Embracing New Paradigms of Data- and Complexity-Based Integration of Control, Communications, and Computing in Network Systems

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Abstract

Modern systems are dominantly characterized by interconnected network systems. They are exemplified by power grids, electric vehicle charging networks, edge computing, renewable generators and controllable loads, autonomous vehicles, smart buildings, smart cities, gene networks, energy and material flow networks, to name just a few. Management of such network systems encounters fundamental issues of information, uncertainty, and complexity, and demands integration of control, communications, and computing.

In this presentation, we will highlight some key motivations and critical issues in networked systems, and explain the importance in pursuing data- and complexity-based approaches. In particular, we will briefly discuss some recent advances in this direction, including data-size reduction in system identification, data transfer frequency reduction in estimation, data volume reduction in decision-based methodologies for modeling, and data travel distance reduction in distributed optimization and control strategies. A few cases will be used to illustrate how communication system properties and uncertainties can impact safety and control performance of network systems.