Cyberphysical Systems

Abstract:
We present a brief historical account of paths leading to the present interest in cyberphysical systems. We follow this up with an account of several foundational research topics that are important for developing a comprehensive understanding of the problems of control over networks.

Proceeding from bottom to top, we address the following problems, and present some answers: (i) In-network information processing: How should data from distributed sensors be fused over a wireless network? Can one classify functions of sensor data vis-a-vis how difficult they are to compute over a wireless network? (ii) Real-time scheduling over wireless networks: How should packets with hard deadlines be scheduled for transmission over unreliable nodes? What QoS guarantees can be provided with respect to latencies and throughputs? (iii) Clock synchronization over wireless networks: What are the ultimate limits to synchronization error? How should clocks be synchronized? (iv) System level guarantees in networked control: How can one provide overall guarantees on of networked control systems that take into account hybrid behavior, real-time interactions, and distributed aspects? (v) Abstractions and architecture: What are appropriate abstractions, and what is an appropriate architecture, to simplify networked control system design and deployment? We describe this in the context of research in the convergence lab at the University of Illinois.

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