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APSIPA SG CHAPTER / IEEE CTSOC / IEEE SMC / IEEE SPS / IEEE IES JOINT SEMINAR ON

EMERGING TRENDS AND INNOVATIONS IN MACHINE LEARNING AND AI

21st Jun 2024 @ Lecture Theatre 1 (Block E2, Level 1), NUS

13:15 **Opening Remarks**
Prof. Woon-Seng Gan

13:30 **Keynote I:** "Toward Interpretable and Sustainable AI/ML"
Prof. Jay Kuo | University of Southern California, USA

14:15 **Talk I:** "Touch, on the Robot Physical Intelligence"
Dr. Wu Yan | A*STAR Institute for Infocomm Research

14:45 **Talk II:** "Redefining Quiet: Developing and Deploying an AI-enabled Soundcape Intervention"
Dr. Bhan Lam | Nanyang Technological University

15:15 **Tea Break**

15:45 **Keynote II:** "Unveil the Principle behind a Problem-Solution Pair with the Toyota Production System"
Prof. Ken Sugiyama | Damas.cus Corporation/Tokyo Metropolitan University

16:30 **Talk III:** "High Dynamic Range Imaging: from Physics-Driven to Neural Augmentation"
Dr. Li Zhengguo | A*STAR Institute for Infocomm Research

17:00 **Talk IV:** "Automatic Speech Recognition with Large Language Models"
Dr. Hexin Liu | Nanyang Technological University

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KEYNOTE I

Toward Interpretable and Sustainable AI/ML

Rapid advances in artificial intelligence (AI) and machine learning (ML) have been attributed to the wide applications of deep learning (DL) technologies. There are, however, concerns with this AI wave. DL solutions are a black box (i.e., not interpretable) and vulnerable to adversarial attacks (i.e., unreliable). Besides, the high carbon footprint yielded by large DL networks is a threat to our environment (i.e., not sustainable). It is essential to find alternative AI technologies that are interpretable and sustainable. To this end, I have researched green AI/ML since 2015. Low carbon footprints, small model sizes, low computational complexity, and mathematical transparency characterize green AI/ML models. They differ entirely from DL models since they have neither computational neurons nor network architectures. They are trained efficiently using labels (but no backpropagation). Green AI/ML models offer energy-effective solutions in cloud centers and mobile/edge devices. They consist of three main modules: 1) unsupervised representation learning, 2) supervised feature learning, and 3) decision learning. Green AI/ML has been successfully applied to various applications. I will use several examples to demonstrate their effectiveness and efficiency.

Speaker Biography

Dr. C.-C. Jay Kuo received his Ph.D. from the Massachusetts Institute of Technology in 1987. He is now with the University of Southern California (USC) as Ming Hsieh Professor, Distinguished Professor of Electrical and Computer Engineering and Computer Science, and Director of the Media Communications Laboratory. His research interests are in visual computing and communication. He is a Fellow of AAAS, ACM, IEEE, NAI, and SPIE and an Academician of Academia Sinica.

Dr. Kuo has received a few awards for his research contributions, including the 2010 Electronic Imaging Scientist of the Year Award, the 2010-11 Fulbright-Nokia Distinguished Chair in Information and Communications Technologies, the 2019 IEEE Computer Society Edward J. McCluskey Technical Achievement Award, the 2019 IEEE Signal Processing Society Claude Shannon-Harry Nyquist Technical Achievement Award, the 72nd annual Technology and Engineering Emmy Award (2020), and the 2021 IEEE Circuits and Systems Society Charles A. Desoer Technical Achievement Award. Dr. Kuo was Editor-in-Chief for the IEEE Transactions on Information Forensics and Security (2012-2014) and the Journal of Visual Communication and Image Representation (1997-2011). He is currently the Editor-in-Chief for the APSIPA Trans. on Signal and Information Processing (2022-2023). He has guided 176 students to their Ph.D. degrees and supervised 31 postdoctoral research fellows.

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KEYNOTE II

Unveil the Principle behind a Problem-Solution Pair with the Toyota Production System

This talk presents how to identify the principle behind a problem-solution pair. Not simply a good solution but a better solution is of utmost importance in the highly competitive situations like industry. The principle behind a problem-solution pair, which often resides behind a curtain, is a key to success. The method in this talk originates from a logic-building process and develops with the help of a widely known principle in production control. A three-point analysis in technical writing is first applied to clarify and refine the problem-solution relationship. An Ohno Doctrine of the Toyota Production System is then applied to the refined problem to unveil the general principle behind the problem-solution pair, which often leads to a better solution. Examples in semiconductor technology and signal processing are presented to show how this technique is applied to the real problems.

