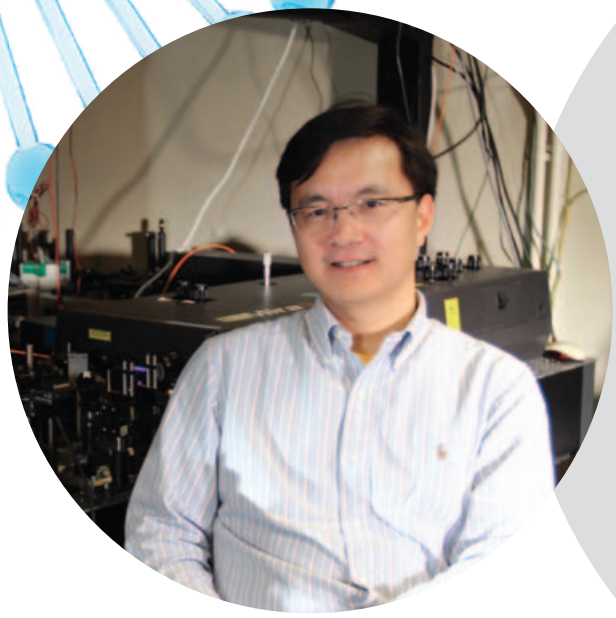
Group Members

- Prof. Jianan QU
- Prof. Albert CHUNG
- Prof. Jun XIA
- Prof. Condon LAU

Group Activities and Projects

1. Nonlinear Optical Imaging of Super-resolution for Future Discovery in Neuroscience
2. New endogenous fluorescence biomarker for non-invasive diagnosis of early cancer
3. Photochemical properties of endogenous biological molecules: fundamental and application
4. Imaging tissue pathology with the combination of diffuse reflectance and autofluorescence
5. Detection of early stage nasopharyngeal and other head and neek cancers by spectroscopic fluorescence endoscopy
6. Near-infrared spectroscopy of biological tissue: Theory and development for selected medical applications
7. Short-wavelength two photon excited endogenous fluorescence for epithelial cancer detection
8. Advanced photonics technology for the assessment of tissue viability in vivo
9. Optical biopsy based on depth-resolved autofluorescence spectroscopy
10. Multivariate fluorescence imaging for detection of early cancer
11. Early Detection Of Nasopharyngeal Cancer By Fluorescence Endoscopy
12. Design and instrumentation of a near-IR Raman system for rapid and reagentless concentration measurements of biologicalanalytes and screening of therapeutical drugs and substances of abuse
13. Concentration measurements of biological analytes by laser Raman spectroscopy
14. fMRI of auditory and visual motion processing
15. fMRI of auditory and visual intensity processing
16. Developing 3D swept source imaging for noninvasive tonotopic mapping
17. Developing MRI compatible endoscope





Prof. Jianan QU

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Primary Research Area
Biomedical Imaging

Research Interests

My laboratory aims to develop advanced optical and photonics imaging technology for non-invasive imaging and sensing of important biological processes. Specifically, we develop label-free multi-modality nonlinear microscopes for the study of early cancer development. The miniaturization of the system based on micro-optics and MEMS technology will lead to clinical applications of the multimodality imaging technology for the non-invasive diagnosis of cancer. The other on-going research projects focus on the discovery of new intrinsic biomarkers. We develop advanced imaging and spectroscopy system to explore the optical signals in tissues and cells in spectral and time domains. The biological information extracted from the signals are used for non-invasive characterization of tissue pathology and diagnosis of diseases.

Highlighted Publications

- Wei Zheng, Dong Li, Shuxia Li, Yan Zeng, Yanqi Yang and Jianan Y. Qu, "Diagnostic value of nonlinear optical signals from collagen matrix in the detection of epithelial precancer", Optics Letters, V.36, 3620-3623 (2011)
- Dong Li, Wei Zheng, Wei Zhang, Seng Khoon Teh, Yan Zeng, Yi Luo and Jianan Y. Qu, "Time-resolve detection enables standard two-photon fluorescence microscope for in vivo label-free imaging of microvasculature in tissue", Optics Letters, V.36, 2638-2640 (2011)
- Yan Zeng, Liguo Jiang, Wei Zheng, Dong Li, Shuhuai Yao and Jianan Y. Qu, "Quantitative imaging of mixing dynamics in microfluidic droplets using two-photon fluorescence lifetime imaging", Optics Letters, V.36, 2236 (2011)

Prof. Albert CHUNG

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(Ph.D., Oxford University)

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Primary Research Area
Medical Image Analysis, Image Processing, Computer Vision

Research Interests

My research interest is medical imaging in particular analysis of brain images and computational reconstruction of blood vessels from angiograms. I am also interested in algorithmic development of image segmentation and registration methods.

Highlighted Publications

- Wilbur C. K. Wong, Ronald W. K. So and Albert C. S. Chung, "Principal Curves for Lumen Center Extraction and Flow Channel Width Estimation in 3-D Arterial Networks: Theory, Algorithm and Validation", IEEE Transactions on Image Processing, (TIP, 2012), accepted.
- Shu Liao and Albert C. S. Chung, "Non-rigid Brain MR Image Registration using Uniform Spherical Region Descriptor", IEEE Transactions on Image Processing, (TIP, 2012), 21(1), 157-169, (2012)
- Yuan Yuan, Yishan Luo and Albert C. S. Chung, "VE-LLI-VO: Vessel Enhancement using Local Line Integrals and Variational Optimization", IEEE Transactions on Image Processing, (TIP, 2010), 20(7), pages 1912-1924,(2011)

Prof. Jun XIA

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Primary Research Area

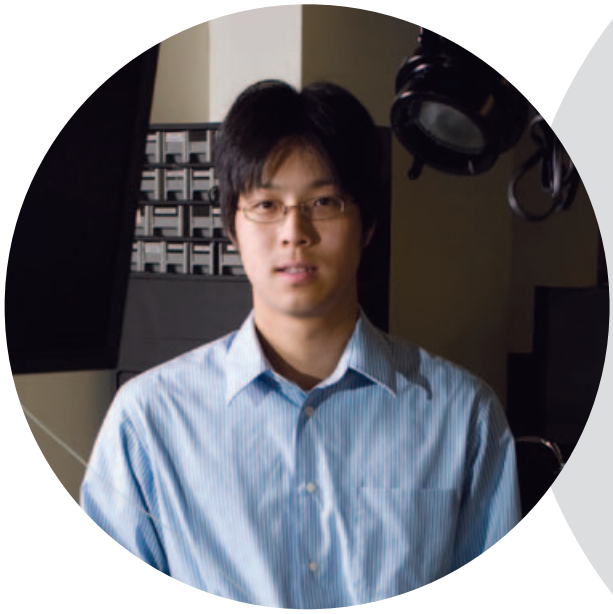
Neuroscience, Cell Biology

Research Interests

- Molecular mechanism of protein trafficking and its implication in brain disorder, diabetes and infertility.
- Molecular and cellular bases of learning and memory, organization of synapse and regulation of synaptic transmission.
- Fluorescent microscope and imaging application in life science

Highlighted Publications

- Xu, J., Xiao, N., Xia, J., "Thrombospondin 1 Accelerates Synaptogenesis in Hippocampal Neurons through Neuroligin 1", Nat. Neurosci. 13 (1): 22-4 (2010)
- Xiao, N., Kam, C., Shen, C., Jin, W., Wang, J., Lee, K.M., Jiang, L., and Xia, J., "PICK1 deficiency causes male infertility in mice by disrupting acrosome formation", J. Clin. Invest. 119(4): 802-812 (2009)
- Xia, J., Zhang, X., Staudinger, J., and Huganir, R.L., "Clustering of AMPA receptors by the synaptic PDZ domain-containing protein PICK1", Neuron. 22(1): 179-87 (1999)



Prof. Condon LAU

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Primary Research Area
Biomedical Imaging

