

# The 18<sup>th</sup> IEEE-EMBS International Summer School and Symposium on Medical Devices and Biosensors

in conjunction with

## The 14<sup>th</sup> International School and Symposium on Biomedical and Health Engineering

**Organized by: Hong Kong Centre for Cerebro-Cardiovascular Health Engineering (COCHE)**  
**In Hybrid Mode on 26-29 Oct 2022**

### About The Events

 <https://www.mdb-s-che.org>

The IEEE-EMBS International Summer School and Symposium on Medical Devices and Biosensors (MDBS) was launched at the University of Wisconsin-Madison in 2002, held subsequently at CUHK in 2004, MIT in 2005, and most of the rest editions in Hong Kong except for those cancelled due to the SARS in 2003 and COVID-19 in 2020. To make up those cancelled events, taking the advantages and benefits of virtual meetings in the COVID era, its 18th and 19th Editions will be held in hybrid modes on 26-29 October and 13-16 November respectively this year. The ceremony of the 20th anniversary of MDBS will be conducted in conjunction with the International Summit on Cerebro-cardiovascular Health Engineering and the International School and Symposium on Biomedical and Health Engineering on 11-14 December, 2022. The physical venue for the making up events and the 20th anniversary celebration will all be at 17-19W, **Hong Kong Science Park, Pak Shek Kok, NT, Hong Kong, China.**

The distinguished scientists and faculty members from the world leading universities in different countries are invited to give speeches and present state-of-the-art technologies in the areas of biomedical and health engineering especially biosensors and wearable medical devices, medical imaging, robotics and AI with applications in the prediction and control of cardiovascular diseases (CVD) and coronavirus diseases (COVID). The main theme of the 18th Edition is "Health Engineering and Informatics for the Control of Cardiovascular Diseases (CVD)".

The Main Topics include but are not limited to:

- Flexible and stretchable sensing with applications
- AI in wearable sensing and medical imaging
- Tonoarteriography (TAG) or unobtrusive continuous blood pressure measurements
- Ultrafast and high-resolution spectroscopy for biomedical application
- Ultrafast 3D pump-probe microscopy
- Ultrafast scan-less time-stretch spectral-encoded imaging at infrared wavelengths based on dual-comb laser system
- Raman Spectroscopy and its Advanced Application in CVD prediction
- Integrative Microfluidic-based Biosensors for Disease Detection
- Neural-vascular Modelling and Applications
- Robust PDE Identification from a Noisy Data Set
- Simultaneous Neural Network Approximations for Smooth Functions
- Intelligent Reality for Digital Healthcare
- Structural optimization for 3D and 4D printing
- Cognitive Automation in eTriage, Detection, and Diagnosis of Acute Stroke in Emergency Rooms

### Organizing Committee

**Conference Chair:** Yuan-ting Zhang at Hong Kong Centre for Cerebro-Cardiovascular Health Engineering & CityU  
**Co-Chairs:** Paolo Bonato at Harvard Medical School, Boston, USA  
 David Clifton at the University of Oxford, Oxford, UK

HKSTP



Chair



Yuan-ting Zhang

Co-Chairs



Paolo Bonato



David Clifton

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**Tentative Programme Overview**

Lectures available on  zoom

Hong Kong Time	US Central Time	Activities
<b>October 26 Wednesday (Physically on-site and virtually by Zoom)</b>		
15:30-15:35	2:30-2:35 (Oct 26 <sup>th</sup> )	<b>Introduction</b>
		<b>Young Research Scientist Presentation</b> <i>Moderator:</i> Yu HUANG, City U of Hong Kong, Chief Scientist of COCHE Shih-Chi CHEN, City U of Hong Kong, Senior Scientist of COCHE
		 
15:35-15:55	2:35-2:55 (Oct 26 <sup>th</sup> )	<b>Zhiwei ZHU</b> Postdoctoral Fellow of The Chinese University of Hong Kong "Ultrafast and high-resolution dual-comb spectroscopy for biomedical application"
15:55-16:15	2:55-3:15 (Oct 26 <sup>th</sup> )	<b>Bingxu CHEN</b> Ph.D student of The Chinese University of Hong Kong "Ultrafast 3D pump-probe microscopy"
		 
