Seminar on Control Theory at Fukuoka

July 25, 2026

@ ACROS Fukuoka

Supported by

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15:00-16:15

Titles:

Part I: JST ASPIRE-CPDS: Activity Report up to FY 2025

Part II: Detecting Destabilizing Nonlinearities in Absolute Stability Analysis of Nonlinear Feedback Systems

Speaker: Yoshio Ebihara (Kyoto University and Kyushu University)

Abstract:

(Part I) JST ASPIRE is a research support program designed to:

- Build a network among the world's top research talent.
- Promote Japan's participation in the international top research community.
- Nurture and mobilize future research leaders.

In 2024, we started the project entitled "Building Mathematical Foundation for Cyber Physical Dynamical Systems: Interdisciplinary Research and Human Resource Development on Control with Prediction and Learning" that is abbreviated as "ASPIRE-CPDS." In this talk, we report on our activities of ASPIRE-CPDS up to FY 2025.

(Part II) This work addresses the absolute stability analysis problem of feedback systems with slope-restricted and repeated nonlinearities. Under the integral quadratic constraint framework, we can employ static O'Shea-Zames-Falb multipliers to obtain an LMI-based criterion that ensures absolute stability. However, this criterion is only a sufficient condition for the absolute stability. In other words, if this ``primal'' LMI is infeasible, no definitive conclusion can be drawn. To overcome this limitation, we consider the corresponding dual LMI that becomes feasible if and only if the primal LMI is infeasible. Our main

result establishes that if the dual solution satisfies a certain rank condition, then it is possible to construct both a destabilizing slope-restricted nonlinearity and a non-zero equilibrium state, thereby proving that the system of interest is not absolutely stable. We also report our latest extension of these results to other problem settings.

16:30-17:30

Title: Linear Quadratic Zonotopic Control for Uncertain LPV Systems: Application to Autonomous Vehicle Path-Tracking

Speaker: Sara IFQIR (Centrale Lille Institute)

Abstract: This talk introduces a new robust state feedback control scheme for Linear Parameter Varying (LPV) systems subject to bounded disturbances and noises. Serving as a deterministic, zonotopic counterpart to the classical stochastic LQG architecture, the framework features an offline-designed Zonotopic Kalman Filter (ZKF) for fast state estimation and a Linear Quadratic Zonotopic (LQZ) control framework for feedback synthesis. By proving the separation principle for this architecture, the optimal controller and estimator gains are computed independently by solving offline Linear Matrix Inequalities (LMIs). Finally, the framework's real-world performance is demonstrated through a vehicle lateral dynamics path-tracking application validated using real experimental data.

Bio: Sara IFQIR received the M.Sc. degree in elec-tronics, electrical energy and automatic control, and the Ph.D. degree in automatic

control from the University of Paris-Saclay, France, in 2016 and 2019, respectively. From November 2019 to August 2021, she worked as a postdoctoral researcher with the University of Bordeaux, France. Since September 2021, she joined Centrale Lille Institute and CRIStAL Laboratory as Associate Professor. Her current research interests include nonlinear, switched and multi-agents systems, robust control, set-membership estimation and fault diagnosis for complex physical systems with special focus on the fields of intelligent vehicles.