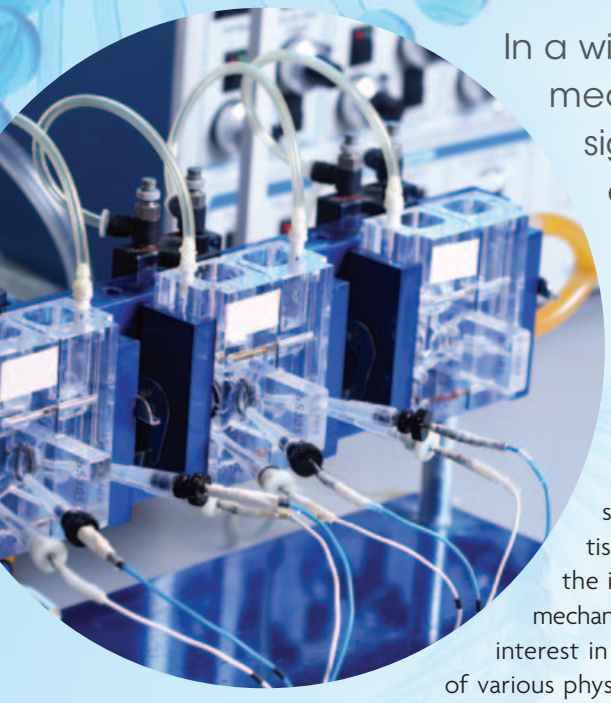
Research Interests

- Develop simultaneous magnetic resonance and optical imaging technologies for system and cellular level imaging.
- Develop image processing algorithms to integrate magnetic resonance and optical information.
- Study auditory and visual processing using functional magnetic resonance and optical imaging.
- Advance early disease detection using magnetic resonance and optical imaging.

Highlighted Publications

- Cheung MM, Lau C, Zhou IY, Chan KC, Cheng JS, Zhang JW, Ho LC, Wu EX, "BOLD fMRI investigation of the rat auditory pathway and tonotopic organization", Neuroimage, 60 (2012)
- Lau C, Zhang JW, Xing KK, Zhou IY, Cheung MM, Chan KC, Wu EX, "BOLD responses in the superior colliculus and lateral geniculate nucleus of the rat viewing an apparent motion stimulus", Neuroimage, 58 (2011)
- Yu CC, Lau C, O'Donoghue G, Mirkovic J, McGee S, Galindo L, Elackattu A, Stier E, Grillone G, Badizadegan K, Dasari RR, Feld MS, "Quantitative spectroscopic imaging for non-invasive early cancer detection", Opt Express, 16 (2008)

MultiScale Biomechanics and Mechanobiology



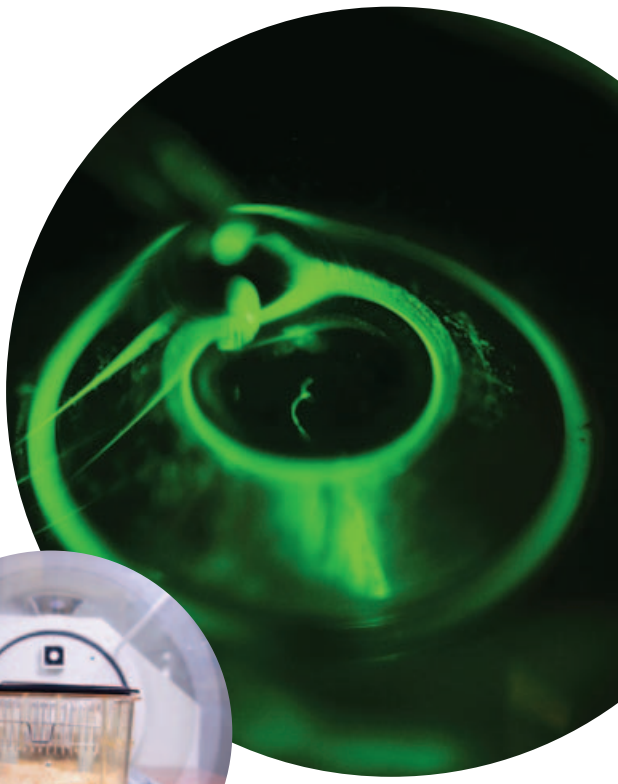
In a wide spectrum of physiological processes, local mechanical forces provide critically important signals that regulate the phenotypic expression of cells and tissues. Ultimately, these mechanical signals are combined with other signals from the cellular microenvironment to modulate functions at the molecular, cellular, tissue, and organ levels.

Although the field of traditional biomechanics has contributed significantly to our understanding of how mechanical forces regulate tissue function, our understanding at the cellular and molecular level of the integrated response of cells to combinations of mechanical and non-mechanical cues is very little. During the last 10-15 years, there has been increasing interest in the fundamental role played by mechanical forces in the regulation of various physiological processes at the molecular and cellular level, which leads to the emergence of the field of study on molecular and cellular mechanobiology. By nature, biomechanics and mechanobiology are interdisciplinary fields combining molecular and cellular biology, physiology, physics, and engineering. The Division of Biomedical Engineering at the Hong Kong University of Science and Technology has several groups interested in multi-scale biomechanics and mechanobiology..

Prof. Qingping Sun's research interests include mechanics and reliability of biomaterials, human surgery device and implants, biophysics of biomotor and motality of cell. His research expertise covers experiment, modelling and simulation of mechanical behavior of biomaterials, multi-scaled phenomena and multi-physics coupling in behavior of biomaterials and biological systems.

Prof. Penger Tong is a veteran soft matter physicist. His interests in biological physics include two primary directions: molecular trafficking in live cells and mechanical properties of live cells and tissues. The first direction is the study of lateral motion of proteins and lipids on live cell membrane. The motion of proteins and lipids plays an essential role in determining the response of living cells to external stimuli and is influenced strongly by the molecular interactions and viscoelastic properties of the cell membrane. Two-color florescent microscopy and multi-particle tracking are used in the study of molecular trafficking. The other direction is the study of mechanical properties of a thin layer of live epithelial cells. His main interest in this area is to build a mechanical platform to accurately measure the moduli and mechanical response of a thin tissue layer to an external strain field. Laser light scattering, atomic force microscopy and various force sensing techniques are used in the experiments.

Prof. Pingbo Huang's group has expertise in ion channel and signal transduction. His group is interested in how chemical and mechanical cues control ion channels and other signaling molecules. Particularly, his group is interested in molecular mechanism of CFTR channel mechanosensitivity, which his group has recently discovered. They are also studying the biological significance of CFTR mechanosensitivity in cell volume regulation, cell migration, and high altitude associated sickness. His group is also exploring how mechanical cues regulate cell migration.



Prof. Yi-Kuen Lee's research interests include Bio-MEMS and microfluidics for medical diagnostics, and optofluidics and study of electromechanobiology of cell. His group is interested in developing 1) novel Bio-MEMS and micro/nanofluidic devices for biomedical diagnostics, especially DNA analysis and cancer diagnostics; 2) new microchips to study single DNA/cell mechanics and their applications, including new Circulation Tumor Cells (CTCs) chips for cancer diagnostics; 3) methodology for micro/nano electrophoresis and electroosmosis for DNA analysis; 4) microfluidic system with closed-loop feedback for screening of Traditional Chinese Medicine (TCM).

