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2023-2024 TC Seminar Series

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*Numerical Optimization for Nonlinear Model Predictive Control:
From Smooth Nonlinearities to Switches, Jumps, and Logic*

Abstract:

Advances in computers and numerical solution methods have been expanding the application of model predictive control (MPC), which solves optimal control problems in real time to perform feedback control. In particular, nonlinear MPC (NMPC) has been gaining attention due to its applications to complex nonlinear mechanical systems. Additionally, software tools for NMPC have rapidly developed to facilitate its implementation. In this talk, I will first present a comprehensive overview of real-time optimization algorithms, software tools, and applications of NMPC. One of the key ideas there is exploiting the smoothness of nonlinearities in problems. Then, I will present recent advances in parallel computation methods for NMPC and an application of NMPC for whole-body control of a quadruped robot with switches and state jumps. Furthermore, I will also introduce ongoing work on computation methods for more general optimal control problems involving equilibrium constraints or signal temporal logic specifications, which appear in various problems in robotics.

Biography:

Toshiyuki Ohtsuka is a Professor at the Graduate School of Informatics, Kyoto University, Japan. He received the B.Eng., M.Eng, and Ph.D. degrees from the Tokyo Metropolitan Institute of Technology, Japan, in 1990, 1992, and 1995, respectively. From 1995 to 1999, he worked as an Assistant Professor at the University of Tsukuba. In 1999, he joined Osaka University as an Assistant Professor at the Graduate School of Engineering. Then, in 2007, he moved to the Graduate School of Engineering Science at the same university as a Professor. In 2013, he joined Kyoto University as a Professor at the Graduate School of Informatics. His research interests include nonlinear control theory and real-time optimization methods with applications to mechanical systems such as drones, robots, and automobiles. He received the SICE Outstanding Paper Award in 2004 and 2013, the SICE Outstanding Book Award in 2012, and the SICE Control Division Pioneer Award and Kimura Award in 2006 and 2014, respectively. He is a member of SICE and a Senior Member of IEEE and AIAA. He is the NOC Chair of the 8th IFAC Conference on Nonlinear Model Predictive Control (NMPC 2024).