



ICAL EPCS 2025

Advanced Control Workshop

Daniel Tavares

September 21, 2025

- The workshop is meant to **gather feedback control**...
 - ...specialists and beginners...
 - ...theorists and practitioners...
 - ...from all kinds of large experimental physics facilities.
- **Feedback control science**...
 - ...is typically not explored in depth in the ICALEPCS community...
 - ...seeks for universal laws which are application-independent...
 - ...may reach applications far beyond the mere control of physical systems.
- **Why in ICALEPCS?**
 - Other options...?
 - Small communities of feedback control specialists are dispersed in many conferences
 - Which one comes first, a workshop or a community?

Systems

1) Particle accelerators

- a) Closed orbit and trajectory feedback systems
- b) Multibunch feedback systems
- c) Low-Level Radiofrequency (LLRF) phase and amplitude feedback
- d) Fast magnet power supplies voltage and current regulation loops
- e) High performance timing systems

2) Beamlines and interferometers

- a) High dynamic mechatronic systems (nanopositioning)
- b) Vibration isolation
- c) Thermal systems

3) Tokamaks

- a) Plasma control

4) Optical and radio telescopes

- a) Adaptive optics
- b) Antenna control

5) Infrastructure / “Industrial” systems

- a) HVAC systems
- b) Cryogenic systems

Control techniques

• Widespread:

- System modeling and plant design
- System identification
- Feedback controller tuning
- Feedforward

• Typical “advanced” techniques:

- MIMO system analysis (singular values)
- Loop shaping
- Kalman filter / LQG
- Model Predictive Control (MPC)

• Rarely seen:

- Robust control (H-infinity / μ -synthesis)
- Adaptive control
- Nonlinear control

- Build a **community and forum** to share ideas and discuss advanced feedback control problems
- Identify **challenging problems** worth tackling
- Collaborate on **modular and shareable solutions** (theory, simulation, algorithms, software, hardware, etc.)
- Reflect on the **major paradigm shifts of the field** and how it affects our work, e.g., the new AI/ML wave and the urge for increasingly autonomous scientific discoveries

Schedule

Sun 21/09		>
Print PDF Full screen Detailed view Filter		
14:00	Advanced Control Workshop Introduction	<i>Daniel Tavares</i> 14:00 - 14:15
	[REMOTE TALK] A Theory of Universal Architectures for and by Control	<i>Prof. John Doyle</i>
15:00		14:15 - 15:30
	Break	15:30 - 16:00
16:00	System Decoupling and Control for High-Dimensional, High-Throughput Orbit Feedback	<i>Hyuntae Kim</i> 16:00 - 16:15
	Advances in Orbit Feedback Control for Enhancing Beam Stability at Advanced Photon Source	<i>PavanaSirisha Kallakuri</i> 16:15 - 16:30
	MPC Implementation for Slow Orbit Correction at MAX IV	<i>Carla Takahashi</i> 16:30 - 16:45
	Model Predictive Control for Industrial Control Systems at CERN	<i>Brad Schofield</i> 16:45 - 17:00
17:00	Design workflow of digital controllers for high-performance mechatronic systems at Sirius' beamlines	<i>Gabriel Brunheira</i> 17:00 - 17:15
	[REMOTE TALK] Reducing Noise in Gravitational-Wave detectors with H-infinity bounded LQG Optimal Control	<i>Prof. Lee McCuller</i>
	Discussion and closing	17:30 - 18:00
18:00		

- This session is **being recorded** for future reproduction in online platforms (e.g. YouTube)
- Questions to remote speakers: **wait for the microphone**
- Slides are available in the Indico page:
indico.cnpem.br/e/iacow2025
- A **group photo** will be taken after the keynote talk, before the coffee break
- Wi-fi info:
 - Network **ICALEPCS2025** / Password: **Accelerator**

Áureo Freitas (MAX-IV)

Hyuntae Kim (University of Oxford)

Sirisha Kallakuri (Argonne National Laboratory)

Idris Kempf (University of Oxford)

Jameson Rollins (Caltech/LIGO)

Brad Schofield (CERN)

Daniel Tavares (CNPEM/LNLS)



Thank you and enjoy the workshop!

Questions and suggestions: daniel.tavares@lns.br

A theory of universal architectures for and by control

John Doyle

- Caltech Jean-Lou Chameau Prof. Emeritus of Control and Dynamical Systems, and BioEngineering.

