

**Module Description, available in: EN***Model predictive control***General Information**

## Number of ECTS Credits

3

## Module code

TSM\_PredContr

## Valid for academic year

2026-27

## Last modification

2024-10-08

## Coordinator of the module

Konrad Stadler (ZHAW, stdl@zhaw.ch)

## Explanations regarding the language definitions for each location:

- Instruction is given in the language specified for each location and module execution.
- Documentation is available in the language(s) listed for each location and module execution. If the documentation is in multiple languages, the percentage distributed is indicated (100% = all documentation provided).
- The examination, including both questions and answers, is provided entirely (100%) in the language(s) specified for each location and module execution. The exams are on-site.

	Lausanne	Lugano	Zurich
<b>Instruction</b>			X E 100%
<b>Documentation</b>			X E 100%
<b>Examination</b>			X E 100%

## Module Category

TSM Technical scientific module

## Lessons

2 lecture periods and 1 tutorial period per week

**Entry level competences**

## Prerequisites, previous knowledge

- Linear Algebra
- Differential equations
- Basic feedback control and dynamic systems
- Basic programming skills in Matlab or Python or equivalent
- General affinity to mathematics(!)

## Brief course description of module objectives and content

Model Predictive Control (MPC) is an optimisation-based approach to control systems and processes. The general mathematical formulation of MPC allows it to be applied to a broad range of systems and considers system constraints intrinsically. The advances in optimisation methods and available computational power have made MPC a valuable alternative to classical control approaches also for fast dynamic systems. Today, MPC applications can be found from the original chemical process control systems to the control of frequency converters with sampling periods down to a few microseconds.

This module focuses on introducing MPC from the theoretical basics to the use of tool kits to support the implementation and generation of working code. As the classical frequency domain control methods are not considered here, this module does not need in-depth knowledge of control systems. A general affinity to mathematics and programming skills are beneficial.

## Aims, content, methods

### Learning objectives and competencies to be acquired

The student is able to

- formulate an optimisation problem and solve it with appropriate tool kits
- formulate model predictive control problems
- apply MPC concepts to real world systems and generate executable code which runs on their control systems

### Module content with weighting of different components

Basic concepts ( 3W)

- Introduction to state space models in continuous and discrete time
- Introduction to optimisation (linear quadratic programs) using tool kits like YALMIP
- Introduction to optimisation with constraints

Basic MPC (3W)

- Linear MPC problem formulation
- Receding horizon concepts
- Limits of MPC

MPC Extensions and examples (5W)

- Reference tracking
- Error free tracking
- Nonlinear optimisation and MPC with nonlinear models
- Buck converter control (explicit MPC) -- optional
- Energy management (scheduling) -- optional

Real-time implementation(3W)

- From problem to code using tool kits like ACADO

### Teaching and learning methods

Lectures with homework assignments which are a mix of theoretical exercises and programming assignments.

### Literature

Comprehensive lecture notes are available.

## Assessment

### Additional performance assessment during the semester

The module does not contain an additional performance assessment during the semester

### Basic principle for exams

**As a rule, all standard final exams are conducted in written form. For resit exams, lecturers will communicate the exam format (written/oral) together with the exam schedule.**

### Standard final exam for a module and written resit exam

Kind of exam

Written exam

**Duration of exam**

120 minutes

**Permissible aids**

*Aids permitted as specified below:*

**Permissible electronic aids**

Personal PC with Matlab/Simulink

**Other permissible aids**

Open book

**Exception: In case of an electronic Moodle exam, adjustments to the permissible aids may occur. Lecturers will announce the final permissible aids prior to the exam session.**

**Special case: Resit exam as oral exam**

**Kind of exam**

Oral exam

**Duration of exam**

30 minutes

**Permissible aids**

*Aids permitted as specified below:*

**Permissible electronic aids**

Personal PC with Matlab/Simulink

**Other permissible aids**

Open book