RESEARCH SEMINAR

Minimum Information Control: Theory, Applications, and Future Outlook

THURSDAY, MARCH 21ST 9:00AM-10:15AM
WALC 3121 OR WEBEX

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ABSTRACT

Control theory is a discipline in information science that explores the utilization of feedback to enable real-time decisions toward desired objectives. The advantage of feedback control over open-loop control is widely acknowledged. In many modern control systems, however, processing the sheer wealth of information available for decision-making can become cumbersome, imperiling efficient real-time processing. Consequently, the ability to select only the essential, task-relevant information from the vast sea of sensory data is increasingly crucial. While animals demonstrate exceptional information selection abilities, replicating such skills remains challenging for machines. This challenge arises in part due to a series of non-trivial questions at the intersection of control theory and information theory: What is the minimum amount of information required for effective control? Which information content is necessary for control? Most fundamentally, how do we quantify the flow of information in feedback systems?

This presentation introduces an approach to quantify feedback information flow using the concept of directed information. Following a brief historical overview of directed information, I elucidate its application in formulating the minimum information control concept. The practical relevance of this formulation is demonstrated by its natural emergence in Networked Control Systems (NCS) design problems. I also showcase its application to simultaneous perception and motion planning. Finally, I discuss how the insights obtained will contribute to the current paradigm of machine perception and learning.

BIOGRAPHY

Takashi Tanaka is an Assistant Professor in the Department of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin since 2017. He received his B.S. degree from the University of Tokyo in 2006, M.S. and Ph.D. degrees from UIUC in 2009 and 2012, all in Aerospace Engineering. Prior to joining UT Austin, he held postdoctoral researcher positions at MIT and KTH Royal Institute of Technology. His research interest is broad in control, optimization, games, and information theory; most recently their applications to networked control systems, real-time data sharing, and strategic perception. He is the recipient of the DARPA Young Faculty Award, the AFOSR Young Investigator Program award, and the NSF Career award.

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