2023 Workshop on Ubiquitous Communication, Computing, and Security Networks

Vehicular Technology Chapter, Communication Society Chapter, IEEE Toronto Section

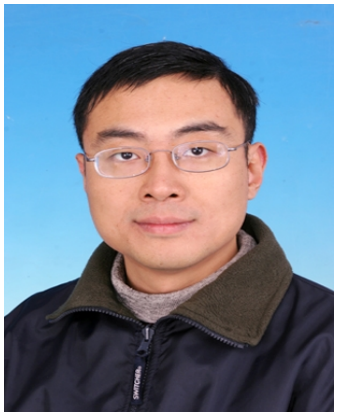
Devoted to Prof. Jon Mark

Organizers: Lian Zhao, Hadeel Mohammad, Ajmery Sultana, and Farhan Pervez

Chairs for VTS Chapter, ComSoc Chapter, and IEEE Toronto Section

9:00 - 9:30	Jianping Pan	Measuring a Low-Earth-Orbit Satellite Network
9:30-10:00	Xiaohui Liang	VPASS: Voice Privacy Assistant System for Monitoring In-home Voice Commands
10:00-10:30	Hao Liang	Stochastic Energy Management and Cyber-Physical Security of Battery Energy Storage Systems in Smart Distribution Systems
10:30-11:00	Lin X. Cai	Near-Field and Far-Field Beamforming Design for RIS-enabled Wireless Communications
11:00-11:30	Rongxing Lu	Achieve Edge-based Privacy-Preserving Dynamic Aggregation Query in Smart Transportation Systems
11:30-12:00	Ning Lu	Toward A Pessimistic-Optimistic Framework for Constrained Bandit Learning
12:00-12:30	Yujie Tang	RLC: A Reinforcement Learning Based Charging Scheme for Battery Swap Stations

Speaker: Jianping Pan, Professor, University of Victoria, Fellow IEEE

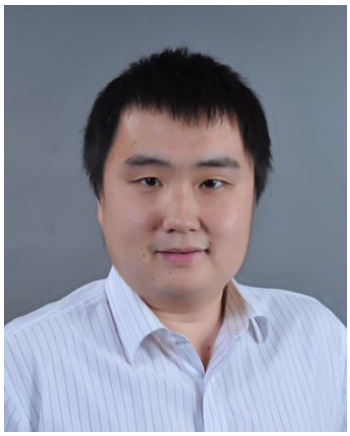


Title: Measuring a Low-Earth-Orbit Satellite Network

Abstract: Starlink and alike have attracted a lot of attention recently, however, the inner working of these low-earth-orbit (LEO) satellite networks is still largely unknown. This talk presents an ongoing measurement campaign focusing on Starlink, including its satellite access networks, gateway and point-of-presence structures, and backbone and Internet connections, revealing insights applicable to other LEO satellite providers. It also highlights the challenges and research opportunities of the integrated space-air-ground-aqua network envisioned by 6G mobile communication systems, and calls for concerted community effort from practical and experimentation aspects.

Bio: Dr Jianping Pan is a professor of computer science at the University of Victoria, British Columbia, Canada. He received his Bachelor's and PhD degrees in computer science from Southeast University, Nanjing, Jiangsu, China, and he did his postdoctoral research at the University of Waterloo, Ontario, Canada. He also worked at Fujitsu Labs and NTT Labs. His area of specialization is computer networks and distributed systems, and his current research interests include protocols for advanced networking, performance analysis of networked systems, and applied network security. He received IEICE Best Paper Award in 2009, Telecommunications Advancement Foundation's Telesys Award in 2010, WCSP 2011 Best Paper Award, IEEE Globecom 2011 Best Paper Award, JSPS Invitation Fellowship in 2012, IEEE ICC 2013 Best Paper Award, NSERC DAS Award in 2016, IEEE ICDCS 2021 Best Poster Award and DND/NSERC DGS Award in 2021, and has been serving on the technical program committees of major computer communications and networking conferences including IEEE INFOCOM, ICC, Globecom, WCNC and CCNC. He was the Ad Hoc and Sensor Networking Symposium Co-Chair of IEEE Globecom 2012 and an Associate Editor of IEEE Transactions on Vehicular Technology. He is a senior member of the ACM and a Fellow of the IEEE.

