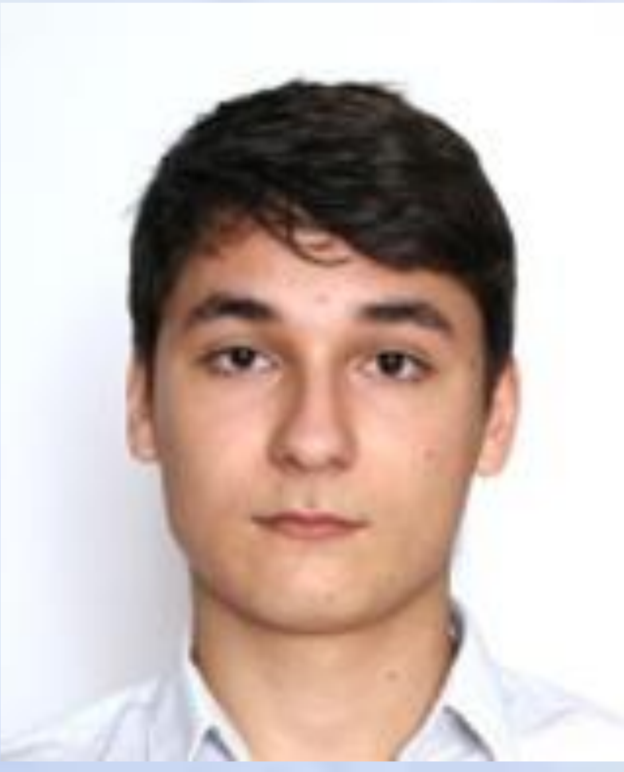
March 6, 11:45-13:00
Pisa, School of Engineering, Aula C12



Tube-Based and Offset Free Model Predictive Control

by *Robert Malik*

FEI STU Department of Robotics and Cybernetics, Faculty of Electrical Engineering and Information Technology, Slovak University of Technology in Bratislava

Model Predictive Control (MPC) is a powerful technique for control systems, producing optimal solutions within a defined prediction horizon. It determines the control sequence by solving a constrained optimization problem, where the physical properties of the system define the constraints. This allows MPC to handle systems with constraints, multivariable systems, and various dynamic behaviors that are modeled. However, MPC is highly dependent on the precision of the model; therefore, traditional MPC approaches face challenges with robustness when applied to systems with uncertainties or external disturbances. Tube-based MPC is a robust control strategy that integrates MPC with a complementary robust control law. This work studies the potential of combining tube-based MPC and offset-free MPC to leverage their respective strengths.

Online Modeling and Predictive Maintenance in Chlor-Alkali Electrolysis

by *Marek Wadinger*

IAM STU Dep. of Information Engineering and Process Control, Institute of Information Engineering, Automation, and Mathematics, Slovak University of Technology in Bratislava

In chlor-alkali electrolysis, maintaining the integrity of ion-exchange membranes is essential for efficient production, yet membrane fouling from impurity accumulation—particularly calcium and magnesium ions—remains a critical challenge that escalates energy consumption and degrades performance. Traditional data-driven models focus primarily on voltage prediction and overlook the dynamic behavior of impurity buildup, while first-principle models are inherently limited in capturing these complex fouling phenomena, limiting their effectiveness for predictive maintenance. In this work, we leverage DMD to identify a linear state-space model that concurrently predicts voltage and estimates key impurity concentrations. While DMD is an established technique, its novel application here lies in its capability to update the model online through real-time laboratory measurements, thereby ensuring model validity over long operational periods. Our open-loop evaluation demonstrates a reduction in mean squared error (MSE) and an improvement in R^2 compared to conventional approaches. Moreover, the framework supports closed-loop predictions, enabling real-time control and predictive maintenance to mitigate membrane fouling and enhance overall process efficiency.

Consortium

Funded by the European Union

This project has received funding from the European Union's Horizon Europe under grant no. 101079342 (Fostering Opportunities Towards Slovak Excellence in Advanced Control for Smart Industries).