16:15-16:35	3:15-3:35 (Oct 26 <sup>th</sup> )	<b>Wanping LU</b> Ph.D student of The Chinese University of Hong Kong "Ultrafast scan-less time-stretch spectral-encoded imaging at infrared wavelengths based on dual-comb laser system"
16:35-16:55	3:35-3:55 (Oct 26 <sup>th</sup> )	<b>Xinrui WANG</b> Ph.D student of CityU - COCHE "Raman Spectroscopy and its Advanced Application in CVD prediction"
		 
16:55-17:00	3:55-4:00 (Oct 26 <sup>th</sup> )	<b>Discussion and Comments</b>
<b>October 27 Thursday (virtually by Zoom)</b>		
		<b>Invited Section</b> <i>Moderator:</i> Peng SHI, City U of Hong Kong, Senior Scientist of COCHE
15:30-16:00	2:30-3:00 (Oct 27 <sup>th</sup> )	<b>Invited Speaker 1: Bee Luan KHOO</b> Assistant Professor, Department of Biomedical Engineering, and Scientist at COCHE Innovator under 35 by the MIT Technology Review, City University of Hong Kong, Hong Kong SAR, China "Integrative Microfluidic-based Biosensors for Disease Detection"
		
16:00-16:30	3:00-3:30 (Oct 27 <sup>th</sup> )	<b>Invited Speaker 2: Rosa Ho Man CHAN</b> Senior Member IEEE Associate Professor, Department of Electrical Engineering City University of Hong Kong, and Scientist at COCHE "From Neural Modelling to Applications"
		 
<b>October 28 Friday (virtually by Zoom)</b>		
		<b>Invited and Keynote Section</b> <i>Moderator:</i> Xuecheng TAI, Chief Research Scientist and Executive Programme Director of COCHE, Professor of Mathematics, University of Bergen, Norway, Chair Professor and Head of the Department of Mathematics, Hong Kong Baptist University
10:20-10:40	21:20-21:40 (Oct 27 <sup>th</sup> )	<b>Invited 3: Hao LIU</b> Assistant Professor, Department of Mathematics, Hong Kong Baptist University "Robust PDE Identification from a Noisy Data Set"
		
10:40-11:00	21:40-22:00 (Oct 27 <sup>th</sup> )	<b>Invited 4: Sean Y S HON</b> Assistant Professor, Department of Mathematics, Hong Kong Baptist University "Simultaneous Neural Network Approximations for Smooth Functions"
		 
11:00-11:30	22:00-22:30 (Oct 27 <sup>th</sup> )	<b>Keynote 1: May Dongmei Wang</b> The Wallace H. Coulter Distinguished Faculty Fellow Fellow of AIMBE, IAMBE, IEEE, Kavli Fellow Professor and Director of Biomedical Big Data, Georgia Institute of Technology and Emory University "Intelligent Reality for Digital Healthcare"
		 
11:30-12:00	22:30-23:00 (Oct 27 <sup>th</sup> )	<b>Invited 5: Kei Fong LAM</b> Assistant Professor, Department of Mathematics, Hong Kong Baptist University "Structural optimization for 3D and 4D printing"
		 
<b>October 29 Saturday (virtually by Zoom)</b>		
		<b>Keynote Section</b> <i>Moderator:</i> Yuanting ZHANG, Chairman and Director of COCHE, and Chair Professor at City U of Hong Kong
10:00-10:30	21:00-21:30 (Oct 28 <sup>th</sup> )	<b>Keynote 2: Stephen T. WONG</b> John S. Dunn Presidential Distinguished Chair in Biomedical Engineering Full Member, Research Institute Professor of Computer Science and Bioengineering in Oncology, Academic Institute Associate Director, Cores, Biostatistics and Bioinformatics Houston Methodist Weill Cornell Medical College "Cognitive Automation in eTriage, Detection, and Diagnosis of Acute Stroke in Emergency Rooms"
		 