Group Members

- Prof. Qingping SUN
- Prof. Penger TONG
- Prof. Pingbo HUANG
- Prof. Yi-Kuen LEE

Group Activities and Projects

1. Role of time scales in phase transition patterns during flagella motion
2. Molecular trafficking in live cells and its correlation with viscoelastic properties of the cell membrane
3. Mechanical manipulation, characterization, and modeling of epithelial monolayers
4. Molecular mechanism of CFTR channel mechanosensitivity
5. The role of CFTR mechanosensitivity in cell volume regulation, cell migration, and mountain sickness
6. The effect of mechanical properties of matrix on cell migration and mechanosensitive signaling molecules involved in cell migration
7. Developing microfluidic electroporation chip with integrated micro coulter counter for drug delivery and electropore dynamics.
8. Developing new Circulation Tumor Cells (CTCs) chips for cancer diagnostics.
9. Developing high-throughput microfluidic system with closed-loop feedback for screening of Traditional Chinese Medicine (TCM)

Prof. Qing-Ping SUN

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Primary Research Area

Bio-Materials, Mechanics of Materials and Medical Devices

Research Interests

My research interests include experiment and modeling of bio-materials and medical devices such as human implants, stents and artificial joints; phase transition processes in ceramics, metals and biological systems; material instability; nonlinear waves and pattern evolution in materials; hysteresis phenomena and multi-scale mechanics modelling; phase transition in micro-/nano-scale tribology of bulk and thin film materials.

Highlighted Publications

- Abbas Amini, Wenyi Yan and Qingping Sun, "Depth dependency of indentation hardness during solid-state phase transition of shape memory alloys", Applied Physics Letters, 99, 021901 (2011)
- Yongjun He, Qingping Sun, "On non-monotonic rate dependence of stress hysteresis of superelastic shape memory alloy bars", International Journal of Solids and Structures, 48, 1688-1695 (2011)
- Y.J. He, Q.P. Sun, "Rate-dependent domain spacing in a stretched NiTi strip", International Journal of Solids and Structures, 47, 2775-2783 (2010)

Prof. Penger TONG

Chair Professor, Division of BioMedical Engineering

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Primary Research Area

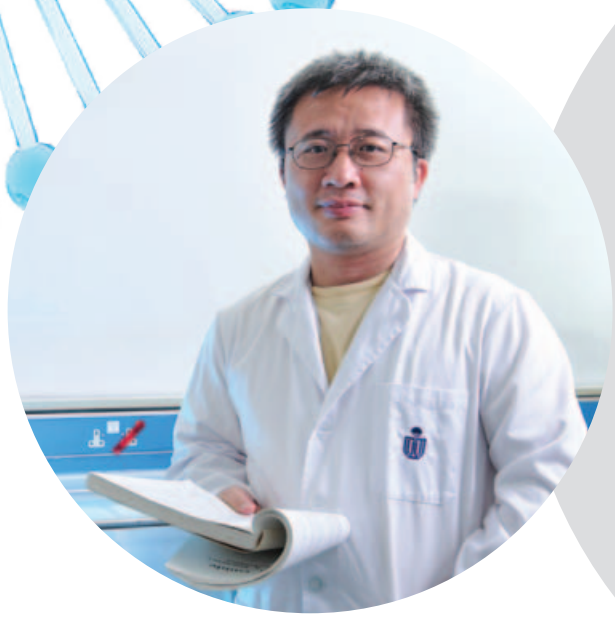
Experimental Soft Condensed Matter Physics

Research Interests

Structures, interactions, and dynamics in colloidal suspensions and polymer solutions and in their mixtures; interactions and dynamics of a monolayer of colloidal particles at liquid-liquid interfaces; non-equilibrium processes in suspensions and at liquid-solid interfaces; sedimentation of non-Brownian particles in simple and complex fluids; microrheological properties of polymer solutions, gels, and biomaterials; anomalous diffusion of membrane-bound proteins and lipids in live cells; mechanical properties of live cells and issues.

Highlighted Publications

- X.-M. Xiong, S. Guo, Z. Xu, P. Sheng, P. Tong, "Development of an atomic-force- microscope-based hanging-fiber rheometer for interfacial microrheology", Physical Review E 80, 061604 (2009).
- W. Chen and P. Tong, "Short-time self-diffusion of weakly charged silica spheres at aqueous interfaces", Europhysics Letters 84, 28003 (2008).
- W. Chen, S.-S. Tan, T. K. Ng, W. T. Ford, and P. Tong,"Attraction between like-charged colloidal particles at aqueous interfaces", Physical Review Letters, 95, 218301 (2005).



Prof. Pingbo HUANG

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Primary Research Area

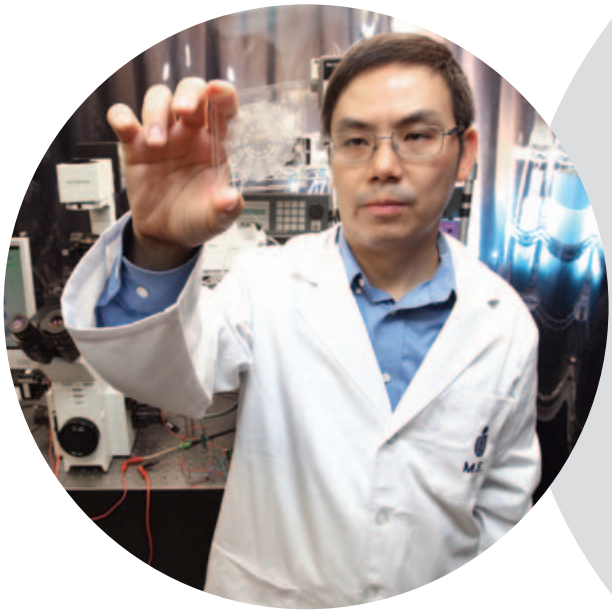
Mechanobiology

Research Interests

The research in my lab focuses on the regulation of epithelial ion channels including CFTR, by chemical and mechanical cues. In addition, my lab is interested in other related questions in epithelial biology and molecular mechanobiology.

Highlighted Publications

- Sun Y, Duan Y, Eisenstein AS, Hu W, Quintana A, Lam WK, Wang Y, Wu Z, Ravid K, and Huang P., "A2B adenosine receptors interact directly with NF-κB1/p105 to control NF-κB activation and inflammation", Journal of Cell Science, Epub ahead of print (Jul 5) (2012)
- Zhang WK, Wang D, Duan Y, Loy MMT, Chan HC, and Huang P. "Mechanosensitive gating of CFTR", Nature Cell Biology, 12(5), 507-12 (2010)
- Wang D, Sun Y, Zhang W, and Huang P. Apical adenosine regulates basolateral Ca++-activated potassium channels in human airway Calu-3 epithelial cells. American Journal of Physiology (Cell Physiology) 294, C1443-C1453 (2008)



Prof. Yi-Kuen LEE

Associate Professor, Division of BioMedical Engineering

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Associate Director of the Institute of Integrated Microsystem
Co-Director, KAUST-HKUST Micro/Nanofluidics Laboratory
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Primary Research Area

Bio-MEMS and Micro/Nanofluidics, Single DNA/Cell Mechanics, CTC Chips for Cancer Diagnostics, Closed-Loop Optimization for Screening of Traditional Chinese Medicine

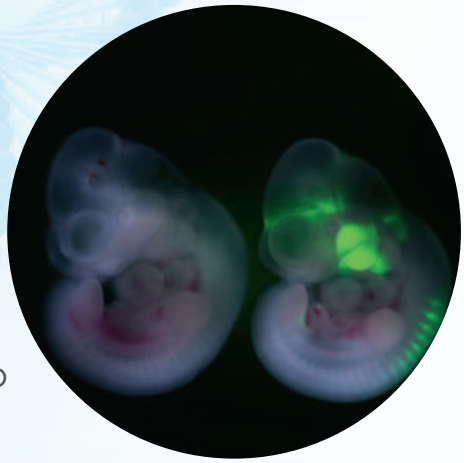
Research Interests

Develop novel Bio-MEMS and micro/nanofluidic devices for biomedical diagnostics, especially DNA analysis and cancer diagnostics. Develop new microchips to study single DNA/cell mechanics and their applications. Develop new Circulation Tumor Cells (CTCs) chips for cancer diagnostics. Develop design methodology for micro/nano electrophoresis and electroosmosis for DNA analysis. Develop microfluidic system with closed-loop feedback for screening of Traditional Chinese Medicine (TCM)

