School of Biomedical Engineering
The University of Hong Kong
香港大學生物醫學工程學院

Future of Biomedical Engineering

SBME International Symposium 2025

November 3—5, 2025, Hong Kong

Programme book

Welcome to
the SBME International Symposium 2025

Dear Colleagues,

We are thrilled to welcome you to the SBME International Symposium 2025: Future of Biomedical Engineering. This will be a unique forum for bringing together leading minds from across the globe to explore the frontiers of Biomedical Engineering.

The School of Biomedical Engineering is a joint initiative of the Faculties of Medicine, Engineering, Science and Dentistry at the University of Hong Kong. This Symposium will serve as a catalyst for interdisciplinary dialogue among world-class researchers, emerging innovators, industry pioneers, and policy leaders. Together, we will explore the transformative technologies and visionary ideas that are shaping the future of healthcare and biomedical innovation.

The title of the Symposium - “Future of Biomedical Engineering” - reflects our collective aspiration to push the boundaries of field and redefine what is possible at the intersection of engineering, biomedicine and human health. From AI-driven diagnostics and regenerative medicine to wearable biosensors and bio-robotics, the future of BME is rich with promise and poised to revolutionize how we understand, treat, and prevent disease.

Our distinguished speakers will share cutting-edge research, discuss emerging trends, and address the global challenges and opportunities that lie ahead. We invite you to engage lively discussions, build meaningful collaborations, and be inspired by the ingenuity and passion that drive the BME community forward.

We look forward to your participation in this exciting journey to shape the future of Biomedical Engineering.

Sincerely,

Organizing Committee
SBME International Symposium 2025

Programme

Day 1
3 November 2025

Time	Programme
8:30	Registration and Coffee
09:00 - 09:15	Opening Ceremony Opening Remarks Speakers: **Professor Jay Siegel** (Vice-President and Pro-Vice-Chancellor (Teaching and Learning)) **Professor CS Lau** Vice-President and Pro-Vice-Chancellor (Health) (Interim), Dean of the Li Ka Shing Faculty of Medicine, The University of Hong Kong.
09:15 – 10:00 (40 minutes + 5 minutes Q&A)	**Professor Evelyn Yim** Session Chair: **Professor Rio Sugimura** **University of Waterloo** Topographical modification of biomaterials for regenerative medicine applications
10:00 – 10:45 (40 minutes + 5 minutes Q&A)	**Professor Song Li** Session Chair: **Professor Rio Sugimura** **University of California Los Angeles** Mechano-Immunoengineering for Cancer Therapy
10:45 – 11:15	Coffee break
11:15 – 12:00 (40 minutes + 5 minutes Q&A)	**Professor Peter Wang** Session Chair: **Professor Rio Sugimura** **University of Southern California** Ultrasound Control of Genetics/Epigenetics and Cellular Functions for Cancer Immunotherapy
12:00 – 13:00	Lunch (onsite catering will be provided)
13:00 – 13:45 (40 minutes + 5 minutes Q&A)	**Professor Paolo Bonato** Session Chair: **Professor Kevin Tsia** **Harvard Medical School** Technology Innovation for Precision Rehabilitation
13:45 – 14:30 (40 minutes + 5 minutes Q&A)	**Professor Patrick Kanold** Session Chair: **Professor Kevin Tsia** **Johns Hopkins University** Illuminating how we hear and learn to hear
14:30 – 15:00	Coffee break
15:00 – 15:45 (40 minutes + 5 minutes Q&A)	**Professor Chris de Zeeuw** Session Chair: **Professor Mu He** **Erasmus University Medical Center** In the Blink of an Eye: from Pavlovian Conditioning to Biomedical Engineering
15:45 – 16:30 (40 minutes + 5 minutes Q&A)	**Professor Shankar Subramaniam** Session Chair: **Professor Mu He** **University of California San Diego** Why have we not cured Alzheimer's disease? Reprogramming of the human brain
16:30 – 17:15 (40 minutes + 5 minutes Q&A)	**Professor Michael Häusser** Session Chair: **Professor Mu He** **The University of Hong Kong** Future perspectives on interfacing with the brain