## **May Dongmei WANG**

*The Wallace H. Coulter Distinguished Faculty Fellow  
Fellow of AIMBE, IAMBE, IEEE, Kavli Fellow  
Professor and Director of Biomedical Big Data,  
Georgia Institute of Technology and Emory University  
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**Dr. May Dongmei WANG** is Wallace H. Coulter Distinguished Faculty Fellow and full professor in BME and ECE at Georgia Institute of Technology (GT) and Emory University (EU). She is Director of Biomedical Big Data Initiative, Georgia Distinguished Cancer Scholar, Petit Institute Faculty Fellow, Kavli Fellow, AIMBE Fellow, IAMBE Fellow, IEEE Fellow, and Board of Directors in American Board of AI in Medicine. Her research is in *Biomedical Big Data with AI-Driven Intelligent Reality (IR) for predictive, personalized, and precision health (pHealth)*. During 20+ years academic professorship and ~4 years industrial research, she published 260+ articles in referred journals and conference proceedings and delivered 250+ invited and keynote lectures. Dr. Wang received BEng from Tsinghua University China, and MS with PhD degrees from GT. She is a recipient of GT Outstanding Faculty Mentor Award, and EU MilliPub Award (for a high-impact paper that is cited over 1,000 times).

Dr. Wang is the Senior Editor for IEEE Journal of Biomedical & Health Informatics (JBHI, Impact Factor 7.02), an Associate Editor for IEEE Transactions for BME, and IEEE Reviews for BME, a panelist for NIH CDMA Study Section, NSF Smart and Connect Health, Brain Canada, and multiple European countries. She was 2016 IEEE Engineering in Medicine and Biology Society (EMBS) Annual Conference Co-Chair, 2014-2015 EMBS Distinguished Lecturer and Emerging Area Editor for Proceedings of National Academy of Sciences (PNAS). Dr. Wang has helped grow Biomedical and Health Informatics (BHI) community since 2012 and is chair for IEEE Biomedical and Health Informatics Technical Community. She currently serves in IEEE Future Directions Committee and International Academy of Medical and Biological Engineering (IAMBE) Executive Committee. At Georgia Institute of Technology (GT), Dr. Wang is in 2022 President LeadingWomen Program and 2021 Provost Emerging Leaders Program, and is 2018-2021 Carol Ann and David Flanagan Distinguished Faculty Fellow. She was 2015-2017 GT Biomedical Informatics Program Co-Director in Atlanta Clinical and Translational Science Institute (ACTSI), and was Director of Bioinformatics and Biocomputing Core in NIH/NCI-sponsored U54 Center for Cancer Nanotechnology Excellence, and Co-Director of GT Center of Bio-Imaging Mass Spectrometry for over 10 years. Dr. Wang's research has been supported by NIH, NSF, CDC, Georgia Research Alliance, Georgia Cancer Coalition, Shriners' Hospitals for Children, Children's Health Care of Atlanta, Enduring Heart, Coulter Foundation, Microsoft Research, HP, UCB, and Amazon

## **Intelligent Reality for Digital Healthcare**

## **Stephen T. WONG**

*John S. Dunn Presidential Distinguished Chair in Biomedical Engineering  
Full Member, Research Institute*

*Professor of Computer Science and Bioengineering in Oncology, Academic Institute*

*Associate Director, Cores, Biostatistics and Bioinformatics*

*Houston Methodist*

*Weill Cornell Medical College*

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**Dr. Stephen T. WONG** holds the John S. Dunn, Sr. Distinguished Endowed Chair in Biomedical Engineering; he is also a Professor of Radiology, Pathology, Laboratory Medicine, Neurology, and Neurosciences, the Associate Director of Translational Research at Methodist Cancer Center, and Chief of Medical Physics and Chief Research Information Officer at Houston Methodist Hospital. In addition, he serves as the Founding Director of the Ting Tsung and Wei Fong Chao Center for BRAIN (Bioinformatics Research and Imaging in the Neurosciences) and Founding Director of the Center for Modeling Cancer Development at Houston Methodist Research Institute. He also holds a dozen of other academic posts across institutions in Texas Medical Center as well as overseas universities and medical schools.

An internationally acclaimed bioengineer and imaging scientist, Dr. Stephen WONG has led teams that developed production automation for first very large scale integration (VLSI) 1MB computer memory chip and the largest online brokerage trading system, and contributed to the first hospital-wide digital radiology image management system in US academic medical centers.