Highlighted Publications

- R. Lin, D.C. Chang and Y.-K. Lee, "Single-Cell Electroendocytosis on a Micro Chip Using In Situ Fluorescence Microscopy", Biomedical Microdevices, 13(6), 1063-1073 (2011)
- W. Wang, Y.C. Chan and Y.-K. Lee, "Biased Reptation Model with Electroosmosis for DNA Electrophoresis in Microchannels with Sub-Micron Pillar Array", J. Micromechanics & Microengineering, 21(8), 085031 (2011)
- X. Niu, Y.-K. Lee, "Efficient Spatial-temporal Chaotic Mixing in Microchannels", J. Micromechanics & Microengineering, 13(3), 454-462 (2003)

Emerging Biomedical Science and Technology



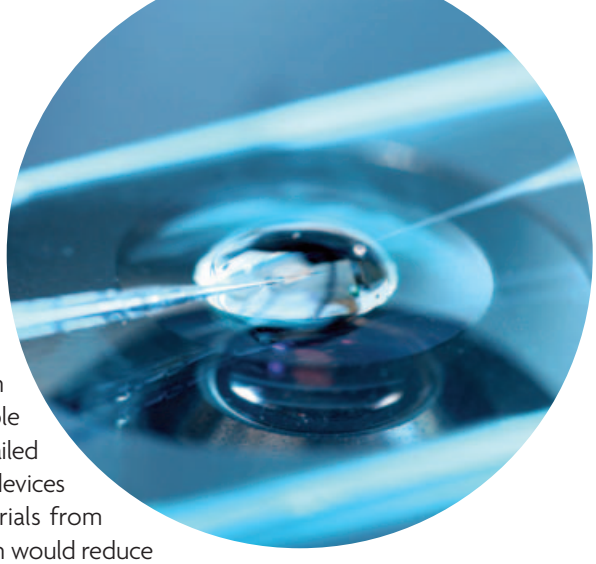
In this emerging area of biomedical science and technology, there are plenty of new frontiers where new tools, instrumentations, and conceptual ideas are being developed at different pace. No single research unit or division would be able to have the expertise to cover them all.

On the other hand, a biomedical engineering unit without the consideration to ride on these emerging technologies and to integrate them into the existing research platforms would be considered as stagnant, when the field is advancing fast. Hence, while we do not envision that the BME division would endeavor into all emerging areas in full force, we do have a general and genuine interest to incorporate novel approaches and capture the forefront of different disciplines into our integrated research projects, which might eventually lead a new biomedical engineering field. In this particular group, the expertise is diverse ranging from clinical to very basic research, spanning computational to mechanical engineering, and expand from mathematical to cell molecular interrogation of the research subjects. While the topics of interest may be more diverse, they all embrace the common thread of using novel approaches and unconventional tools to tackle important biomedical questions of interest.

In this cluster, Prof. Matthew Yuen's lab specializes in computer aided practices including modeling, design, engineering and manufacturing. The research in his group often copes with soft material such as human tissues, material interface, thermal interface material, biocompatible adhesive deployment, where various computer aided, feature based modeling would offer insights into the prediction of differentiation vascular tissues and soft objects. The research is therefore instrumental to medical diagnosis applicable to clinical cases.

Prof. King Lau Chow applies his developmental genetics background to venture into biomaterial/stem cell interface. Using biomaterial scaffold resembling the porosity, calcium phosphate content and isoform composition, induction of bone cell differentiation was evaluated. Manipulating the matrix conditions, the importance of abiotic factors in controlling cell differentiation and growth is revealed, which would allow better development of prosthetic material in surgical applications. To extend the work of differentiation into modeling tissue behavior and cellular communication, synthetic biology approach has been taken to artificially build non-existing genetic circuit in mammalian cell system and to couple cell signaling events for cellular synchronization. The ultimate goal is to control critical cell-tissue patterning events, and potential creating genetic devices for rhythmic discharge of therapeutics in cell and animal models.

Prof. John Kwok is a neurosurgeon with a long history of clinical practice and an expertise in catheterization of intracranial vessels. His research focuses on endoluminal surgery. Catheterization via the endovascular route was used for treating stroke, heart attacks and peripheral artery diseases with the deployment of stents, coils, balloon and flow diverting devices to replace open surgery. It offers minimal invasive intervention with reduction of surgical trauma and hospitalization time. This endoluminal surgery can also be applied to any tubular structure within the human body such as the biliary tree, the bronchial tree and the urinary tract. Research in these areas will expand the



application into new areas with higher successful rate. To make this possible, design of endoluminal devices demands a good understanding of flow dynamics and mechanical behaviors of the luminal structures such as the vascular tree. X-ray and computer imaging have provided valuable information in visualization and detection of vascular defects and the detailed development of the diseases. The design of most effective endoluminal devices made of metals, alloys, biodegradable gelatinous and adhesives materials from macro to nano environments are under investigation, the success of which would reduce the future recurrence.

Prof. Ching-Pin Chang's research work centers on understanding cardiovascular development and related diseases. The experimental findings would lead to translational research at the bedside. His group characterizes the differentiation and interplay of endocardial, myocardial, pericardial and neural crest cells, and how they integrate to form functional heart tissues. The knowledge would offer insights to the understanding of adult cardiovascular diseases, the differentiation gene expression profiles and the definition of the pathophysiological states. The purpose is to offer an entry point for possible regeneration or repair of heart tissue using adult stem cells derived from other tissue origins. This research would ultimately provide an effective cardiovascular treatment to patients.

Prof. Chun Liang utilizes yeast as a model to study how cell cycle and DNA replication. Adopting molecular, biochemical and genetic approaches, novel components have been identified to be responsible for DNA replication initiation and cell cycle control. The expression and protein profiles of these components would be used for diagnostic application across different cancer types and disease models. Ongoing effort exploits the knowledge of these genetic elements to develop target assays for screening and evaluation of anti-cancer drug efficacy.

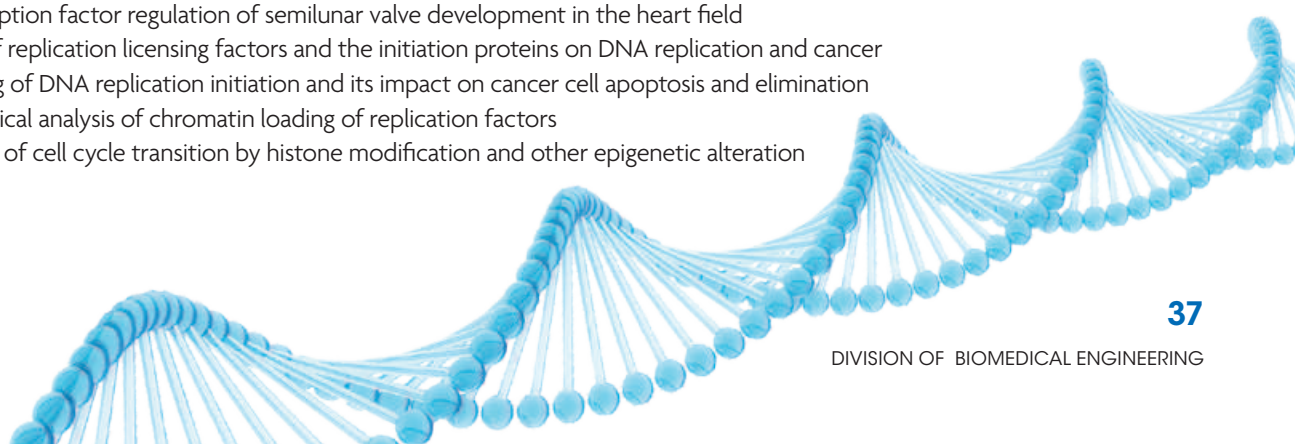
Prof. Guang Zhu approaches the similar cancer problem from a biophysical angle. His laboratory focuses on the dissection of structure functional nature of specific proteins related to DNA replication, epigenetic modification and cancer regulation. He is using multidisciplinary approaches, especially by biophysical methods, e.g., NMR spectroscopy and ITC, to characterize the nature of these proteins and screen for chemicals that have structural impact on these molecules, and thus controlling the disease development and symptom manifestation.