Speaker: Xiaohui Liang, Associate Professor, University of Massachusetts, Boston



Title: VPASS: Voice Privacy Assistant System for Monitoring In-home Voice Commands

Abstract: Voice assistant systems (VAS), such as Google Assistant or Amazon Alexa, provide convenient means for users to interact verbally with online services. VAS is particularly important for users with severe health conditions or motor skills impairment. At the same time, voice commands may contain highly-sensitive information about individuals. Therefore, sharing such data with service providers must be done in a carefully controlled and transparent manner in order to prevent privacy breaches. One important challenge is identifying which voice commands contain sensitive information. Different individuals are likely to have distinct interpretations of what is sensitive and what must be kept private, depending on gender, age, cultural background, etc. Furthermore, even for the same individual, the context in which a command is issued can result in significantly different sensitivity perceptions. We introduce a framework named VPASS that supports the management of personalized privacy requirements for VAS systems. Specifically, we propose mechanisms to quantify two key aspects: the amount of information disclosure and the level of privacy sensitivity that each voice command has. Our mechanisms employ deep transfer learning techniques for processing voice commands and can accurately detect privacy-sensitive commands based on an individual's prior history of VAS interaction. Finally, VPASS generates monthly reports or immediate privacy alerts based on the privacy policies pre-defined by users.

Bio: Xiaohui Liang is the Acting Chair and Associate Professor in the Department of Computer Science at the University of Massachusetts, Boston (UMB). His research interests lie in the security and privacy of mobile healthcare, the Internet of Things, and wearable computing. He has over 120 publications, including CCS, NDSS, INFOCOM, IEEE Transactions on Dependable and Secure Computing (TDSC), and IEEE Transactions on Information Forensics and Security (TIFS). His Google Scholar H-Index is 53, and his total citation is 12,169 as of Nov. 2023. He received the Early Career Research Excellence Award from UMass Boston College of Science and Mathematics in 2020, the Early Career Award for Excellence in Scalable Computing from the IEEE Technical Committee on Scalable Computing in 2017, the Best Land Transportation Paper Award from IEEE Vehicular Technology Society in 2017, the Internet of Things Technology Research Award from Google in 2016, and the Best Paper Awards in ICC 2021 (Communication and Information System Security), IPCCC 2020, and BodyNets 2010. He is an IEEE Senior Member, ComSoc Member, CISTC member, and ACM Member.

Speaker: Hao Liang, Associate Professor, University of Alberta, Tier 2 Canada Research Chair

Title: Stochastic Energy Management and Cyber-Physical Security of Battery Energy Storage Systems in Smart Distribution Systems

Abstract: Battery energy storage systems (BESSs) are vital for improving the sustainability, efficiency, and resiliency of smart distribution systems (SDSs). With proper energy management, BESSs can provide a wide range of applications for both demand-side and grid-scale services in SDSs. However, there are various elements in SDSs with randomness, such as renewable energy sources (RES), load demand, electricity price, and the mobility of electric vehicles (EVs) and electric buses (EBs), which can significantly affect the performance of energy management of BESSs. Moreover, due to the highly coupled cyber and physical systems in SDSs, the cyber-physical attacks that leverage common cyber-attacks to stealthily cause cascaded physical failures seriously threaten the effective and reliable energy management of BESSs. In this talk, I will briefly review some of our recent progresses on stochastic energy management and cyber-physical security for BESSs in SDSs, in four main aspects: 1) Stochastic multi-timescale energy management scheme for greenhouses with RES and electrical/thermal energy storage systems; 2) Hierarchical and decentralized stochastic energy management of residential BESSs at high penetration levels; 3) Stochastic energy management of EB charging stations with bus-to-grid capabilities; 4) Numerical models of false data injection attacks (FDIAs) in multiphase power distribution systems and the corresponding detection schemes. Future research directions will also be discussed.

Bio: Dr. Hao Liang is an Associate Professor in the Department of Electrical and Computer Engineering at the University of Alberta, Canada, as well as a Tier 2 Canada Research Chair in Intelligent Energy Systems. He received his Ph.D. degree from the Department of Electrical and Computer Engineering, University of Waterloo, Canada, in 2013. From 2013 to 2014, he was a postdoctoral research fellow in the Broadband Communications Research (BBCR) Lab and the Electricity Market Simulation and Optimization Lab (EMSOL) at the University of Waterloo. Dr. Liang's current research interests are in the areas of smart grid, cyber-physical systems, wireless communications, and wireless networking. He is a co-recipient of the Outstanding Paper Award from IEEE CCECE'23, the 2018 IEEE Power & Energy Society Prize Paper Award, the Best Conference Papers on Electric Vehicles, Energy Storage, Microgrids, and Demand Response from IEEE PES GM'16, and the Best Student Paper Award from IEEE VTC Fall-2010.