Speaker Biography

40 years of experience developing telecommunications, speech, and audio signal processing systems for consumer and network system products. In addition to proven record of technology adoption in products and international standards as well as publication and granted patents, marketing and sales experience to develop over 300 new contacts in the world in two years and proof-of-concept (PoC) evaluations with world-leading companies for technical licensing are unique as a research engineer.

Once representing Japan for ISO/IEC MPEG Audio standardization including an Interim Chair of the Audio Subgroup at the Angra dos Reis Meeting in Brazil, experiences extend to ITU and 3GPP standardizations as a delegate. Established a bridging career between industry and academia through 20+ year teaching experience at universities and supervision of 75 internship students. Delivered 190 invited talks in 91 cities in 31 countries, and received 23 awards. The sole inventor or a co-inventor of 272 registered patents in Japan and overseas as well as 6 registered trademarks. Fellow of IEEE as well as Honorary Member and Fellow of IEICE. A Distinguished Lecturer for Signal Processing Society (2014-2015) and Consumer Electronics Society (2017-2018), and a Distinguished Industry Speaker for Signal Processing Society (2020-2021), IEEE. Recognized as a Renowned Distinguished Speaker (The Rock Star) in 2020 by Consumer Electronics Society, IEEE.

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TALK I

Touch, on the Robot Physical Intelligence

The sense of touch is arguably the most fundamental yet taken-for-granted sensing modality in human physical interactions. It enriches our perception, enabling dexterous manipulation and acting as a safety net. Likewise, robots have been increasingly required to work outside their historical cages and manipulate a growing range of objects. Achieving human-like dexterity in robots is important for their successful blending into our human environments. This requires robots to move beyond basic grasping and perform more complex manipulation tasks. In this talk, we will discuss how robots can leverage the power of touch to acquire and internalise various dexterous manipulation skills, paving the way for physical intelligence for robots.

Speaker Biography

Yan Wu is the Deputy Head of the Robotics and Autonomous Systems Division at A*STAR Institute for Infocomm Research, where he also works as a Principal Scientist and Leader of the Manipulation and Human-Robot Collaboration Group. Since Sept 2023, he is concurrently the Co-Lead (Technology) at the Robotics Horizontal Technology Coordinating Office at Agency for Science, Technology and Research, Singapore.

Yan received his BA(Hons) in Engineering from the University of Cambridge in 2007, and PhD in Electrical Engineering from Imperial College London in 2013. From Aug 2012, he worked concurrently at the UCL Institute of Child Health as a Research Associate and Great Ormond Street Hospital as a Research Fellow. Since Dec 2013, he has been with the A*STAR Institute for Infocomm Research, Singapore. Yan is the current Chair of the IEEE Systems, Man and Cybernetics Society, Singapore Chapter and Member of the IEEE Robotics and Automation Society Technical Committees on Cognitive Robotics, Haptics and Neuro-Robotics Systems. He is also the current Vice President of the Pattern Recognition and Machine Intelligence Association. He serves or has served as an Associate Editor at various editorial boards, such as IEEE Robotics and Automation Society Conference Editorial Board, IEEE Intelligent Transport Systems Society Conference Editorial Board and Frontier in Robotics and AI. Yan is a Senior Member of the IEEE. His research interests include dexterous manipulation, embodied robot learning and interaction, and service and assistive robotics.

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TALK II

Redefining Quiet: Developing and Deploying an AI-enabled Soundcape Intervention

Urban noise poses a significant threat to public health, as highlighted by the World Health Organization, and undermines the pursuit of harmonious "City in Nature" soundscapes. This talk introduces the soundscape approach, a paradigmatic shift in urban sound management. Through our automatic masker selection system (AMSS), we present the development and deployment of an innovative soundscape intervention that integrates rejuvenating naturescapes into urban environments using strategically deployed sensors, speakers, and a pre-trained machine learning inference model. Focusing on traffic-exposed outdoor residential sites, the AMSS analyzes ambient noise in real-time, dynamically tailoring biophilic sounds to elevate perceived “Pleasantness” in accordance with ISO 12913 standards. Field validation involving 68 residents demonstrated a significant enhancement in “Pleasantness,” correlating with increased restorativeness and positive mood. This intervention not only proves the efficacy of AMSS but also aligns with the United Nations Sustainable Development Goals by advancing perception-based urban sound management.

Speaker Biography

Dr. Bhan Lam, is a dedicated researcher and academic in the field of environmental noise control and soundscapes. He completed his B.Eng. (Hons.) and Ph.D. degrees at the School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore, in 2013 and 2019, respectively. He was awarded the NTU Research Scholarship and EEE Graduate Award, which supported his Ph.D. studies under the guidance of Prof. Woon-Seng Gan.