Group Members

- Prof. Matthew YUEN
- Prof. John KWOK
- Prof. Chun LIANG
- Prof. King Lau CHOW
- Prof. Ching-Pin CHANG
- Prof. Guang ZHU

Projects

- Investigation of biocompatible material based conductive adhesive
- Boolean operation on mesh surfaces
- Osteoinductivity analysis of different calcium phosphate based ceramics
- Impact of 3D scaffold and the porosity of hydroxyappetite on mesenchymal cell differentiation
- Construction of mammalian oscillators and a synchronization device for cell and tissue behavior regulation
- Epigenetic regulation and chromatin remodeling during cardiovascular development
- Transcription factor regulation of semilunar valve development in the heart field
- Roles of replication licensing factors and the initiation proteins on DNA replication and cancer
- Blocking of DNA replication initiation and its impact on cancer cell apoptosis and elimination
- Biophysical analysis of chromatin loading of replication factors
- Control of cell cycle transition by histone modification and other epigenetic alteration



Prof. Matthew Ming-Fai YUEN

Professor, Division of BioMedical Engineering

Head & Professor of Mechanical Engineering

(Ph.D., Bristol University)

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Home Page

http://www.me.ust.hk/people/faculty.html

Primary Research Area

CAD/CAM/CAE, Electronic Packaging

Research Interests

CAD/CAM/CAE:

- Featured-base modeling
- Soft object modeling
- Collaborative product development
- Precision machine and system design

Electronic Packaging

- Interfacial delamination
- Thermal interface materials
- Printed electronics
- Molecular modeling

Highlighted Publications

- Chen, M., Chen, X.Y., Tang, K., Yuen MMF, "Efficient Boolean operation on manifold mesh surfaces", Computer-Aided Design and Applications, 7 (3), 405-415 (2010)
- Liu, Y.-J., Yuen, M.M.F., "Geometry-optimized virtual human head and its applications", Computers and Graphics, 32 (6), 624-631 (2008)
- Yang, C., Yuen MMF, Gao, B., Ma, Y., Wong, C.P., "Investigation of a biocompatible polyurethane-based isotropically conductive adhesive for UHF RFID tag antennas", Journal of Electronic Materials, 40 (1), 78-84 (2011)

Prof. King Lau CHOW

Professor, Division of BioMedical Engineering
Professor, Division of Life Science
(Ph.D., Baylor College of Medicine)

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Home Page
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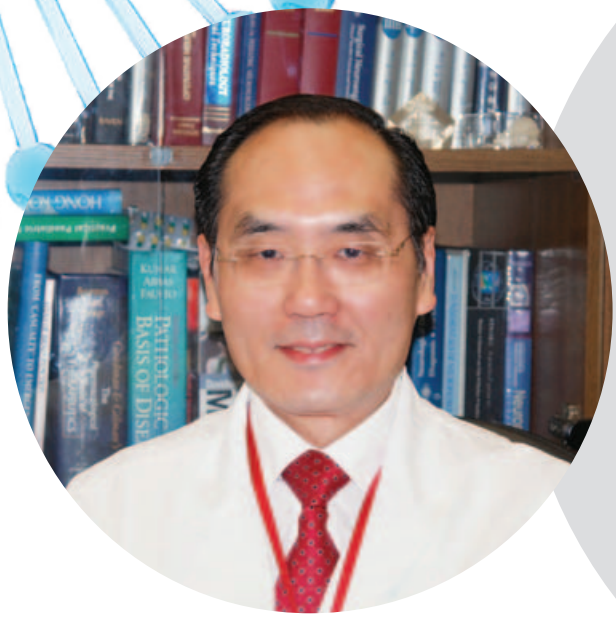
Primary Research Area
Developmental Genetics, Neurobiology, Evolution and Synthetic Biology

Research Interests

Research in my lab centers on a broad spectrum of developmental questions including determination of body pattern, organ assembly, regulation of tissue morphogenesis, chemosensory control of mating behavior and evolution. I use Caenorhabditis elegans and mouse as the genetic models to examine how differentiation of body shape and sensory organs are controlled by multiple genetic components acting in the BMP signaling pathway and a network of transcription factors dictating cell differentiation events. Regulators of the signaling event are of particular interest. Both biochemical and genetic approaches are adopted to dissect these functions and their molecular mode of operation, which is also evaluated in cell culture to confirm their significance. I also use a reversed engineering approach to reconstruct genetic circuit in cellular system to understand the execution of developmental circuitry.

Highlighted Publications

- Lee, J.T.Y., Wang, K., Tsang, S.W.H. Chow, K.L., "Comparative in vitro osteoinductivity study of CaP ceramics (HA, α-TCP, β-TCP) using 10T1/2 cells with different controls and possible correlations with other systems.", Journal of Biomaterials and Nano-Biotechnology 2:121-130 (2011)
- Tsang, S.W.H. and Chow, K.L., "Cryopreservation of mammalian embryos: advancement of putting life on hold.", Birth Defects Research Part C: Embryo Today: Reviews. 90: 163-175 (2010)
- Wong, Y.F., Sheng, Q., Chung, J.W.L., Chan, J.K.F. and Chow, K.L., "mab-31 functions at TGF-β signal-receiving cells for sensory ray patterning in C. elegans male tail development.", BMC Developmental Biology 10(1):82 (2010)



Prof. John, Ching Kwong, KWOK

Adjunct Professor, Division of BioMedical Engineering

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Primary Research Area

- Endovascular treatment for cerebral vascular diseases
- Applications of 3D neurovascular and neuro-radiological imagings in neurosurgery
- The application of human placenta as vascular model for endovascular devices

Research Interests

1. Endovascular therapies for cerebral aneurysms, arteriovenous malformations and dural fistulas
2. New therapies for carotid artery pathology. Stent angioplasty of intracranial and cervical stenosis. Supra-aortic trunks lesions and endovascular treatment.
3. Mechanical thrombolysis of acute thrombotic stroke.
4. New technologies in embolization of intracranial tumours and delivery of cytotoxic agent by intra-arterial route.
5. The pathogenesis of intracranial vertebral artery dissection and endovascular treatment options
6. Flow dynamics and pathogenesis of cerebral vascular diseases

Highlighted Publications

- "Mid-term outcome of Pipeline Embolization Device for intracranial aneurysms – a prospective study in 143 patients with 178 aneurysms", Radiology, accepted and to be published in Oct 2012.
- Tan C.B., Chan K.Y., Kwok J.C.K, "The feasibility of three-dimensional Guglielmi detachable coil for embolization of wide neck cerebral aneuerysm. ", Interventional Neuro-radiology (2000)
- Datta NN, Rehman S, Kwok J.C.K., "Reversible dementia due to dural AV fistula: a simple surgical option", Neurosurgical Review, 21, 174-76 (1998)

Prof. Ching-Pin CHANG

Adjunct Associate Professor,
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Associate Professor of Medicine, Stanford University
(Ph.D., Stanford University)

