

ESE Research Seminar

Networks That Ask for Help: Uncertainty, guidance, and trust on the road to AI-native 6G

Professor Omar Alhussein, Khalifa University, UAE



Abstract: Zero-touch, self-configuring networks are a defining ambition of AI-native 6G. This talk explores a pragmatic path toward that goal, built on two simple design principles, namely (1) AI-algorithms complementarity: learned and classical components achieve more when composed together, each supplying what the other lacks (as when a classical solver draws global guidance from a language model while lending it algorithmic guarantees in return); and (2) calibrated escalation: systems to quantify their own uncertainty and ask (an oracle for labels, or a human operator for clarification) when that uncertainty warrants it, and less and less as confidence is earned. We develop these principles through three recent works from our NetAI group. First, an active machine learning framework for 6G, in which the network queries an oracle for the labels and samples it is most

uncertain about, cutting data acquisition and annotation costs while improving mmWave throughput prediction. Second, an LLM-aided A* algorithm for non-geometric network graphs, where a classical solver asks a language model for guidance, thereby reducing search exploration while keeping imperfect guidance harmless. Third, an uncertainty-driven intent translation system, in which a fine-tuned LLM turns operator intents into configurations and uses two tiers of uncertainty, namely predictive uncertainty to decide whether to deploy or escalate, and token-level entropy to pinpoint what clarifying questions to ask. These threads rely on our open-source NWDAF-enabled 5G testbed, which extends Free5GC with event-driven analytics and an LLM/RAG agentic intent interface, grounding the vision in a system that runs today. Together, they suggest a design philosophy for trustworthy network autonomy: (1) compose generative models with classical guarantees, (2) quantify what the system does not know.

Bio: Omar Alhussein received his Ph.D. in Electrical and Computer Engineering from the University of Waterloo, Canada, in 2020, and his Master of Applied Science (MASc.) degree in Engineering Science from Simon Fraser University, Canada, in 2015. Since Fall 2023, he has been an Assistant Professor in the Department of Computer Science at Khalifa University, United Arab Emirates. Prior to joining Khalifa University, he worked as a Senior Research Engineer with the Advanced Networking Team at Huawei Technologies Canada in Ottawa from 2020 to 2023. Dr. Alhussein serves as an Associate Editor for IEEE Transactions on Network and Service Management, and for Peer-to-Peer Networking and Applications, Springer Nature. His research interests include network intelligence and optimization, semantic task-oriented network systems, and quantum-assisted networked systems.

Date and Time: 11:00am - 12:00pm (MST), Monday, July 13th, 2026.

Location: ICT 516 (Refreshments will be provided).

Invited By Professor Qiang (John) Ye