Dr. WONG has more than twenty years of research and management experience in industry and academia, including Hewlett-Packard, AT&T Bell Laboratories, the Japanese Fifth Generation Computer Systems Project, Philips Medical Systems and Royal Philips Electronics, Charles Schwab, University of California - San Francisco/Berkeley, Harvard University and Houston Methodist Hospital. He received his senior executive education from the MIT Sloan School of Management, Stanford University Graduate School of Business and Columbia University Graduate School of Business. He holds many patents and has published over 300 peer-reviewed papers and four books. He also serves on and chairs NIH study panels, conference program committees, and the editorial boards of twelve scientific journals. As an international authority, he is sought as a speaker on medical imaging, systems biology, healthcare IT, drug development, biophotonics, clinical neuroscience and other related topics.

## **Cognitive Automation in eTriage, Detection, and Diagnosis of Acute Stroke in Emergency Rooms**

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## **Bee Luan KHOO**

*Assistant Professor, Department of Biomedical Engineering,  
Innovator under 35 by the MIT Technology Review,  
City University of Hong Kong, Hong Kong SAR, China  
Email: blkhoo@cityu.edu.hk*



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**Dr. Bee Luan KHOO** is a biomedical scientist focused on detecting, prognosis, and characterization of disease heterogeneity using multidisciplinary techniques. She joined the City University of Hong Kong in 2019. She is recognized for her efforts by the MIT Technology Review as an Innovator under 35 (Asia 2018) for her work on microfluidic devices with direct clinical relevance. Dr. Khoo's work includes the design and utilization of microfluidic devices for personalized cancer management and evaluation. She has also developed various microfluidic biochips for the direct isolation of primary cancer cells, diseased blood cells, or malaria-infected cells for rapid disease detection. Dr. Khoo has authored more than 30 articles in peer-reviewed journals and has presented in various invited international conferences. As a senior postdoctoral research fellow in the Singapore MIT alliance of Research and Technology, she was awarded the Young Investigator national grant award by the National Medical Research Council. Dr. Khoo recently received the Young Investigator award 2020 to support upcoming projects in disease detection via the Interstellar Initiative, funded by the Japan Agency for Medical Research and Development (AMED) and the New York Academy of Sciences.

## **Integrative Microfluidic-based Biosensors for Disease Detection**

## **Rosa Ho Man CHAN**

*Senior Member IEEE*

*Associate Professor, Department of Electrical Engineering*

*City University of Hong Kong*

*Email: rosachan@cityu.edu.hk*



**Dr. Rosa Ho Man CHAN** is currently an Associate Professor in the Department of Electronic Engineering at City University of Hong Kong. She received her B.Eng (1st Hon.) degree in Automation and Computer-Aided Engineering from the Chinese University of Hong Kong in 2003. Her undergraduate studies had brought her to New York University (US) to study computer animation and visual effects and Kyushu University (Japan) to research on microfluidics for astronautics applications. She was later awarded the Croucher Scholarship and Sir Edward Youde Memorial Fellowship for Overseas Studies in 2004 to pursue her graduate studies at University of Southern California (USC). In the summer of 2010, she was supported by Google Scholarship to participate in the Singularity University Graduate Studies Program at NASA AMES. Dr. Chan received her Ph.D. degree in Biomedical Engineering in 2011 at USC, where she also received her M.S. degrees in Electrical Engineering and Aerospace Engineering. Her research interests include computational neuroscience, neural prosthesis and brain-computer interface applications. She was the co-recipient of the Outstanding Paper Award of IEEE Transactions on Neural Systems and Rehabilitation Engineering in 2013, for their research breakthroughs in mathematical modelling for hippocampal cognitive prosthesis and memory facilitation. Dr. Chan was the Chair of the Hong Kong-Macau Joint Chapter of IEEE Engineering in Medicine and Biology Society (EMBS) in 2014 and is elected to the IEEE EMBS AdCom as Asia Pacific Representative (2018-2020).

## **From Neural Modelling to Applications**

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## **Hao LIU**

Assistant Professor, Department of Mathematics,  
Hong Kong Baptist University  
*Email: seanyshon@hkbu.edu.hk*



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**Dr. Hao LIU** is an assistant professor in Hong Kong Baptist University. Dr. Liu received the Bachelor degree in applied and computational mathematics from Hong Kong Baptist University in 2014, and the Ph.D. degree in applied mathematics from The Hong Kong University of Science and Technology in 2018. Before joined HKBU, he was a postdoc at Georgia Institute of Technology.