Speaker: Lin X Cai, Associate Professor, Illinois Institute of Technology, Chicago

Title: Near-Field and Far-Field Beamforming Design for RIS-enabled Wireless Communications

Abstract: In this talk, we propose a novel beamforming design for wireless communications with reconfigurable intelligent surface (RIS) in both near-field and far-field scenarios. We first develop a generic model to analyze spherical waves and explore the boundary between the near-field and far-field regions. Based on this model, we introduce a novel beamforming design for both the near-field and far-field areas. We demonstrate that near-field beamforming can be broken down into two parts: direction-related beamforming and distance-related beamforming, where the direction-related beamforming is similar to far-field beamforming. A practical codebook (CB) design suitable for both continuous and discrete RIS phase shifts is proposed and validated by extensive simulations.

Bio: Lin X. Cai received the M.A.Sc. and Ph.D. degrees in Electrical and Computer Engineering from the University of Waterloo, Waterloo, Canada, in 2005 and 2010, respectively. She is currently an Associate Professor with the Department of Electrical and Computer Engineering, Illinois Institute of Technology, Chicago, Illinois, USA. Her research interests include green communication and networking, intelligent radio resource management, and wireless Internet of Things. She received a Best Paper Award from the IEEE Globecom 2011, an NSF Career Award in 2016, the IIT Sigma Xi Research Award in the Junior Faculty Division in 2019, and the N2Women Stars award in Computer Networking and Communications in 2021. She serves as an executive editorial committee member of IEEE Transaction on Wireless Communications, and an Associate Editor of IEEE Transaction on Vehicular Technologies, and a co-chair for IEEE conferences.

Speaker: Rongxing Lu, Professor, University of New Brunswick, Fellow IEEE, Mastercard IoT Research Chair

Title: Achieve Edge-based Privacy-Preserving Dynamic Aggregation Query in Smart Transportation Systems

Abstract: As the proliferation of smart vehicles has fostered an abundance of real-time data, various data analysis tools, such as aggregation queries, are expected to be deployed to extract insights and make transportation systems much smarter. Meanwhile, to cope with the growing service scale, edge servers are employed to collect data and deliver the service, which however provokes privacy concerns related to the reported data and user queries. Previously reported solutions on privacy-preserving aggregation queries focus on static datasets or require data persistence, leading to storage pressure and slower query responses. In this talk, we present a privacy-preserving dynamic aggregation query scheme using edge servers, specifically addressing the problem of online aggregation queries. By combining homomorphic encryption and predicate encryption, our scheme enables the edge server to aggregate real-time data and respond to queries, safeguarding sensitive information from vehicles and data users. The integration of advanced cryptographic primitives ensures data and query privacy and integrity. Comprehensive theoretical analyses demonstrate our scheme's effectiveness in privacy preservation, boasting a manageable computational and communication overhead. The scheme, thus, presents a practical solution for privacy-preserving dynamic aggregation queries, fulfilling an unmet need in real-time transportation systems.

Bio: Rongxing Lu is a Mastercard IoT Research Chair, a professor at the Faculty of Computer Science (FCS), University of New Brunswick (UNB), Canada. Before that, he worked as an assistant professor at the School of Electrical and Electronic Engineering, Nanyang Technological University (NTU), Singapore from April 2013 to August 2016. Rongxing Lu worked as a Postdoctoral Fellow at the University of Waterloo from May 2012 to April 2013. He was awarded the most prestigious "Governor General's Gold Medal", when he received his PhD degree from the Department of Electrical & Computer Engineering, University of Waterloo, Canada, in 2012; and won the 8th IEEE Communications Society (ComSoc) Asia Pacific (AP) Outstanding Young Researcher Award, in 2013. Dr. Lu is an IEEE Fellow. His research interests include applied cryptography, privacy enhancing technologies, and IoT-Big Data security and privacy. He has published extensively in his areas of expertise (with H-index 85 and citation 31,200+ from Google Scholar as of August 2023), and was the recipient of 10 best (student) paper awards from some reputable journals and conferences. Currently, Dr. Lu served/serves as the Chair of IEEE ComSoc CIS-TC (Communications and Information Security Technical Committee), and the founding Co-chair of IEEE TEMS Blockchain and Distributed Ledgers Technologies Technical Committee (BDLT-TC). Dr. Lu is the Winner of 2016-17 Excellence in Teaching Award, FCS, UNB.

