DATA-BASED SYSTEMS AND CONTROL

Overview

Traditional systems and control theory relies on model-based methods, which assume the availability of a precise mathematical model of the system to be controlled. However, as engineering systems grow increasingly complex, deriving accurate mathematical models becomes challenging. Simultaneously, advancements in technology provide unprecedented access to data, making data-driven approaches a transformative alternative to model-based methods.

This course provides a comprehensive introduction to data-driven control, equipping participants with the tools to analyze and design feedback controllers directly from system data. It delves into cutting-edge developments in the field, focusing on the data informativity framework, which determines the conditions under which collected data are sufficient for solving analysis and control problems effectively.

Through this course, participants will learn how to leverage data for control design without the need for explicit mathematical models. Practical case studies and applications will demonstrate how data-driven techniques are applied to address real-world engineering challenges, such as robotics, autonomous systems, and industrial process control.

The course integrates core concepts from system theory, linear algebra, and mathematical programming, ensuring participants gain both theoretical insights and practical skills. Designed for Master's and Ph.D. students in electrical, control, and computer engineering, as well as researchers and professionals, this course prepares attendees to address the challenges of modern, data-rich engineering systems with innovative solutions.

Course participants will gain knowledge through interactive lectures, hands-on experiments, and software simulations using tools like MATLAB, Python, etc. Case studies and real-world applications will further inspire research motivation, ensuring participants are equipped to address contemporary challenges in data-based systems and control.

Modules	• **Module 1:** Foundations of Data Informativity • **Module 2:** State Feedback Design and Noisy Data Framework • **Module 3:** Quadratic Matrix Inequalities (QMIs) • **Module 4:** Designing Controllers from Noisy Data • **Module 5:** Advanced Control Design from Data
You Should Attend if you are	▪ **A Control Systems Engineer or Research Scientist** looking to explore modern, data-driven techniques for analyzing and designing control systems without relying on precise mathematical models. ▪ **A Master's or Ph.D. Students in Electrical, Control, or Computer Engineering** are interested in advanced topics such as the data informativity framework, quadratic matrix inequalities, and robust control methods. ▪ **A Faculty Member or Academic Researcher** seeking to enhance your understanding of cutting-edge data-driven control theory and its applications in real-world engineering challenges. ▪ **A Professional or Practitioner in Systems and Control** aiming to apply data-driven approaches to tackle the complexities of modern engineering systems, where accurate modeling is difficult but data is abundant. This course is tailored for individuals eager to gain expertise in the state-of-the-art methods of data-based systems and control, with applications across diverse engineering fields.
Fees	Interested candidates may apply online by clicking the below Google link: https://forms.gle/yuocnLwPBPwoHseU6 Candidates registering early will be given preference in the shortlisting process. The participation fees for the course are as follows: ■ Participants from abroad: USD 350 (including Accommodation and food) ■ Industry/Research Organizations: INR 20,000 (including Accommodation in the guest house and food) ■ Academic Institutions: INR 10,000 (including Accommodation and food) ■ Students: INR 5,000 (including Accommodation and food) ■ Students from Host Institute: INR 1,000 (Without accommodation and food)

	The fee includes: ■ Instructional materials ■ Accommodation (in hostels) and Food ■ Access to computers for tutorials and assignments ■ Usage of laboratory equipment ■ 24-hour free internet facility Accommodation in the Guest House & Food: ■ Accommodation & food in the guesthouse will be provided on an availability and payment basis for participants who require it.
Course Coordinator	**Tushar Jain** **School of Computing and Electrical Engineering** **Indian Institute of Technology Mandi, Himachal Pradesh-175075** **Phone: 01905-27788, 01905-267787** **E-mail: tushar@iitmandi.ac.in**
Registration Link	**Last Date of Registration: 7th March 2025** **Click on the Registration Link** **Start date of course: 07 April to 11 April 2025**
Website	**https://sites.google.com/iitmandi.ac.in/data-based-systems-control/contact-us**

The Faculty

Prof. M.K. (Kanat) Camlibel is a distinguished academic specializing in applied mathematics, with a focus on control and piecewise linear dynamical systems. He is currently a full professor at the Bernoulli Institute, University of Groningen, where he has been serving since 2001 in various academic roles. He completed his Ph.D. at Tilburg University in 2001, with a thesis on "Complementarity Methods in the Analysis of Piecewise Linear Dynamical Systems," under the supervision of Prof. Hans Schumacher. His academic journey also includes an M.Sc. (1994) and B.Sc. (1991) in Control and Computer Engineering from Istanbul Technical University. Professor Çamlıbel's research contributions have been recognized with several prestigious awards, including the 2021 IEEE Control Systems Letters Outstanding Paper Award and multiple Teaching Awards at the University of Groningen. His groundbreaking work includes extensions of Willems' fundamental lemma for state-space systems. With a career spanning over two decades, his academic appointments have included roles at Eindhoven University of Technology, Dogus University, and Centrum voor Wiskunde en Informatica (CWI) in Amsterdam. His

expertise is reflected in a robust publication record, mentorship of students, and contributions to advancing control systems and mathematical modeling.

Coordinator

Tushar Jain

Dr. Tushar JAIN received the degree of Doctor in Control, Identification and Diagnostic from Universite de Lorraine, Nancy, France in 2012. He previously received the degree of M.Tech. in System modeling and control from Indian Institute of Technology (IIT) Roorkee in 2009. From 2013 to 2014 and 2014 to 2015, he was a Post-doc researcher and Academy of Finland researcher respectively in the Research Group of Process Control at Aalto University, Finland. Since 2015, he is with the School of Computing and Electrical Engineering, IIT Mandi. During these last years, his research interest has been mainly concentrated on mathematical control theory, fault tolerant control, fault diagnosis and climate-controlled agriculture. He has received thrice the best paper award for his research work. He has authored a book entitled Active Fault-Tolerant Control Systems: A Behavioral System Theoretic Perspective. He is a senior member of the Institute of Electrical and Electronics Engineers (IEEE).