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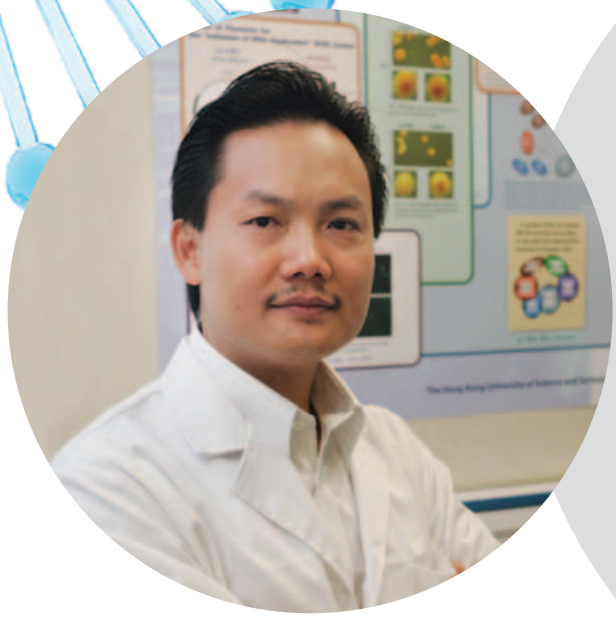
Primary Research Area
Developmental Biology, Adult Pathophysiology, Tissue Regeneration

Research Interests

The ultimate goal of my laboratory is to define the molecular mechanisms underlying cardiovascular development and disease and translate the bench findings to clinical applications. One objective is to understand how major types of cardiac cells (endocardial, myocardial, epicardial and neural crest cells) interact with each other to generate heart tissues. Another objective of the laboratory is to use the insights derived from developmental studies to investigate the pathogenesis of adult cardiovascular diseases. Furthermore, to understand tissue repair mechanisms, we are investigating the biology of adult stem cells in various tissues that include hair follicles and blood vessels under different pathophysiological conditions. Our goal is to integrate studies of developmental biology, adult pathophysiology, and tissue regeneration toward the understanding and treatment of human diseases.

Highlighted Publications

- Lin CY, Lin CJ, Chen CH, Chen RM, Zhou B, Chang CP, "The secondary heart field is a new site of calcineurin/Nfatc1 signaling for semilunar valve development", J Mol Cell Cardiology, 52(5): 1096-102 (2012)
- Chang CP, Bruneau B., "Epigenetics and cardiovascular development", Annu Rev Physiol, 74: 13.1-13.28 (2012)
- Han P, Hang CT, Yang J, Chang CP, "Chromatin remodeling in cardiovascular development and physiology", Circulation Research, 108: 378-96 (2011)



Prof. Chun LIANG

Affiliated Faculty, Division of BioMedical Engineering

Associate Professor, Division of Life Science

Associate Director, Center for Cancer Research

(Ph.D., Brown University; Postdoc, Cold Spring Harbor Laboratory)

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Primary Research Area

DNA Replication and Cell Cycle Control; Anticancer Drugs; Molecular Cancer Detection

Research Interests

- Investigation of the mechanism and cell cycle control of DNA replication in the budding yeast Saccharomyces cerevisiae and human cells;
- Identification and characterization of novel proteins for the initiation of DNA replication and cell cycle control by using yeast genetic screens and yeast molecular genetic, cellular and biochemical approaches;
- Identification and characterization of replicators and replication origins in human cells; study of regulation of DNA replication in normal and cancer cells; Examination of genomics and proteomics of cancer and other diseases;
- Development of anticancer drugs screening platforms and targeted anticancer drugs with low toxicity towards normal cells; Research and development of therapeutics from natural sources, traditional Chinese medicinal herbs and synthetic compounds; Development of molecular cancer detection methods with replication-initiation proteins as markers.

Highlighted Publications

- Zhai, Y., Yung, P., Huo L., and Liang C., "Cdc14p resets the competency of replication licensing by dephosphorylating multiple initiation proteins", J. Cell Sci. 123, 3933-3943 (2010)
- Feng, D., Tu Z., Wu, W., and Liang, C., "Inhibiting the Expression of DNA Replication-Initiation Proteins Induces Apoptosis in Human Cancer Cells", Cancer Res. 63: 7356-7364(2003)
- Zhang, Y., Yu, Z., Fu, X., and Liang, C., "Noc3p, a bHLH protein, plays an integral role in the initiation of DNA replication in budding yeast", Cell, 109, 849-860 (2002)

Prof. Guang ZHU

Affiliated Faculty, Division of BioMedical Engineering

Professor, Division of Life Science
(Ph.D., University of Maryland)

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Primary Research Area
Structure-function of Biomolecules,
NMR Spectroscopy, Drug Design

Research Interests

My laboratory is interested in studying structure and function of proteins, DNA and RNA that play important roles in cancer with use of multidisciplinary approaches, especially the biophysical methods, such as NMR spectroscopic method, and ITC. Based on the knowledge obtained from our research, we will search and design chemicals that can possibly provide the treatment for various cancers. We are also interested in developing NMR technology to tackle difficult biological problem. Currently, we are focusing on structure-functional study of proteins involved in regulation and epigenetic control of genomic DNA replication.

Highlighted Publications

- C. Liu, R. Wu, B. Zhou, J. Wang, Z. Wei, B. Tye, C. Liang and G. Zhu, "Structural Insights into the Cdt1-Mediated Mcm2-7 Chromatin Loading", Nucleic Acids Research, in press (2012)
- Z. Hao, M. Tan, C. Liu, F. Rui, E. Wang and G. Zhu, "Studying base pair open-close kinetics of tRNALeu by TROSY-based proton exchange NMR spectroscopy", FEBS Letter 584,4449-52 (2010)
- Y.Yin, V. C. Yu, G. Zhu* and D. C. Chang,* "SET8 plays a role in controlling G1/S transition by blocking lysine acetylation in histone through binding to H4 N-terminus tail," Cell Cycle 7 (10) 1423-1432 (2008)

International Advisory Committee

Professor Arup CHAKRABORTY (MIT)

Robert T. Haslam Professor of Chemical Engineering
Professor of Chemistry
Professor of Biological Engineering
Director, Institute for Medical Engineering and Science
Massachusetts Institute of Technology
National Academy of Engineering
American Academy of Arts and Sciences

Professor Shu CHIEN (UCSD)

Professor of Bioengineering
Professor of NanoEngineering
University of California, San Diego
Member of US Academies (NAE, NAS, Medicine, Academy of Arts and Sciences)
Academia Sinica (Taiwan)
Foreign Member of Chinese Academy of Sciences
National Medal of Science (2011)

Professor Xiaoqin WANG (Johns Hopkins)

Professor of Biomedical Engineering
Professor of Neuroscience
Professor of Otolaryngology
Director, Laboratory of Auditory Neurophysiology
Johns Hopkins University
Chair, Department of Biomedical Engineering, Tsinghua University

Bioengineering Program

Bioengineering Program (BIEN), an interdisciplinary program of School of Engineering, is hosted by the Division of Biomedical Engineering with active participation by faculty members of the Schools of Engineering and Science. Currently we have 58 affiliated faculty members (33 from SENG and 25 from SCI). We are committed to educate graduate engineers who can bring systematic and quantitative approach to the study of biological systems; and who have the necessary knowledge to contribute to the biomedical industry, to optimize existing bioprocesses and develop new biotechnologies. This program will allow students to apply the tools of engineering, computer science, and physical sciences to their study of biological processes.

Program Benefits

The two postgraduate programs (MPhil and PhD) and the undergraduate minor program are funded by the Government of Hong Kong through the University Grants Committee. The BIEN program aims to create an engineering discipline that:

- Advances our understanding of biological systems
- Develops innovative solutions for today's health problems
- Integrates bio-based systems for engineering applications
- Opens new avenues for technological innovations for the twenty-first century
- Contributes to improving the quality of our lives

Postgraduate Program

The BIEN program comprises of four concentration streams to address different applications in the bioengineering area. The four streams are: (1) Biological Information Engineering, and (2) Bioprocessing and BioProduct Design, and (3) BioMEMS and Biomaterials, (4) Pharmaceutical Engineering.

Master of Philosophy (MPhil) Program in Bioengineering

Students must undertake coursework (12 credits), attend Bioengineering seminars, pass a language course and successfully complete a thesis to demonstrate competence in bioengineering research. Full time study normally takes two year to complete. Part-time is also available.