Programme

Day 2

4 November 2025

Time	Programme
09:15 – 10:00 (40 minutes + 5 minutes Q&A)	**Professor Anqi Qiu** Session Chair: **Professor Wei-Ning Lee** **The Hong Kong Polytechnic University** Towards Precision Mental Health in Early Life
10:00 – 10:45 (40 minutes + 5 minutes Q&A)	**Professor Michael Miller** Session Chair: **Professor Wei-Ning Lee** **Johns Hopkins University** On the Data Science of Petascale Models for Neuroimaging: From Tissue to Tangles to Transcripts
10:45 – 11:15	Coffee break
11:15 – 12:00 (40 minutes + 5 minutes Q&A)	**Professor Cheng Chen** Session Chair: **Professor Wei-Ning Lee** **The University of Hong Kong** Medical Imaging AI: from specialist to multimodal and generalist medical intelligence
12:00 – 13:00	Lunch (onsite catering will be provided)
13:00 – 13:45 (40 minutes + 5 minutes Q&A)	**Professor Denis Wirtz** Session Chair: **Professor Joshua Ho** **Johns Hopkins University** 3D cellular mapping of solid tumors and new CAR T therapies to resolve them
13:45 – 14:30 (40 minutes + 5 minutes Q&A)	**Professor Jia Liu** Session Chair: **Professor Joshua Ho** **Harvard University** Soft and Flexible Brain-Computer Interfaces and NeuroAI
14:30 – 15:00	Coffee break
15:00 – 15:45 (40 minutes + 5 minutes Q&A)	**Professor Samuel Stupp** Session Chair: **Professor Joshua Ho** **Northwestern University** Bioactive Supramolecular Therapeutics: An Emerging Frontier
15:45 – 16:30 (40 minutes + 5 minutes Q&A)	**Professor Shiming Zhang** Session Chair: **Professor Joshua Ho** **The University of Hong Kong** Wearable Bioelectronics: Materials, Devices, and AI-Embedded Hardware-Software Co-Design
16:30 – 17:15 (40 minutes + 5 minutes Q&A)	**Professor Tian Xu** Session Chair: **Professor Joshua Ho** **Westlake University** From AI for Medicine to Science for AI: Deep Nature and Quantification Biology

Programme

Day 3
5 November 2025

Time	Programme
09:15 – 10:00 (40 minutes + 5 minutes Q&A)	**Professor Eric Honoré** Session Chair: **Professor Sangjin Lee** **Institut de Pharmacologie Moléculaire et Cellulaire** Molecular and Integrative Mechanobiology: Force-gated Ion Channels
10:00 – 10:45 (40 minutes + 5 minutes Q&A)	**Professor Hala Zreiqat** Session Chair: **Professor Sangjin Lee** **The University of Sydney** Redefining musculoskeletal regeneration: Innovations and vision for the future of biomedical engineering
10:45 – 11:15	Coffee break
11:15 – 12:00 (40 minutes + 5 minutes Q&A)	**Professor Kevin Tsia** Session Chair: **Professor Sangjin Lee** **The University of Hong Kong** Decoding cell with microscopy - from petabyte-scale data generation to intelligent morphological profiling
12:00 – 12:45 (40 minutes + 5 minutes Q&A)	**Professor Patrick Cai** Session Chair: **Professor Sangjin Lee** **The University of Manchester** Engineering Synthetic Genomes

Abstract

3D cellular mapping of solid tumors and new CAR T therapies to resolve them

Professor **Denis Wirtz**
Johns Hopkins University
Whiting School of Engineering Department
USA

Our group has recently developed CODA, an AI-based platform to map whole diseased and healthy organs and organisms in 3D and at single-cell resolution. CODA solves the challenge of imaging large volume samples, while preserving high spatial resolution. Through integration with other multi-omic approaches – such as spatial transcriptomics and proteomics - CODA allows for unprecedented cellular and molecular profiling of tissues. I will discuss the new biological insights into tumor onset and progression gained from the use of CODA, including ovarian and pancreatic cancers, and associated biomedical implications for early detection of cancer. I will also introduce our new CAR T therapies that exploit synthetic velocity receptors that dramatically increase the ability of traditional CAR T cells to readily infiltrate fibrotic tumors. We demonstrate their enhanced effectiveness in pancreatic, ovarian, and lung cancer.

Abstract

On the Data Science of Petascale Models for Neuroimaging: From Tissue to Tangles to Transcripts

Professor **Michael Miller**
John Hopkins University
Department of Biomedical Engineering
USA

I will review progress in the data science of Computational Molecular Anatomy for unifying the molecular scales and tissue continuum based on Dirac measures as generalized representations of the brain. I will show applications to understanding the spatio-temporal flow of neurodegenerative disease in humans as measured via MRI and digital pathology techniques and show applications to mouse spatial transcriptomics.

