

Join us for the 6G Industry Wireless Research Workshop, co-hosted by NI and ZoX Tech. With this event we aim to bring together a network of leading researchers and educators who are focusing on the design and research of the next generation wireless communication system and looking for a platform-based approach for accelerating their leading research in advanced wireless technology. This half-day event is limited to a small number of leading group leaders and professors to allow for effective networking and feedback between top wireless researchers worldwide. We salute your achievement in this field and kindly invite you to participate in this symposium.

6G Research – The Path to the Next Wireless Standard

Chen Chang, NI

NI has been proud to be working with global leading academic researchers since the very early days of 5G. We serve our customers through a flexible, software-based platform that gives our customers the ability to rapidly prototype new ideas. For looking beyond 5G, we are also actively working on early prototyping systems for 6G and this talk would share NI's vision on 6G research and our platform to help academic researchers on NI's identified research topics.



Chen Chang received the M.S degree and the Ph.D in EECS from University of California, Berkeley in 2003 and 2005, respectively. He is strategic business development director of Semiconductor and Electronics BU in NI. Before joining NI, he was the founder and CEO of BEEcube on innovation of FPGA and 5G telecom equipments. In 2015, BEEcube was acquired by NI. He is also the Compliance Workgroup Chair of OpenRF consortium.



Hang Cao received the B.S and the M.S in Information Engineering from Southeast University in 2011 and 2014, respectively. He joined NI in 2014 as Engineer Leadership Program and is now APAC business development manager for wireless research in NI.

Anti-Spoofing of Civil GNSS Signals

Ao Peng, Xiamen University

The security problem of Global Navigation Satellite System is widely concerned recently. The static receivers such as reference station of Ground Based Augmentation System and Timing Receivers is easily to be attacked by some advanced spoofing approach since the position of the receiver is fixed and the parameters of received signals are easily to be estimated. The characteristic of civil GNSS signal and receiver model is analyzed, and the main anti-spoofing approaches for a civil GNSS receiver are introduced.



Ao Peng received the M.Sc degree and the Ph.D in Communication and Information System from Xiamen University, Fujian, China, in 2011 and 2014, respectively. In 2015, he joined the School of Informatics, Xiamen University, where he is currently an Assistant Professor. His research interests including satellite navigation, indoor navigation and multi-source positioning and navigation.

Gray Box: Deep Reinforcement Learning-enabled Approach for Large-Scale Dynamic System Simulation

Yang Yang, ShanghaiTech University

The massive data generated by large-scale dynamic systems makes its optimization facing a big challenge. Traditional White Box-based methods directly model the internal operating mechanism of the system, so massive amounts of measured data need to be handled, which is costly and time-consuming. The poor interpretability of the Black Box-based methods makes it difficult to adapt to the dynamic environments. In this talk, we propose a novel Gray Box-based approach namely Deep Reinforcement Learning-enabled Constraint Set Inversion Algorithm (DRESIA), which establishes a quantitative model of the nonlinear interoperability effects of system internal states which simplifies the White Box's complex mechanism of reconstruction and prediction and retains the interpretability of the model, therefore improves the prediction efficiency of feasible region while also improving the generalization ability.



Dr. Yang Yang is a full professor at ShanghaiTech University, China, serving as the Master of Kedao College and the Director of Shanghai Institute of Fog Computing Technology (SHIFT). He is also an adjunct professor with the Research Center for Network Communication at Peng Cheng Laboratory, China. Yang's research interests include fog computing networks, service-oriented collaborative intelligence, wireless sensor networks, IoT applications, and advanced testbeds and experiments. He has published more than 300 papers and filed more than 80 technical patents in these research areas. Yang is a Fellow of the IEEE.

Design/Implementation of Computer Vision Based Beamforming and Deep Learning based Channel Extropalation

Gao FeiFei, Tsinghua University



Merging artificial intelligence in to the system design has appeared as a new trend in wireless communications areas and has been deemed as one of the 6G technologies. In this talk, we will present how to apply the deep neural network (DNN) for various aspects of physical layer communications design, including the channel estimation, channel prediction, and beamforming, etc. We will show that applying DNN can deal with the conventionally unsolvable problems, thanks to the universal approximation capability of DNN. We have also build test-bed to show the effectiveness of the AI aided wireless communications.

