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Control Across Different Temporal Scales: A Mechatronic-System Perspective

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ABSTRACT:

Since the invention of microprocessors, fast sampling has been the dogma for building realtime systems in applications from healthcare to manufacturing. Increasingly prevalent data-intensive measurements such as imaging and streaming videos, however, remain widely separated from high-speed realtime applications. This talk discusses a system-theoretical framework for closed-loop controls under such mismatched sensing and actuation. Drawing from subfields of information science and sampled-data controls, we discuss (1) modeling and online signal processing that understand multi-scale thermo-mechanical interactions to reliably address imperfect, potentially irregular sensor feedback, and (2) the realization of control strategies that maximize performance beyond conventional bandwidth limits. Along the path, we share the hardware-control co-design of a home-brew laser additive manufacturing testbed and broader relations to robotic inspection for aerospace manufacturing.

BIOGRAPHY:

Xu Chen is an assistant professor of Mechanical Engineering at the University of Washington, Seattle. He pursues a research passion in dynamic systems, information processing, and controls, to better understand and engineer smart machines that positively impact our lives. He leads the MACS Lab — a team focusing on sensing, actuation, and automation that facilitate, e.g., robots that inspect complex, highly reflective parts in aerospace, and additive manufacturing that make engineered materials with extraordinary properties at low unit costs compared to conventional machining. Xu Chen's work -- funded by NSF, DOD, DOE, states, and industries -- has led to four Best Paper Awards, servo algorithms in industrial mass production in the information storage industry, top-ranked adaptive control methods in international benchmark evaluations, and the graduation of two University Scholars. Dr. Chen is a recipient of the National Science Foundation CAREER Award, the Young Investigator Award from ISCIE / ASME International Symposium on Flexible Automation, and the inaugural UTC Institute for Advanced Systems Engineering Breakthrough Award in 2016. He also leads UW's participation in the Advanced Robotics for Manufacturing Institute, a Manufacturing-USA Initiative, and serves in the Scientific Advisory Committee of the Boeing Advanced Research Center.