Abstract

Mechano-Immunoengineering for Cancer Therapy

Professor **Song Li**
University of California
Department of Bioengineering
USA

Immune cells are highly responsive to mechanical cues within their microenvironment; however, how to harness this mechanosensitivity to improve cell manufacturing and disease therapy remains unresolved. Here, we present a scalable microfluidic platform for fabricating microspheres that act as synthetic viscoelastic activating cells (SynVACs) with programmable mechanical and biochemical properties. We show that the viscoelasticity of SynVACs profoundly influences T cell function. Compared with rigid or purely elastic artificial cells, SynVACs promote superior T cell expansion, characterized by an increased $CD8^{+}$/$CD4^{+}$ T cell ratio, enhanced tumor cytotoxicity, greater efficiency in chimeric antigen receptor (CAR) transduction, and a marked enrichment of T memory stem cells. The resulting engineered CAR-T cells exhibit improved tumor clearance not only in a human lymphoma mouse model but also in an ovarian cancer xenograft model, maintaining prolonged in vivo persistence that suppresses tumor growth and recurrence. These findings reveal the critical role of mechanical signaling in T cell engineering and highlight the potential of SynVACs as a powerful tool for CAR-T therapy and immunoengineering. Building on this platform, we further developed a biomimetic "charging station" that integrates chemotactic and activation cues to facilitate the recruitment, activation, and expansion of CAR-iNKT cells. This system significantly enhances tumor infiltration, strengthens long-term immune memory, and achieves superior efficacy compared to conventional CAR-iNKT therapies in solid tumor models.

Abstract

Wearable Bioelectronics: Materials, Devices, and AI-Embedded Hardware-Software Co-Design

Professor **Shiming Zhang**
The University of Hong Kong
Department Electrical and Electronic Engineering
Hong Kong, China

In 1977, Shirakawa and colleagues made a groundbreaking breakthrough in organic semiconductor research (Chemical Communications 16 (1977): 578-580), earning them the Nobel Prize in 2000. In 2002, Berggren and colleagues reported organic electrochemical transistors (OECTs) based on the mixed-conducting organic semiconductor PEDOT:PSS (Advanced Materials 14.1 (2002): 51-54). This enabled the development of stable mixed-conducting devices that operate at room temperature and in aqueous environments, marking the start of a new era in bioelectronics. However, multidimensional mismatches between mixed-conducting organic semiconductors and human body—such as environmental compatibility (dry vs. wet), mechanical mismatches (rigid vs. soft), and dimensional compatibility (2D thin films vs. 3D bulk materials)—have hindered further progress in wearable bioelectronics. In this talk, I will present how our team, through molecular, polymer, and supramolecular co-design methods, discovered macroscopic semiconducting behavior in bulky hydrogels (Science 2025, Nature Electronics 2024, Nature Materials 2025). I will show how these supramolecular gel semiconductors and new concept devices provide a new foundation, and why AI-embedded hardware-software co-design is needed for next-generation wearable bioelectronics, supported by illustrative examples.

Abstract

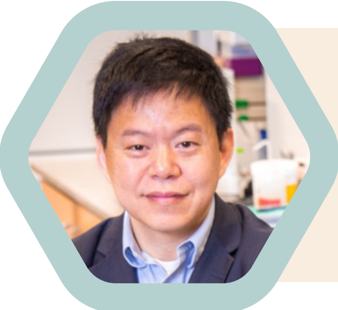
Soft and Flexible Brain-Computer Interfaces and NeuroAI

Professor **Jia Liu**
Harvard University
Department of Engineering and Applied Sciences
USA

