

# Application of Machine Learning in Accelerating MPC for Chemical Processes

## Presenters:

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2. Patrik Valábek, [patrik.valabek@stuba.sk](mailto:patrik.valabek@stuba.sk), PhD student, <https://www.uiam.sk/~valabek/>,

## Summary

The aim of this workshop is to provide hands-on experience for applications of machine learning tools in connection with control theory. Specifically, we will introduce several possibilities as to how the MPC can be accelerated. We will provide a general overview and introduction to machine learning case studies suggesting suitable architectures and data preparation. Next, the workshop will introduce traditional MPC-mimicking procedures to generate approximate explicit control laws and procedures to general controllers posed as neural networks with stability guarantees. Case studies and examples will be tailored to chemical processes and problems arising in this domain. The workshop is primarily intended for graduate students and early-stage researchers, as well as for all community members interested in hands-on applications of machine learning tools in process control. Furthermore, the workshop will be organized in interactive mode; hence, participants will gain experience in experiment preparation and coding examples.

## Intended audience

The workshop is primarily intended for graduate students and early-stage PhD students, and for researchers eager to learn more about merging machine learning with applications in control. The workshop will be structured in an introductory fashion, but following knowledge is required:

- model predictive control,
- optimization (general knowledge e.g. about gradient method, quadratic programming),
- (optional) basics of explicit MPC – will help to understand the broader perspectives.

## Tentative schedule

We aim for a 4-hour workshop, where 90 minutes will be allocated to a presentation and overview of the topic, and subsequent time will be devoted to a hands-on experience. The presentation will be given by Martin Klaučo, while the exercises will be organized by Patrik Valábek, PhD student of Dr. Klaučo, with the assistance of Dr. Klaučo.

We encourage the participants to have installed MATLAB version 2022a, 2022b, 2023a. (With higher versions we might experience some issues). Furthermore, following set of toolboxes will help with tasks during the hands-on session:

1. `tbxManager` (<https://www.tbxmanager.com/>)
2. YALMIP (installed via the command: `tbxmanager install yalmip`)

3. (optional) MPT3 (installed via the command: `tbxmanager install mpt mptdoc cddmex fourier glpk mex hysdel lcp yalmip sedumi espresso`)
4. MATLAB toolboxes: Statistics and Machine Learning Toolbox, Deep Learning Toolbox, Control Toolbox, Optimization Toolbox