

Course Topic: *Optimal and Model Predictive Controls*

Outline:

Dynamic optimization is a powerful tool for a large variety of engineering problems dealing with complex dynamic systems. Methods of optimal control and model predictive control (MPC) are essential means to realize dynamic optimization. These methods adjust system inputs such that the system performance is optimized over a finite time horizon, using available information from a dynamic model of a system. The area of advanced MPC is an active research area and the application of MPC is dramatically increasing particularly with the advent of fast MPC techniques. The MPC techniques have been utilized in various industries like process control, oil refineries, automotive, building, and power systems. This course includes introduction to optimal and model predictive controls. In particular the following topics will be covered:

- Optimality conditions, Polyhedra
- Linear programming (LP), quadratic programming (QP)
- Optimal control (general structure, solution infinite time, solution preceding horizon, $1/\infty$ norm optimal control)
- Preceding horizon control
- Robust optimal control.

The evaluation of this course is done by a combination of student presentations, assignments, and final project with the mark distribution outlined in Table A.

Table A: Project/Course Description (3 credits)

Item	Section	Description	Deliverable	Final grade contribution
1	Presentations	Reading course materials and delivering presentations to reflect the understanding gained. Depending on the number of students registered in the class, each student might need to deliver 5-6 talks during the semester.	Classroom Presentations	30%
2	Homework	A minimum of 5 assignments on the topic of MPC theory and its applications	Report	20%
3	Project	Application of MPC to a challenging engineering research topic	Report + Simulation model + Results	50%

Notes:

- Frequency of sessions/meetings: twice per week
- The course instructor needs to interview each student before taking this course to ensure the student has required prior background.