Understanding brain function through large-scale brain-computer interfaces (BCIs) is essential for deciphering neural dynamics, treating neurological disorders, and developing advanced neuroprosthetics. A grand challenge in this field is to achieve simultaneous, large-scale, stable recording of neural activity, with single-cell resolution, millisecond precision, and cell-type specificity across three-dimensional (3D) brain tissue, throughout development, learning, and aging. In this talk, I will introduce a suite of soft and flexible bioelectronic technologies engineered to meet this challenge and enable the development of NeuroAI systems inspired by biological intelligence. First, I will present tissue-like bioelectronics, capable of tracking the activity of individual neurons in behaving animals across their entire adult life. I will address the electrochemical limitations of soft materials and share our strategies to overcome them, establishing a scalable platform for large-scale, stable, and long-term brain mapping, compatible for human clinical applications. Next, I will discuss the creation of “cyborg organisms” by integrating stretchable mesh-like electrode arrays into 2D sheets of stem/progenitor cells, which undergo 2D-to-3D morphogenesis to form brain organoids or embryonic brains. This enables continuous 3D electrophysiological recording during development. I will then highlight how the brain’s dynamic nature—and the challenge of capturing neural changes over time—can be addressed using our stable electronics to decode neural representational drift. These platforms support long-term, adaptive neural decoding and facilitate integration with neuromorphic algorithms for real-time interpretation of intrinsic neural dynamics. Building on this, I will introduce DriftNet, a deep neural network framework inspired by neural dynamics. DriftNet mitigates catastrophic forgetting, outperforming conventional and state-of-the-art lifelong learning models and equipping large language models with cost-effective, NeuroAI-driven lifelong learning capabilities. Finally, I will present our latest efforts integrating 3D single-cell spatial transcriptomics, electrophysiology, and agentic AI to map brain activity with cell-type specificity. I will conclude by outlining a future vision where soft electronics, spatial omics, and AI agents converge to construct a comprehensive brain cell functional atlas, transforming next-generation BCI and NeuroAI applications.

Abstract

Ultrasound Control of Genetics/Epigenetics and Cellular Functions for Cancer Immunotherapy



Professor **Peter Wong**
University of Southern California
Alfred E. Mann Department of Biomedical Engineering
USA

Cell-based cancer immunotherapy is quickly emerging as a promising therapeutic intervention for cancer treatment. However, non-specific killing against healthy tissues (e.g. on-target/off-tumor effect) is a major hurdle for solid tumor treatment. Here we show that the genetics and cellular functions of chimaeric antigen receptor T cells (CAR-T cells) within tumors can be remotely controlled by focused ultrasound (FUS) via a CAR cassette under a controllable promoter. In mice with subcutaneous tumors, T cells with the inducible CAR and activated via FUS mitigated on-target off-tumor activity and enhanced the suppression of tumor growth, compared with the performance of standard constitutive CAR-T cells. We have also developed controllable on- switch gene cassettes to reprogram the target cancer cell by FUS. Viral vectors were used to deliver the gene cassettes into the tumor cells, which will be activated by FUS to produce synthetic antigens and then targeted by CAR T for cancer immunotherapy. We applied this system to successfully treat prostate cancer cells whose locally metastasized tumors are confined in space but intermingled with vessels and nerves. This local activation of engineered cells by FUS should allow a high precision and safety in eradicating tumors. Recently, we have integrated FUS and CRISPR technologies to remotely guide the focused genomic editing and regulations in vivo. Hence, this approach for immunotherapy should open new opportunities to integrate engineering physics with genetic medicine and lead to successful translation from fundamental science and engineering to cancer therapy and clinical applications.

Abstract

Topographical modification of biomaterials for regenerative medicine applications

Professor **Evelyn Yim**
University of Waterloo
Department of Chemical Engineering
Canada

Biological cell niche comprises of biochemical and biophysical signals. An ideal scaffold for tissue engineering application should mimic the microenvironment and present the appropriate biochemical and biophysical cues such as topographies and rigidity to regulate cellular responses. Our research group is interested in studying the interfacial interactions of cells with the extracellular substrate and how to apply this knowledge to stem cell differentiation and tissue engineering applications. In this presentation, nanotopography-modulation on cell behaviors for applications in small diameter vascular grafts and corneal tissue engineering will be presented as examples of applying nanotopography in regenerative medicine applications.

The nanotopography- regulation on adult stem cells and pluripotent stem cells (PSCs) will also be discussed as an example of topography-induced differentiation in the last part of the presentation. In attempt to understand the sensing mechanisms for nanotopography, we investigated the roles of focal adhesion signaling and cytoskeletal contractility in topography- induced differentiation. The potential mechanisms for topography-induced cell behavior will be discussed.