Dr. Lam’s research focuses on acoustics, soundscape, and signal processing for active control. He has contributed to the field with more than 90 refereed journal articles and conference papers. Notably, his patented anti-noise windows (WO2022055432) was shown to significantly reduce perceived annoyance and loudness of typical urban noise through open windows. This work was published in Nature Scientific Reports and was recognized as a top-100 paper in 2020. Most recently, his patent-pending AI-based soundscape augmentation system (WO-2023211385-A1) underwent successful field trials in a residential estate in collaboration with the Housing and Development Board of Singapore, effectively transforming a traffic-exposed site into an environment of comparable pleasantness to a shielded location. Dr. Lam’s contributions and expertise have been recognized on several occasions. He had the honor of being an invited representative at the 2020 Global Young Scientist Summit, World Cities Summit 2024 Young Leader, and also served as an invited tutorial speaker at APSIPA ASC 2020.

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TALK III

High Dynamic Range Imaging: from Physics-Driven to Neural Augmentation

As development of machine learning and AI, it is time for AI to step into an important stage: AI for X. This talk is about AI for high dynamic range (HDR) imaging which is one of the most popular and important computational imaging. A high contrast nature scene could have an HDR by up to 10 orders of magnitude. However, the dynamic range that can be captured with a single exposure is very limited, and the recording of image data usually uses 8 bits, resulting low dynamic range (LDR) images which inevitably have unfavorable over-/under-exposed regions. Therefore, in extremely bright or dark situations, there will be a significant loss of detailed information, which severely affects high-level computer vision tasks such as intelligent driving and navigation. HDR imaging has been introduced to address the issue effectively. In this talk, we will talk about different R&D problems relevant to HDR imaging as well as different methods on studying these problems. The main objective of this talk is to discuss with our audiences on a possible new framework of neural augmentation which fuses generalization of physics-driven methods and learning of data-driven methods.

Speaker Biography

Zhengguo Li received the B.Sci (Applied Mathematics). and M.Eng. (Automatic Control) from Northeastern University, Shenyang, China, in 1992 and 1995, respectively, and the Ph.D. degree (Automatic Control) from Nanyang Technological University, Singapore, in 2001. His research interests include video processing and delivery, computational photography, switched and impulsive control, sensor fusion and physics-driven deep learning.

He has co-authored one monograph, more than 200 journal/conference papers including more than 70 IEEE Transactions, and eleven granted USA patents, including normative technologies on scalable extension of H.264/AVC and HEVC. He has been actively involved in the development of H.264/AVC and HEVC since 2002. He had three informative proposals adopted by the H.264/AVC and three normative proposals adopted by the HEVC. Currently, he is with the Agency for Science, Technology and Research, Singapore.

Zhengguo served as a sponsorship/exhibition chair of IEEE ISCAS 2024, TPC Chair of IEEE IECON 2023 and 2020, a special session chair of IEEE ICASSP 2022, General Chair of IEEE ICIEA 2020, 2016 and 2011, a Technical Brief Co-Founder of SIGGRAPH Asia, and leading Workshop Chair of IEEE ICME in 2013. He was an Associate Editor of IEEE Signal Processing Letters from 2014-2016, IEEE Transactions on Image Processing from 2016-2020, IEEE Transactions on Circuits and Systems for Video Technology from 2020-2023, APSIPA Transactions on Signal and Information Processing from 2022-2025, and a Senior Area Editor of IEEE Transactions on Image Processing from 2020-2024. He is a distinguished lecturer of APSIPA in 2023-2024 and a distinguished lecturer of IEEE Industrial Electronics Society in 2024. He is the chair of SIPTM Tech Committee, APSIPA in 2023-2024. He is Fellow of IEEE and Asia-Pacific Artificial Intelligence Association.

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TALK IV

Automatic Speech Recognition with Large Language Models

Large Language Models (LLMs) have demonstrated exceptional effectiveness, solving a wide range of natural language processing tasks. Recently, their capabilities have been extended to include automatic speech recognition (ASR), which is a technology that converts spoken language into text to enable a computer or device to identify and process human speech.

This talk begins with an introduction to traditional ASR tasks and the evolution of LLMs. I will next introduce existing works that integrate LLMs in ASR systems. Finally, I will present our efforts to enhance LLMs with ASR capabilities and the extension to a noisy scenario.

Speaker Biography

Hexin Liu is currently a postdoctoral research fellow with the College of Computing and Data Science, Nanyang Technological University, Singapore. He received the B.E. degree from the Harbin Institute of Technology, Harbin, China, in 2016, and the M.S. degree and Ph.D. degree in 2018 and 2023 from Nanyang Technological University, Singapore. His research interests include machine learning and deep learning techniques for spoken language processing. He is a Member of ISCA and IEEE.

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