Speaker: Ning Lu, Assistant Professor, Queens' University, Tier 2 Canada Research Chair

Title: Toward A Pessimistic-Optimistic Framework for Constrained Bandit Learning

Abstract: The online optimization of time-varying quantities with unknown statistics is a common issue in modern engineering problems, particularly in communication networks. The multi-armed bandit (MAB) problem is a suitable model for many of these problems, where the player must choose actions that yield random rewards from an unknown distribution. In many cases, these problems also have arm selection constraints, where playing or not playing an arm expends some budgeted resource. Recent work has introduced pessimistic-optimistic algorithms to handle these constraints and track constraint violations using virtual queues. However, many engineering problems require additional modeling considerations, such as delayed feedback or arm switching costs, that may not fit neatly within this framework. In this talk, we will introduce an extensible framework for pessimistic-optimistic algorithms that can accommodate these additional considerations. We will also introduce our recent work exploring constrained bandit learning with delayed feedback and with switching costs, along with some novel results that more broadly impact constrained bandit learning problems.

Bio: Dr. Ning Lu is an Assistant Professor in the Department of Electrical & Computer Engineering at Queen's University. He is also a Tier 2 Canada Research Chair in Future Communication Networks. Dr. Lu received the B.Eng. (2007) and M.Eng. (2010) degrees from Tongji University, Shanghai, China, and Ph.D. degree (2015) from the University of Waterloo, Waterloo, ON, Canada, all in electrical engineering. Prior to joining Queen's University, he was an assistant professor in the Department of Computing Science at Thompson Rivers University, Kamloops, BC, Canada. From 2015 to 2016, he was a postdoctoral fellow with the Coordinated Science Laboratory, University of Illinois at Urbana-Champaign. He also spent the summer of 2009 as an intern in the National Institute of Informatics, Tokyo, Japan. His current research interests include real-time scheduling, distributed algorithms, and reinforcement learning for wireless communication networks. He has published more than 40 papers in top IEEE journals and conferences, including IEEE/ACM Transactions on Networking, IEEE Journal on Selected Areas in Communications, ACM MobiHoc, and IEEE INFOCOM, etc. He was a recipient of John R. Evans Leaders Fund. He received a best paper award at the 2014 IEEE GLOBECOM. He has served as journal guest editor, TPC member of major IEEE conferences, and reviewer of refereed journals.

Speaker: Yujie Tang, Assistant Professor, Dalhousie University

Title: RLC: A Reinforcement Learning Based Charging Scheme for Battery Swap Stations

Abstract: Battery Swapping Station (BSS) is emerging as a promising solution to the prevalent issue of range anxiety among Electric Vehicle (EV) users. Typically, BSS replaces the drained battery of an incoming EV with a fully charged one. In this talk, we introduce a cutting-edge battery charging and swapping approach for BSS, termed Reinforcement Learning-based Charging (RLC). This innovative strategy enables the provision of partially charged batteries to EVs with lower energy requirements while simultaneously minimizing the overall energy expenditure of BSS. Technically, RLC employs an ensemble learning-based forecasting module to predict the electricity demand pertaining to EV battery swapping. Furthermore, it utilizes Deep Deterministic Policy Gradient (DDPG) to strategize the battery charging process within BSS. Specifically, the predicted electricity demand is fed into the DDPG agent, enabling it to adapt to the changing patterns of EV arrivals. Our experimental results indicate that RLC outperforms the baseline charging schemes in terms of overall electricity cost, average State of Charge (SOC) discrepancy rate, and battery service rate.

Bio: Dr. Yujie Tang is an Assistant Professor with the Faculty of Computer Science, Dalhousie University, Canada. Prior to joining Dalhousie University, she was an Assistant Professor with the School of Computer Science and Technology at Algoma University, Canada, from July 2019 to August 2022. From October 2017 to June 2019, she worked as a Postdoctoral Fellow at the Department of Electrical and Computer Engineering, University of Waterloo, Canada. She received her Ph.D. degree in Electrical and Computer Engineering from the University of Waterloo, Canada, in 2017. Her research interests include Internet of Vehicles, resource management in heterogeneous networks, machine learning, software-defined networking, cooperative networking, and cognitive radio networks. She is a member of IEEE, IEEE ComSoC, and IEEE VTS. She has served on the technical committees of major conferences in communications and networking including IEEE INFOCOM, GLOBECOM, ICC, VTC and ICNC.