BBCR Workshop on
Intelligent Computing for Future Networks

August 2, 2022

University of Waterloo, Waterloo, ON, Canada

Workshop Agenda	
14:00 – 14:45	Invited Talk I: Task Offloading in Mobile Edge Computing for Internet of Things by Prof. Ning Zhang, University of Windsor, Canada
14:45 – 15:30	Invited Talk II: Autonomous Self-Regulation of UAV Communication Networks with Dynamic UAV Crew by Prof. Ran Zhang, Miami University, USA
15:30 - 16:15	Invited Talk III: Spectrum Efficiency Enhancement and Delay Minimization in 5G Networks by Prof. Yujie Tang, Algoma University, Canada
16:15 – 17:00	Invited Talk IV: Learning from Delayed Semi-Bandit Feedback under Fairness Guarantees by Prof. Ning Lu, Queen's University, Canada

1st Invited Talk

Tuesday, 2nd August 2022, 14:00 – 14:45

Room 4152, EIT building, University of Waterloo

Title: Task Offloading in Mobile Edge Computing for Internet of Things

Abstract: Internet of things (IoT) lays the foundation for a wide range of applications, such as environmental monitoring, smart city, and intelligent transportation systems. As IoT devices are constrained with resources, mobile edge computing (MEC) emerges as a new paradigm whereby data generated by IoT devices can be offloaded to nearby edge servers so that their tasks can be served locally and quickly. Due to the dynamic, heterogeneous, and time-varying MEC environment, it is vital to perform offloading in an efficient way to meet the service requirements. In this talk, two research works on offloading will be presented, including i) deep reinforcement learning aided dynamic task offloading for IoT; and ii) offloading in MEC with energy harvesting. Finally, some research directions are discussed.

Speaker's Biography: Dr. Ning Zhang received the Ph.D degree in Electrical and Computer Engineering from University of Waterloo, Canada, in 2015. Since 2020, he has been an Associate Professor at University of Windsor, Canada. His research interests include connected vehicles, mobile edge computing, wireless networking, and security. He is a Highly Cited Researcher (Web of Science) and the founding chair for IEEE SIG on AI Empowered Internet of Vehicles. He serves/served as an Associate Editor of IEEE Transactions on Mobile Computing, IEEE Internet of Things Journal, IEEE Transactions on Cognitive Communications and Networking, and IEEE Systems Journal. He also serves/served as a TPC chair for IEEE VTC 2021, IEEE SAGC 2020, and BSC 2023, a general chair for IEEE SAGC 2021, a chair for track of several international conferences and workshops including IEEE ICC, IEEE VTC, IEEE INFOCOM Workshop, and ACM Mobicom Workshop. He received 8 Best Paper Awards from various conferences and journals. He also received IEEE TCSVC Rising Star Award and IEEE ComSoc Young Professionals Outstanding Nominee Award.

2nd Invited Talk

Tuesday, 2nd August 2022, 14:45 – 15:30

Room 4152, EIT building, University of Waterloo

Title: Autonomous Self-Regulation of UAV Communication Networks with Dynamic UAV Crew

Abstract: Unmanned aerial vehicles (UAVs) have been demonstrating impressive potentials in next generation wireless communications. Compared to the terrestrial cellular base stations, UAVs equipped with wireless transceivers can serve as mobile base stations, and stand out in providing highly on-demand services with flexible 3D mobility, better wireless connectivity with higher chance of Line-of-Sight links, and much lower deployment cost with almost infrastructure-free network construction. As promising the UAVs are, how to optimally regulate the UAV network when the serving UAV crew dynamically change remains embryonic. To this end, our work investigates how the UAV communication networks should responsively handle and further proactively control the dynamic change of the UAV crew. Specifically, responsive self-regulation of the network is first studied when one or more UAVs are about to quit or join the network, with considering dynamic user distribution. We target an optimal UAV trajectory control strategy which can relocate the UAVs whenever the UAV crew is about to change, rather than passively dispatch the UAVs after the change. Moving one step further, a proactive control strategy is developed for the solar-powered self-sustainable UAV communication network. The strategy can proactively control the quit and join-in of the UAVs by pre-shaping their solar-charging plan leveraging on the time-variability of solar radiation intensity and user traffic demand. The research outcomes are expected to provide valuable inspirations and benchmarking to autonomous AI powered management of aerial access communication networks under a dynamic network setup.