Doctor of Philosophy (PhD) Program in Bioengineering

Students must successfully complete an advanced study program including postgraduate courses and a thesis of significant original research. Students are required to undertake coursework (15 credits) and attend Bioengineering seminars and pass a language course. All students must pass a qualifying examination set by the program. The full time program usually takes a minimum of three years. Part-time is also available.

Undergraduate Minor Program

The goal of this minor program is to stimulate students' interests and develop their knowledge and skills in bioengineering. Because of the interdisciplinary nature of bioengineering, the program is structured to encourage students to

1. widen their scope of learning to encompass different areas of science and engineering;
2. integrate the principles in biology and engineering in a specific application direction.

This program also intends to foster a collaborative environment among different schools and departments to contribute to the development of a strong interdisciplinary program in HKUST.

- Established in September 2006
- 255 students graduated with minor as in September 2011

Area of Concentration

Bioprocessing
Biological Informatics and Data Processing
Applied Bioscience

Curriculum Requirements

The Bioengineering Minor Program requires a minimum of 18 credits

- 6 credits must be taken from compulsory course, of which one course is from the School of Science and one from School of Engineering.
- 12 credits of elective courses must be taken from the approved course list.

About the Students

Fact

We attract top quality students from reputable local, mainland & overseas Universities as follows:

- University of Ottawa
- ETH Zurich
- Bandung Institute of Technology
- Tsinghua University
- Peking University
- Fudan University
- Zhejiang University
- The Hong Kong University of Science & Technology
- The University of Hong Kong

Average new intake per year

~10

Ph.D to MPhil Ratio

7 : 3

A number of our Ph.D. candidates are supported by the Hong Kong Ph.D. Fellowships

Our Students

Jessica Law - 2011 PhD Graduate

I have recently graduated from the BIEN PhD program and I would like to say a few words about the programme. When I first joined the programme, I realised that all the students and faculties were coming from different disciplines. I wondered how could everyone fit well into this program. It turned out that this program offers a wide choice of courses for students and these helped the students to explore subjects that they have never come across. They offered courses from cell biology to electrical engineering that was definitely beneficial to students who would like to work in an interdisciplinary area. The cross subjects training built up student's analytical mind in different research aspects. Besides the taught courses, regular seminars given by invited guests or faculties also broaden our horizons. We are not just working on our own PhD research project, indeed, we also have plenty of chances to meet and discuss with other faculties and students in other disciplines. In conclusion, BIEN offers a good platform for students from different backgrounds to exchange idea and knowledge.

Jieying Zhong - 2012 PhD Graduate

I had been in the program for more than five years and got the PhD degree in Bioengineering recently. The experience of postgraduate study in BIEN program is important and unique. The program is a platform that attracts and gathers faculty and students from disciplines of a wide spectrum. Students will have the chance to get exposed to various subjects within the broad theme of bioengineering. We all benefits from the active communication and collaboration between different backgrounds. The BIEN seminar is my personal favorite part of the program. Renowned scholars, both internal and invited, and fellow student take turns to give excellent talks on their research in a weekly base. All of them are inspiring, informative and well organized. With the variety, effective communication and collaboration in the program, expertise and strengths complement with each other.

Yu Yu - Current PhD Student

BIEN is a great program for those who want to do interdisciplinary study in Bioengineering. I like this program very much, it gives me great opportunities to learn many other aspect of Bioengineering from student and invited speaker's seminar, including microfabrication, computational biology, tissue engineering, electrochemistry and etc., besides my own field of drug delivery. The program also has a very flexible curriculum, which gives us great freedom to select courses of interest from different departments and school. Being exposed to these different subjects not only broadens my horizon, but also helps me to think out of box while working on my own research.

Naushad Hossain - Current PhD Student

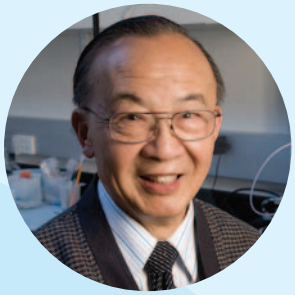
I completed my undergraduate studies from the University of Ottawa, Canada. I came to Hong Kong to pursue my PhD studies in the Bioengineering (BIEN) program. I am impressed with the collaborative nature of the program. Professors in other departments are ready to work with students from other fields. I like the general collegial atmosphere of BIEN, and to meet students from other departments. I enjoy the vivaciousness of Hong Kong. As a keen traveler, one of my motivation to come to Hong Kong is experience living in Asia while at the same time doing research in a world class institution.

BME Activities

To effectively connect scholars and students in local institutions with overseas peers in this exciting endeavor, Division of Biomedical Engineering is committed to hosting conference on biomedical engineering every other year, starting from 2013. The objective of the conference is to gather scientists in this emerging and exciting field to Hong Kong to present in-depth lectures on the new development of the topical area and to provide a discussion platform enabling interaction and brainstorming of local scientists with renowned scientists. It is hoped that the HKUST BME Conference (USTBME) will catalyze and accelerate research activities in biomedical engineering of our local scientists and provide our industrialist in the sectors of health-care products and medical devices a fresh perspective view in product design and technology innovation.

Distinguished Seminar Series

Starting from 2012, BME invites eminent scientists to give distinguished scientific talks on biomedical research area to enable an exchange of ideas between the speakers, students, faculty and the public on the latest advances in biomedical related research. We hope that the seminar series could promote BME as a center of interdisciplinary collaboration, innovation and knowledge.



Prof. Shu Chien

University of California, San Diego

- Perspectives in Biomedical Engineering

Prof. Arup K Chakraborty

Massachusetts Institute of Technology

- How to Hit HIV where It Hurts
- Physico-chemical Concepts in Immunology and Virology (3-day Short Course)

Prof. Robert H. Austin

Princeton University

- Applications of Micro and Nanofabrication in Biotechnology

Prof. Michael Sheetz

Columbia University

- Cellular Mechanosensing of the Microenvironment by Actin-Dependent Stretch-Relaxation Cycles

Prof. Marc Garbey

University of Houston

- A Road Map for Computational Surgery: Challenges and Opportunities

Prof. Xiaoqin Wang

Johns Hopkins University

- Neural Mechanisms Underlying Vocal Communication

Joint University Workshop and Collaboration

BME organizes Joint University Workshop regularly. Professors from both Universities will meet at the UST campus, give in-depth talks, exchange ideas and explore the direction of collaboration. In the past few years, we have organized workshops with Seoul National University and University of Tokyo. In 2012, collaboration with Chiba University has been established. We look forward to have more opportunities to collaborate with Universities worldwide in order to build up a solid and strong collaboration network.

Infrastructure and Facility

BME Division Facilities

The Bioengineering Laboratory is hosted by BME, it provides essential equipment items for most daily biological experiments. It supports students of the bioengineering program and their supervisor's research group.

BME is planning to build a communal laboratory to house facilities in biomedical engineering. Equipment items in the laboratory should strengthen our competitiveness in the focused research areas of the Division.

Bioengineering Laboratory

Since 2003, Bioengineering Laboratory (BELAB) supports faculty research groups from different departments.

Projects supported by BELAB are in the areas of:

- BioMEMS and Biomaterials
- Bioprocessing and Bioproduct Design
- Biological Information Engineering

Facilities

Biological Information Engineering

- DNA Microarray Spotter
- Real Time PCR System

Bioprocessing and Bioproduct Design

- Rotary Evaporator
- Tissue Culture Facility
- Fluorescence Microscope
- Fluorescence Plate Reader
- Digital Imaging System
- Sonifier cell disruptor

BioMEMS and Biomaterials

- Thermal Cycler
- DNA Microarray Spotter
- Tissue Culture Facility
- Fluorescence Microscope
- Plasma Cleaner

University Communal Facilities

HKUST provides world class research facilities for the university community and collaborators. Several communal facilities equipped with advanced equipment items are built, namely Nanoelectronics Fabrication Facility (NFF), Biosciences Central Research Facility (BioCRF) and Materials Characterization and Preparation Facility (MCPF).

