

Resilience and Security of Networked Control Systems (With Applications to Autonomous Multi-Agent Systems)

Abstract: As the scale of networked control systems (NCS) increases and interactions between different subsystems become more sophisticated, questions of their resilience to failures increase in importance. Human intervention in those systems increases this complexity, especially when it comes in the form of an adversary. In this talk, we first introduce two challenges we face in studying the resilience of NCSs: 1) Classical robust and fault-tolerant control techniques may not be sufficient to address the resilience of NCSs against strategic adversarial actions, 2) The impact of the underlying network topology on the resilience of NCSs against strategic adversaries is not quantified. To address these two challenges, we 1) Extend the concept of fault detection and fault tolerance in control systems to incorporate strategic adversarial actions, using tools from systems theory and game theory, and 2) Reinterpret some notions of resilience in the language of graphs, using tools from graph theory and structured systems theory. The applications of the theoretical works are discussed for secure control of teams of autonomous agents. Finally, some of my active research projects (and industrial collaborations) in safe and secure vehicle autonomy will be briefly explained.

Biography: Mohammad Pirani is a senior research scientist with the Department of Electrical and Computer Engineering, University of Waterloo. Before that, he held postdoctoral research positions at the University of Toronto (from 2019 to 2021) and KTH Royal Institute of Technology, Sweden (2018 to 2019). He received his M.A.Sc. in Electrical and Computer Engineering and Ph.D. in Mechanical and Mechatronics Engineering, both from the University of Waterloo, Canada, in 2014 and 2017, respectively. His research interests include resilient and secure networked control systems with applications to intelligent transportation systems and multi-agent systems. He is a member of the IEEE-CSS technical committee on smart cities.