Speaker's Biography: Ran Zhang (S'11 - M'15 – SM'22) received his B.Sc. and Ph.D. degrees in Electrical and Computer Engineering from Tsinghua University, China, and University of Waterloo, Canada, in 2010 and 2016, respectively. He then joined the Ottawa Research Center, Huawei Technologies, Canada, in 2016 as a system engineer. He is currently an assistant professor with Department of Electrical and Computer Engineering, Miami University, Oxford, OH, USA. His research interests include radio resource management for next-generation wireless communication networks, Internet of Things (IoT), channel coding for 5G New Radio, machine learning, unmanned aerial systems (UAS), robot-assisted e-healthcare, autonomous vehicular networks, and smart grid. He received a Best Paper Award from the IEEE GLOBECOM 2014, a CFR Faculty Research Award from Miami University in 2021, and the NSF Engineering Research Initiation (ERI) Grant in 2022.

3rd Invited Talk

Tuesday, 2nd August 2022, 15:30 – 16:15

Room 4152, EIT building, University of Waterloo

Title: Spectrum Efficiency Enhancement and Delay Minimization in 5G Networks

Abstract: The fifth generation (5G) technology aims at delivering enhanced mobile broadband, massive network capacity, more reliable and ultra-low latency communication, and a more uniform user experience to more users. Hence, 5G will expand the mobile ecosystem into new realms and create new possibilities for a variety of applications, including transportation, healthcare, Internet of things (IoT), agriculture, logistics, manufacturing and more. Driven by these new use-cases, the demand for network resources increases at an exponential rate and thus poses resource constraints and management challenges for 5G networks.

In this talk, I will present my research regarding spectrum efficiency enhancement and delay minimization in 5G networks. First, I will present a cross-tier cooperation framework in heterogeneous cloud radio access networks that mitigates inter-tier interference and enhances spectrum efficiency. Then, I will highlight a centralized routing scheme with mobility prediction which minimizes the overall vehicular service delay in vehicular ad hoc networks. Lastly, I will conclude the talk with an outlook towards integrating the vehicular network architecture with artificial intelligence strategies to identify advancement and future directions for resource allocation and management issues in 5G networks.

Speaker's Biography: Dr Yujie Tang received her Ph.D. degree in Electrical and Computer Engineering from the University of Waterloo, Waterloo, ON, in 2017. She was a postdoctoral fellow with the Broadband Communications Research Group at the University of Waterloo, Waterloo, ON, from 2017 to 2019. From 2019, she has been an assistant professor with Algoma University, Sault Ste. Marie, ON. She will join the Faculty of Computer Science, Dalhousie University, Halifax, NS, in September 2022. Her research interests include Internet of Vehicles, machine learning, software-defined networks, cognitive radio networks, cooperative networks, and resource management in heterogeneous networks. She is a member of IEEE, IEEE ComSoC, and IEEE VTS.

4th Invited Talk

Tuesday, 2nd August 2022, 16:15 – 17:00

Room 4152, EIT building, University of Waterloo

Title: Learning from Delayed Semi-Bandit Feedback under Fairness Guarantees

Abstract: Multi-armed bandit frameworks, including combinatorial semi-bandits and sleeping bandits, are commonly employed to model problems in communication networks and other engineering domains. In such problems, feedback to the learning agent is often delayed (e.g., communication delays in a wireless network or conversion delays in online advertising). Moreover, arms in a bandit problem often represent entities required to be treated fairly, i.e., the arms should be played at least a required fraction of the time. In contrast to the previously studied asymptotic fairness, many real-time systems require such fairness guarantees to hold even in the short-term (e.g., ensuring the credibility of information flows in an industrial Internet of Things (IoT) system). To that end, in this talk, we introduce the Learning with Delays under Fairness (LDF) algorithm to solve combinatorial semi-bandit problems with sleeping arms and delayed feedback, which we prove guarantees strong (short-term) fairness. While previous theoretical work on bandit problems with delayed feedback typically derive instance-dependent regret bounds, this approach proves to be challenging when simultaneously considering fairness. We instead derive a novel instance independent regret bound in this setting which agrees with state-of-the-art bounds. We verify our theoretical results with extensive simulations using both synthetic and real-world datasets.

Speaker's Biography: 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, 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 research interests include modeling, analysis, control, optimization, and learning of networked computer systems, such as communication networks, cloud/edge networks, and Internet of Things. He has served on the technical committees of several major conferences in networking such as IEEE INFOCOM, GLOBECOM, and ICC. He received a Best Paper Award from IEEE GLOBECOM 2014.