

Seminar on Control Theory at Fukuoka

December 20, 2025

@ ACROS Fukuoka

Supported by

SICE Kyushu Branch

JST ASPIRE Grant Number JPMJAP2402



ASPIRE

先端国際共同研究推進事業

14:00-15:30

Homogeneous Finite/Fixed-Time Stabilization of LTI Systems under State Quantization

Yu Zhou (Hiroshima University, Japan)

Abstract: This talk addresses the problem of finite and fixed-time stabilization for linear time-invariant (LTI) systems in the presence of state quantization, using a homogeneous control framework. Quantized control has received significant attention due to practical limitations such as constrained communication bandwidth and memory resources. Quantization, which encodes continuous signals into discrete values, introduces non-negligible effects into feedback loops. Finite and fixed-time stability, which ensures convergence within a uniformly bounded time, is particularly desirable for time-critical systems. Homogeneous systems are popular for achieving this property because their convergence rates are determined by the degree of homogeneity. This talk explains how homogeneity can be systematically exploited in both controller design and quantizer design to guarantee finite and fixed-time stabilization of LTI systems.

Bio: Yu Zhou is a Specially Appointed Assistant Professor at the Graduate School of Advanced Science and Engineering, Hiroshima University, Japan. He conducted his Ph.D research at INRIA Lille within the Valse team. He obtained his Ph.D. from Centrale Lille in January 2025. He received his B. Eng. degree in Flight Vehicle Power Engineering in 2017 and his M. Eng. degree in Aerospace Science and Technology in 2020 from the Beijing Institute of Technology, China. His research interests include control over networks and robotic control for high-speed and agile motion tasks.

16:00-17:30

On Recent Theoretical Advances in the Stochastic MPC framework for Uncertain Linear Systems and Practical MPC Applications in Anesthesia Dynamics

Kaouther Moussa (INSA Hauts-de-France)

Abstract: This talk will firstly present some new theoretical results linked to the Stochastic Model Predictive framework, namely, the exact characterization of covariance dynamics for discrete-time linear systems affected by stochastic i.i.d. additive and parametric uncertainties. It will present how the use of some Kronecker product related transformation can help to derive a deterministic characterization of the error dynamics in the tube-based MPC framework, a key step for tractable chance-constraint tightening. In the case of parametric stochastic uncertainties, however, the derived exact characterization brings some challenges, particularly with respect to the control design, since such characterizations involve bilinear terms in the control gain. This problem will be addressed through the use of a Kronecker identity allowing to linearize the system, a descriptor representation is then used together with the S-variable approach in order to derive sufficient conditions with reduced conservatism. Then, this presentation will address some practical challenges related to biomedical systems (particularly anesthesia dynamics), such as handling varying equilibrium points and range tracking for some health indicators; and will illustrate how MPC for tracking based techniques can address such issues. Finally, the talk will outline future research directions, both theoretical and practical, related to MPC methods and their use in biomedical systems control.

Bio: Kaouther Moussa is an associate professor in control at INSA Hauts de France (engineering school) and LAMIH (research laboratory) at Valenciennes, France. She completed her PhD in Grenoble Polytechnic Institute (Grenoble INP) and Gipsa-Lab, on optimization-based control and probabilistic certification of regions of attraction for cancer dynamics, followed by a postdoctoral position at the same laboratory within the TActical Multi-Objectives Swarming UAVs project. Her research focuses on predictive control and uncertainties handling through probabilistic and stochastic approaches, with an emphasis on biomedical applications. She is a recipient of a research grant for young researchers from the French National Research Agency (ANR) for the Clinical project (2024-2028), which lies at the intersection of learning and control approaches for the prediction and monitoring of anesthesia dynamics.