Feifei Gao, Associate Professor, IEEE Fellow, Department of Automation, Tsinghua University, China. Prof. Gao's research interest include signal processing for communications, array signal processing, convex optimizations, and artificial intelligence assisted communications. He has authored/ coauthored more than 150 refereed IEEE journal papers and more than 150 IEEE conference proceeding papers that are cited more than 10000 times in Google Scholar. Prof. Gao has served as an Editor of IEEE Transactions on Wireless Communications, IEEE Journal of Selected Topics in Signal Processing (Lead Guest Editor), IEEE Transactions on Cognitive Communications and Networking, IEEE Signal Processing Letters, IEEE Communications Letters, IEEE Wireless Communications Letters, and China Communications. He has also serves as the symposium co-chair for 2019 IEEE Conference on Communications (ICC), 2018 IEEE Vehicular Technology Conference Spring (VTC), 2015 IEEE Conference on Communications (ICC), 2014 IEEE Global Communications Conference (GLOBECOM), 2014 IEEE Vehicular Technology Conference Fall (VTC), as well as Technical Committee Members for more than 50 IEEE conferences.

Perspective on Communication Applications Using 5G NR AiM

Cheng-Nan Hu, Oriental Institute of Technology

Jasson Tsai, Philip Lo, Xusheng Gao, Foxconn

New hardware technologies employing radio-frequency integrated circuits (RFICs) with antenna arrays have been adopted to implement fifth-generation (5G) wireless communication systems and beyond 5G (B5G) systems in a new radio (NR) spectrum of the mm-wave band. These systems would first be used for applications in the 20–40-GHz region, before gradually being used in applications in THz carrier frequencies (6G). With mm-wave technology, 5G/B5G mobile networks exploiting high data-rate applications pave the way for the integration of multiple networks serving diverse sectors, domains and applications, such as multimedia, virtual reality (VR) /augmented reality (AR), Machine-to-Machine (M2M) /Internet of Things (IoT), automotive, Smart City etc. To provide a satisfactory quality of service demands the frequent channel estimation and beamforming to compensate for the tremendous propagation loss and to real-timely access into the network under low latency requirement. The mm-wave Beamforming (BF) scheme controls the best beam direction formed by setting radiation signal's phase of the multiple antenna elements and maximizes the transmission rate according to the best beam direction. However, mm-wave BF schemes suffer from high calculation load and large overhead. Building and keeping a robust RF link between a master device and a slave device in a wireless transmission system is required to characterize the entire channel state information (CSI) which can be attained by employing the channel sounder system.

In this study, an active low-cost 5G NR antenna-in-module (AiM) design is proposed and validated experimentally. Incorporating the proposed 5G NR AiM with the Zox/NI's based-band system, the mm-wave channel sounder system is established to show the improvement on angular accuracy of the AOA/AOD information and the reduction on estimated time. Finally the real-timed 8K video data-stream over developed 5G NR AiM for wireless communication is demonstrated lively, showing the amazing performance.



Cheng-Nan Hu (M'96-SM'2013) received a B.S. degree in electronic engineering from the Chung-Cheng Institute of Technology, Taiwan, in 1982, and M.S. and Ph.D. degrees from the National Chiao-Tung University, Taiwan in 1989 and 2000, respectively. From 1982 to 2000, he worked with the National Chung Shan Institute of Science and Technology (NCSIST), Taiwan, where he researched phased arrays and reflector antenna designs. Since 2006, he has

been working in the Department of Communication Engineering at the Oriental Institute of Technology (OIT), Taipei, Taiwan. He has published more than 70 papers in journals and conferences. In 2016, he was promoted as a professor in OIT. His research activities involve the design and test of the active–passive phased antenna arrays, beam forming architecture for MIMO applications, and microwave system integration test.

Multi-frequency Multi-scenario Wireless Channel Measurements and Modeling

Future 6G wireless communication networks show the trend of global coverage, all spectra, and full applications. The related wireless channels show new characteristics in spatial, temporal, and frequency domains. This talk mainly introduces channel measurement experiments at sub-6 GHz in urban and suburban scenarios, and at mmWave bands in various indoor and outdoor scenarios. The wireless channels at different frequency bands and in different scenarios are characterized and modeled. Some future challenges on wireless channel researches are also discussed.



Jie Huang is an Associate Professor with the National Mobile Communications Research Laboratory, School of Information Science and Engineering, Southeast University. He received the B.E. degree from Xidian University in 2013 and the Ph.D. degree from Shandong University in 2018. Then he was a Postdoctoral Research Associate with Southeast University, supported by the National Postdoctoral Program for Innovative Talents. In 2019, he was a Postdoctoral Research Associate with Durham University, U.K. His research interests include wireless channel measurements and modeling, and 6G key technologies. He is the PI of a NSFC young scholar project and has published more than 40 papers. He received Best paper awards from WPMC 2016 and WCSP 2020.