Abstract

Technology Innovation for Precision Rehabilitation

Professor **Paolo Bonato**
Harvard Medical School
Department of Physical Medicine & Rehabilitation
USA

Medicine is being fundamentally reshaped by advances in biological sciences and innovations from biomedical engineering. A compelling example of this evolution is the use of robotics and digital health technologies in stroke rehabilitation. Robotics has dramatically advanced motor retraining protocols, enabling the delivery of high-dosage, high-intensity, and task-specific interventions crucial for meaningful motor recovery. Robotic systems enable continuous interaction with patients, allowing for real-time adjustments to the forces that guide movement and promote the learning of new motor patterns. While robotic devices excel at capturing motor performance during training sessions, other critical dimensions of a patient's response are more effectively assessed via digital health technologies. When integrated with AI-based algorithms, these tools enable the continuous monitoring of a patient's progress. They generate proxy measures for clinical endpoints, allowing clinicians to personalize and adapt intervention strategies as needed. This data-driven, precision rehabilitation model not only enhances outcomes for stroke survivors but also offers a scalable framework that can be extended across various domains of medicine. As these technologies continue to mature, they hold the promise of enabling proactive, predictive, and patient-specific care. Ultimately, the integration of robotics, digital health, and AI is redefining how we deliver care in rehabilitation and beyond.

Abstract

Decoding cell with microscopy - from petabyte-scale data generation to intelligent morphological profiling

Professor **Kevin Tsia**
The University of Hong Kong
Department of Electrical & Electronic Engineering
Hong Kong, China

Pairing up optical microscopy and computer vision becomes a common strategy adopted in a broad spectrum of biological and biomedical screening applications. The common rationale is to generate the characteristic “fingerprint” profiles of cell morphology that could underpin the cell states/functions but obscured through visual inspection or even in the molecular assay. In this talk, I will introduce how the synergism between ultrafast imaging, microfluidics, and deep learning allows us to overcome some of these current limitations. Specifically, I will present a few high-throughput, deep-learning-powered imaging techniques and imaging cytometry pipelines developed in our laboratory over the past few years. These platforms allow us to significantly scale up the single-cell phenotyping throughput (beyond millions of cells per run within ten minutes) - approaching to the petacyte-scale imaging capability; to enrich the phenotyping content by integrating with the biochemical cell-based assay in a single platform. These techniques have achieved biophysical/mechanical phenotyping specificity and sensitivity that were once inconceivable. Combined with self-supervised/unsupervised deep learning, these methods are now successfully employed in many biological research and clinical applications, including delineating immune-cell sub-types and their activations, predicting targeted-drug sensitivity, and more emerging applications, including genetic screens with image-based profiling.

Abstract

In the Blink of an Eye: from Pavlovian Conditioning to Biomedical Engineering

Professor **Chris De Zeeuw**
Erasmus MC and Netherlands Institute for Neuroscience
Department of Neuroscience
The Netherlands

Over the past several decades, theories about the role of the cerebellum in Pavlovian conditioning have evolved. A relatively simple view that highlighted the contribution of one major form of heterosynaptic plasticity to associative learning has given way to a plethora of perspectives, which suggest that many different forms of synaptic and non-synaptic plasticity, acting at various cerebellar sites, can contribute to learning-dependent-timing of both sensorimotor and cognitive processes. As a consequence, impairment of one or more of these forms of plasticity can lead to not only motor but also mental disorders. Using biomedical technologies, we can now readily reveal the aberrations in associative conditioning that can be linked to diseases such as autism and attention deficit hyperactivity disorder. In my lecture, I will highlight the development of recording technologies that started with eyeblink conditioning in mouse mutants up to the state-of-the-art BlinkLab App that allows for diagnosing mental health disorders in large populations around the world.

Abstract

Towards Precision Mental Health in Early Life

Professor **Anqi Qiu**
The Hong Kong Polytechnic University
Department of Health Technology and Informatics
Hong Kong, China

This talk explores how fetal programming—the process by which in-utero experiences shape lifelong development—lays the foundation for mental health in early life. We examine how maternal psychological stress during pregnancy influences fetal brain development and increases susceptibility to later psychopathology. Drawing on findings from a large longitudinal birth cohort, we highlight the dynamic interplay between maternal mental health, genetic factors, and early environmental exposures in shaping child brain structure and function. By integrating neuroimaging, molecular, and behavioral data, we illustrate how early-life biological signatures of risk can be identified before clinical symptoms emerge. Finally, we present advances in AI-driven predictive modeling for the early detection of mental health vulnerability and discuss emerging precision intervention strategies aimed at fostering resilience and optimizing developmental outcomes. Together, these insights chart a path toward precision mental health in early life, where individualized risk profiling and targeted prevention can transform child mental health care.

