Lingnan University 嶺南大學 香港 Hong Kong
Lingnan University
Institute for Advanced Study

LUIAS Distinguished Lecture

Safe and Intelligent Decision-Making under Uncertainty: Predictive Control Meets Machine Learning

Speaker

Prof Dr -Ing Rolf FINDEISEN

Head of Control and Cyber-physical Systems Laboratory
Technical University of Darmstadt

Scan to Register

Date: 9 March 2026 Time: 4:00PM - 5:20PM

Venue: LYH201/2, 2/F, Lau Lee Yuen Haan Amenities Building

Mode: Face-to-face

Abstract

Modern autonomous systems, ranging from robots and medical devices to intelligent vehicles and energy systems, must operate safely and reliably in uncertain and dynamic environments. Their decision-making processes naturally unfold on multiple time scales: rapid control actions are required to ensure stability and safety in real time, while learning and adaptation evolve more gradually as data is collected over repeated interactions.

In this talk, I present model predictive control as a principled framework for real-time, constraint-aware decision making. Predictive control provides a mathematically grounded mechanism to compute safe and performance-oriented actions under physical limitations through repeated optimisation. At the same time, machine learning enables systems to adapt and improve their internal models, refine objectives, and reduce uncertainty over longer horizons. However, integrating learning into safety-critical decision-making raises a fundamental question: how can we enhance performance and adaptability without compromising formal safety and stability guarantees?

We discuss how learning-based methods—such as Gaussian processes, neural networks, and Bayesian optimisation—can be integrated into predictive control without sacrificing safety or performance guarantees. The central idea is to explicitly account for the uncertainty introduced by learned components within the decision-making process itself. This leads naturally to hierarchical, multi-time-scale architectures in which fast control layers enforce safety and constraint satisfaction, while slower learning layers enhance long-term performance.

Applications in robotics, autonomous vehicles, chemical processes, and exoskeleton systems illustrate how repeated interaction and structured learning can systematically improve behaviour while retaining formal guarantees. Finally, I outline emerging directions toward context-aware and semantically informed decision-making frameworks that combine data-driven intelligence with rigorous system-theoretic foundations.

Biography

Rolf Findeisen heads the Control and Cyber-Physical Systems Laboratory at Technical University of Darmstadt, where he is a full professor of control engineering. His research develops optimisation-based and learning-enabled methods for decision making in dynamical systems, with a particular focus on predictive control under uncertainty and system-theoretic performance guarantees.

He received his doctorate from the University of Stuttgart and previously held a professorship in Systems Theory and Automatic Control at Otto-von-Guericke University Magdeburg. His work bridges systems theory, optimal control, and machine learning, advancing learning-augmented predictive control frameworks with formal guarantees. Applications span robotics and human-assistance systems, autonomous and automotive systems, energy and process systems, and biomedical engineering.

He has held visiting positions at ETH Zürich, EPFL, MIT, UC Berkeley, and Imperial College London. He is actively engaged in the international control community, serving in leading roles within IEEE CSS and IFAC, and contributing to the organisation and scientific direction of major international conferences.

ALL ARE WELCOME

Enquiries
2616 8847
luias@ln.edu.hk

EDUCATION for SERVICE
作育英才・服務社會