The Nanoelectronics Fabrication Facility (NFF)

The first microfabrication laboratory established at a tertiary institution in Hong Kong.

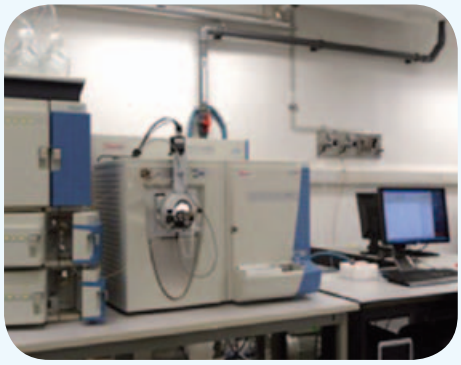
Mission

Provide facilities to conduct teaching and research, particularly in new discrete semiconductor devices, novel microsensors and microactuators, advanced nanoelectronics process technology and application specific integrated circuits (ASIC).

Services

- 3D Nano-electronics Devices
- Display Technology
- Micro-sensors
- Micro-Electro Mechanical System
- Silicon Photonics Technology
- Power Semiconductor Devices and Technology
- Advanced Packaging Program
- Advanced Process Module Development
- Gene Chip
- Compound Semiconductor Technology

Bioscience Central Research Facility (BioCRF)



Provides state-of-the-art communal equipments, trainings, and other activities to aid R&D in all areas of biological sciences.

Facilities

Biochemical Analysis

- Fast Protein Liquid Chromatography System
- Isothermal Titration Calorimeter
- ProteomeLab Protein Characterization System

Cell Biology

- Electroporation System
- Patch-clamp System
- Flow Cytometer

General Research

- Centrifuges
- Luminometer
- Real-time PCR Systems
- EnVision Multilabel Reader
- Odyssey Infrared Imaging System
- Typhoon TRIO System

Tissue analysis

- Histopathology Suite

Proteomics

- Liquid Chromatography Mass Spectrometer
- MALDI TOF/TOF Mass Spectrometer

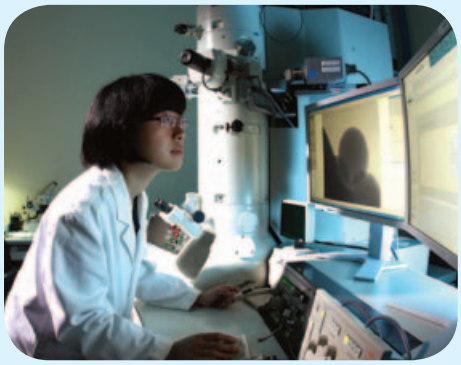
Microscopy

- Atomic Force Microscope
- HT Live Cell Imaging System
- Live Cell Observation Station
- STED Microscope
- CARS Microscope
- Laser Scanning Confocal Microscope
- TIRF Microscope

High-throughput analysis

- Bio-Plex Multiplex Analyzer

Materials Characterization and Preparation Facility (MCPF)



MCPF possess a wide range of sophisticated and modern equipment needed for in-house and collaborative materials research. It consists of eleven main research laboratories for sample preparation, optical characterization, surface analysis, electron microscopy, scanning probe microscopy, electrical and magnetic characterization, thin film deposition, thermal analysis, X-ray diffraction.

Services

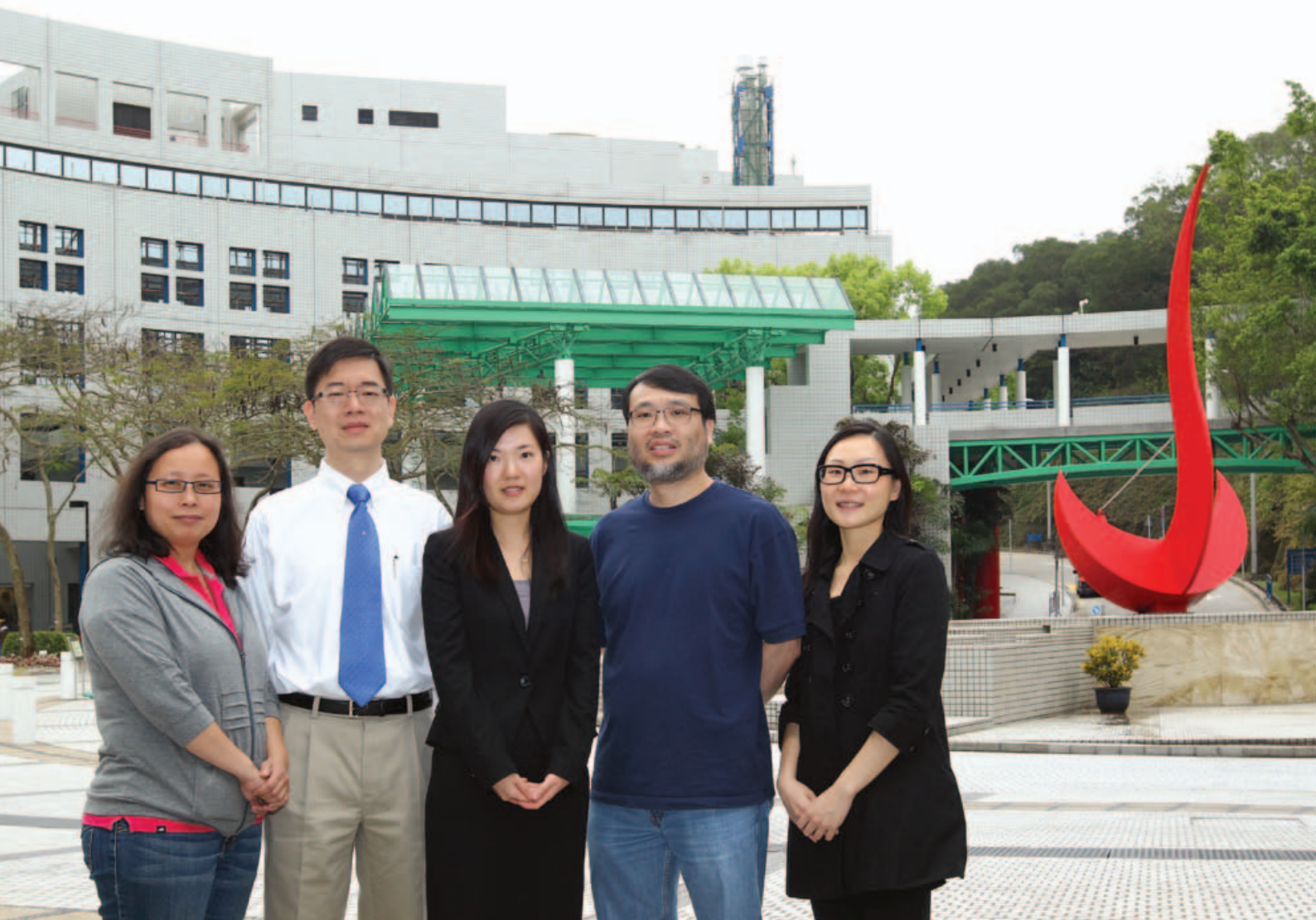
- Scanning Probe Microscopy
- Nuclear Magnetic Resonance
- Optical Characterization
- Thermal Analysis
- Sample Preparation-Electron Microscopy
- Nano Fabrication
- Scanning Electron Microscopy (SEM)
- X-Ray Diffraction
- Thin Film
- Electrical/Magnetic Characterization
- Sample Preparation-General
- Element Analysis
- Liquid Helium Plant
- Transmission Electron Microscopy (TEM)

Our Faculty

We look forward to getting your inputs for the development of this young Division of Biomedical Engineering.

Thank You

The Division's faculty and students have been well served by a group of professional administrative and technical staff as shown below whose contributions to the Division should definitely be noted and acknowledged.



HKUST BME

DIVISION OF BIOMEDICAL ENGINEERING

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