Abstract

Medical Imaging AI: from specialist to multimodal and generalist medical intelligence

Professor **Cheng Chen**
The University of Hong Kong
Department of Electrical and Electronic Engineering
Hong Kong, China

Artificial Intelligence (AI) is catalyzing a paradigm shift in healthcare, with the potential to fundamentally transform the landscape of patient care. In particular, AI-driven medical imaging technologies have demonstrated remarkable promise in enabling precise, efficient, and personalized diagnosis and treatment. As medical data becomes increasingly diverse, integrating multimodal imaging and non-imaging information has emerged as a key frontier in advancing medical AI. In this talk, I will present our research work from task-specific specialist models to multimodal and general-purpose medical intelligence. I will highlight novel methodologies that address technical challenges associated with diverse medical data with representative applications in disease diagnosis, medical reasoning, and treatment decision-making. This talk will also discuss the future opportunities and challenges for multimodal AI and large foundation models in shaping the next generation of intelligent healthcare.

Abstract

Molecular and Integrative Mechanobiology: Force-gated Ion Channels

Professor **Eric Honoré**
Institut de Pharmacologie Moléculaire et Cellulaire
France

The conversion of force into an electrical cellular signal is mediated by the opening of different types of mechanosensitive ion channels (MSCs), including Piezo1/2 and TREK/TRAAK K 2P channels. Mechanoelectrical transduction plays a key role in hearing, balance, touch, and proprioception and is also implicated in the autonomic regulation of blood pressure and breathing. Thus, dysfunction of MSCs is associated with a variety of inherited and acquired disease states. Significant progress has recently been made in identifying these channels, solving their structure, and understanding the gating of both hyperpolarizing and depolarizing MSCs. Besides prototypical activation by membrane tension, additional gating mechanisms involving channel curvature and/or tethered elements are at play. Moreover, our recent studies indicate a community effect between different structural and functional classes of mechanosensitive ion channels. Piezo1/2 ion channels are capable of conformational signaling and up-modulate the mechanical gating of K 2P channels. I will discuss the structure-function properties of force-gated ion channels and their pathophysiological role.

Abstract

Bioactive Supramolecular Therapeutics: An Emerging Frontier

Professor **Samuel Stupp**
Northwestern University
Department of Materials Science and Engineering, Chemistry, Medicine, and Biomedical Engineering
UK

Novel treatments for challenging diseases such as cancer, neurodegenerative conditions, and osteoarthritis, as well as serious injuries are critical for transformative improvements in human quality of life and healthy aging. Most efforts around the world focus on small molecule drugs, biologics such as growth factors and antibodies, as well as the promise of cell therapies. Many diseases and injuries of course could benefit from regeneration of tissues that become dysfunctional and thus the nature of therapies needs to be different from those in use today. During development, homeostasis, or post injury, tissue regeneration relies on signals nested in the mechanically supportive environment of extracellular matrices (ECMs). Using this bio-inspired notion, our laboratory has focused on the development of supramolecular therapeutics for regeneration as bioactive and fully biodegradable artificial ECMs. In our work these systems are based on megascale assemblies of peptides or glycopeptides that can "directly" activate cell receptors or amplify signaling by endogenous growth factors. Thus, in the translational context these novel therapeutics are considered either "drugs" or "drug-devices" since they signal cells directly and importantly can have much longer half-lives than protein or nucleic acid therapeutics. The lecture will illustrate examples of these supramolecular systems with breakthroughs on their potential for bone and cartilage repair for osteoarthritis, neurodegenerative diseases, cardiovascular therapies, and spinal cord injury.

Abstract

Engineering Synthetic Genomes

Professor **Patrick Cai**
University of Manchester
Manchester Institute of Biotechnology
UK

Over the last 12 years, my lab has been building synthetic yeast chromosomes from scratch. These synthetic genomes are engineered to allow genome-wide directed evolution with a system call SCRaMbLE (Synthetic Chromosome Recombination and Modification by LoxP-Mediated Evolution). SCRaMbLE allows the synthetic cells to process the information (e.g. environmental stress) differently from their wildtype counterparts, and also enables them to re-configure the genomes to cope with the environments. I will present our latest progress in design, synthesis and transplant synthetic chromosomes and its applications. Finally, I will also discuss the progress of developing biocontainment strategies for synthetic genomes.