### **From Neural Modelling to Applications**

Partial differential equation (PDE) is an important tool to describe physical laws in many disciplines. Traditional ways in discovering PDEs from data sets requires a lot of time. As the advances of technology, large amounts of data are easy to collect and store, which provides new opportunities for data-driven identification of PDE. This presentation addresses our recent work on identifying PDEs from a given data set. In PDE identification, many existing methods cannot deal with data with heavy noise. We propose a new strategy to denoise the data and compute partial derivatives with improved accuracy. We also propose sparse regression based methods that can efficiently identify the underlying PDE from data with large noise.

## **Sean Y S HON**

Assistant Professor, Department of Mathematics,  
Hong Kong Baptist University  
*Email: seanyshon@hkbu.edu.hk*



**Dr. Sean Y S HON** is now an Assistant Professor at Hong Kong Baptist University. He has a keen interest in numerical analysis and mathematics of data science. Sean's current research focuses on developing theory and numerical methods for evolutionary partial differential equations and deep learning. Dr. Sean is also interested in efficient solvers for interfacial motions and preconditioning on Toeplitz-related systems. These research areas play crucial roles in scientific computation. For example, accurate numerical methods are needed for modelling multi-phase flow and spiral crystal growth, and image segmentation. Since the exact solutions of these problems are often unavailable, it is of great importance to develop efficient yet flexible methods which provide numerical approximations. As for Toeplitz-related systems, they are ubiquitous in maths and physics: they arise in numerical partial differential equations, approximation theory, compressed sensing, image processing, to name just a few. Thus it is essential to develop preconditioners to speed up the matrix inversion that involves such Toeplitz structure.

### **From Neural Modelling to Applications**

We establish in this talk approximation results of deep neural networks for smooth functions measured in Sobolev norms, motivated by recent development of numerical solvers for partial differential equations using deep neural networks. Our approximation results are nonasymptotic in the sense that the error bounds are explicitly characterized in terms of both the width and depth of the networks simultaneously with all involved constants explicitly determined. This is joint work Haizhao Yang (University of Maryland).



## Kei Fong LAM

Assistant Professor, Department of Mathematics,  
Hong Kong Baptist University  
*Email: seanyshon@hkbu.edu.hk*



**Dr. Kei Fong LAM** Received his Ph.D. from University of Warwick, U.K., in 2014, and after a 3-year postdoc at University of Regensburg, Germany, followed by a 3-year Research Assistant Professorship at Chinese University of Hong Kong, Dr. Kei Fong LAM joined Hong Kong Baptist University in 2020 as an Assistant Professor.

### **From Neural Modelling to Applications**

3D printing is an umbrella term for a set of technologies that manufacture highly intricate and complex designs not feasible with traditional die-casting or injection molding methods. 4D printing builds on these technologies to create designs capable of changing their shape and functionalities via external stimulus. But despite their popularization in recent years, several limitations prevent greater integration of 3D and 4D printing into existing production lines. In this talk we report on some mathematical problems and results based on a structural topology optimization framework. Namely, for 3D printing we attempt to identify designs that are self-supporting and for 4D printing we attempt to discover the structure of a shape morphing design that would yield specific configurations after applying an external stimulus. This is joint work with Harald Garcke (Regensburg), Robert Nurnberg (Trento) and Andrea Signori (Milan).

## **Zhiwei ZHU**

*Postdoctoral Fellow of The Chinese University of Hong Kong*

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**Ultrafast and high-resolution dual-comb spectroscopy for biomedical application**

## **Bingxu CHEN**

*Ph.D student of The Chinese University of Hong Kong*

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**Ultrafast 3D pump-probe microscopy**

## **Wanping LU**

*Ph.D student of The Chinese University of Hong Kong*

*Email: wanpinglu00@gmail.com*



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**Ultrafast scan-less time-stretch spectral-encoded imaging at infrared wavelengths based on dual-comb laser system**

## **Xinrui WANG**

*Ph.D student of City U of Hong Kong*

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**Raman Spectroscopy and its Advanced Application in CVD prediction**

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Moderator:

Yu HUANG, City U of Hong Kong, Chief Scientist of COCHE

Shih-Chi CHEN, City U of Hong Kong, Senior Scientist of COCHE