Abstract

Why have we not cured Alzheimer's disease? Reprogramming of the human brain

Professor **Shankar Subramaniam**
University of California San Diego
Jacobs School of Engineering
USA

Metrics of cognition, such as dementia, provide the first clues to neurodegenerative disorders like Alzheimer's disease. What are the early events that presage the onset of dementia? How is the brain reprogrammed in Alzheimer's disease? Is there a hope of reversing Alzheimer's disease? Do other neurodegenerative diseases like Parkinson's and Huntington's show similar reprogramming? Do mechanisms of reprogramming offer a strategy for drug screening? Can we develop human brain models for AD? This talk will address these issues from molecular and cellular perspectives. Using multiomics measurements on human brain model systems, namely, iPSC-derived neurons and cortical organoids from non-demented control and AD patients, we demonstrate that dedifferentiation, loss of neuronal identity, and loss of synaptic machinery are hallmark endotypes of AD, and hence, drugs targeting plaques and tangles are unable to address the root causes of the pathology. We also show the causative factors of neuronal state change and offer insights into potential therapeutic routes.

Abstract

Redefining musculoskeletal regeneration: Innovations and vision for the future of biomedical engineering

Professor **Hala Zreiqat**
University of Sydney
School of Biomedical Engineering, Faculty of Engineering
Australia

Musculoskeletal diseases and injuries remain a major global health challenge, particularly among ageing populations where impaired repair of musculoskeletal tissues, including bone and cartilage, continues to limit recovery and quality of life. Our research focuses on developing next-generation biomaterials that integrate advanced chemistry, nano-architecture, and cellular biology to address these challenges. The presentation will highlight our recent work on bioactive ceramics and nanostructured 3D-printed biomaterials designed for personalised, cell-free healing and enhanced regeneration of aged and diseased bone. These biomaterials combine architectural precision, bioactive ion modulation, and anti-senescence strategies to support robust bone repair in large and complex skeletal defects.

Beyond materials innovation, this work contributes to a broader vision for biomedical engineering, one that unites materials science, computation, and medicine to achieve lifelong skeletal health. By integrating bioactive materials, mechanobiological insights, and data-driven design, we aim to accelerate translation from the laboratory to the clinic. The presentation will also reflect on how international collaboration, interdisciplinary training, and sustainable innovation can shape the next phase of musculoskeletal care and the future of biomedical engineering.

Abstract

Illuminating
how we hear and learn to hear

Professor **Patrick Kanold**
Johns Hopkins University
Deptartment of Biomedical Engineering
USA

Our research seeks to uncover how we process sensory information, and how experiences and interactions with the environment shape the brain. Since hearing is crucial for communication in both humans and animals, our research focusses on the auditory system. We use in vivo and in vitro imaging alongside optical stimulation to examine how the auditory cortex encodes sensory information, how these representations evolve, and how experience shapes these the encoding of sounds.

Work from our laboratory has revealed how ensembles of neurons in the auditory cortex represent complex sounds, uncovered the underlying neural circuitry, and demonstrated that behavior actively modulates how neurons encode auditory information.

The ability of the brain to process sound emerges during early development, is refined by sensory input during "critical periods" and continues to adapt with experience throughout life. Our latest findings suggest that both sensory experiences and self-generated actions during early development, even before the critical period, can influence brain function. Ongoing research seeks to unravel the mechanisms and enduring impact of these formative experiences on auditory cortical processing.

Abstract

From AI for Medicine to Science for AI: Deep Nature and Quantification Biology

Professor **Tian Xu**
Westlake University
School of Life Sciences
China

Tian Xu received B.S., Ph.D. and postdoctoral training from Fudan University, Yale University, and UC Berkeley, respectively. He was HHMI Investigator, CNH Long Professor and Vice Chairman of Genetics, and President Special Advisor at Yale before joining Westlake University in 2018.

The Xu lab pioneered genetic dissection of growth control and identified all the key growth regulators and pathways, which elucidated principles of developmental biology and contributed to understanding of pathogenic mechanisms and development of drugs. The lab recently focuses on AI for Medicine and Science for AI. DeepAdaptor and DeepT2Vec provide method for standardizing transcriptomic data and algorism for training. The DeepNature life language model enables prediction for disease, indication, toxicity, and mechanism for small molecule and herbal drugs. Multiple drugs are in different phases of clinical trials. The new quantification biology study has revealed brain region, neural mechanism and math model, which facilitates development of new AI.

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