



# FRTN15 PREDICTIVE CONTROL 2020

Welcome to the course *FRTN15 Predictive Control* given by the Department of Automatic Control, Lund University (WWW address <http://www.control.lth.se>).

## Personnel

The lectures are given by Rolf Johansson (Rolf.Johansson@control.lth.se, tel. 046-222 8791, office M:5147; Office hour M16.00-17.00). Problem solving sessions, laboratory and project supervision are given by Marcus Greiff (tel. 076 32 21 49, Marcus.Greiff@control.lth.se, Office hour W 13-14, M:2156), and Julian Salt (tel. 046-2221570, Julian.Salt\_Ducaju@control.lth.se, Office hour F13-14, M:2427).

News are available on [www.control.lth.se/course/FRTN15](http://www.control.lth.se/course/FRTN15).

## Prerequisites

Automatic Control (FRT 010) & Some background in discrete-time signals and systems.

## Course Material

- Lecture notes: *Predictive and Adaptive Control* (R. Johansson), KFS, Lund, 2020;
- Lab manuals, exercises and solutions are available on the web site [www.control.lth.se](http://www.control.lth.se).

## Lectures

Lectures will be held in M:E or M:B on Tuesdays 13.15–15.00 or 15.15-17.00; Thursdays 13.15–15.00 or 15.15-17.00.

W.	Date	N <sup>o</sup>	Contents
4	21/1	L1	Introduction. Signals & Systems. Real-time Parameter Estimation. <b>(M:E)</b>
	23/1	L2	Automatic Tuning, Gain Scheduling, Auto-calibration. <b>(M:B)</b>
5	28/1	L3	ARMAX models. Pole Assignment. Model matching. Optimal Control. <b>(M:E)</b>
	30/1	L4	Pole Assignment. Model Matching. Disturbance Models. <b>(M:B)</b>
6	4/2	L5	Optimal Prediction. Optimal Predictive Control. The Kalman filter. <b>(M:E)</b>
	6/2	L6	Adaptive Control. <b>(M:B)</b>
7	11/2	L7	Adaptive Control. <b>(M:E)</b>
	13/2	L8	Model Predictive Control. <b>(M:B)</b>
8	18/2	L9	Iterative Learning Control (ILC). Iterative Feedback Tuning (IFT). <b>(M:E)</b>
	20/2	L10	Model Predictive Control. <b>(M:E)</b>
9	25/2	L11	Stability: Lyapunov theory. <b>(M:E)</b>
	27/2	L12	Input-Output Stability. Passivity. <b>(M:B)</b>
10	3/3	L13	Stochastic Adaptive Control. <b>(M:E)</b>
	5/3	L14	Implementation. Applications. <b>(M:E)</b>

## Problem Solving Sessions

Problem solving sessions are given on F10-12 in E:1147.

W.	Date	N <sup>o</sup>	Contents
4	29/1	E 1	Simulation of adaptive systems.

**Notice simulation sessions in Lab C on Jan 29 at 10.15-12 or 13.15-15. SIGN UP!**

5	31/1	E 2	Real-Time Parameter Estimation.
6	7/2	E 3	Optimal Prediction. Optimal estimation. Kalman filter.
7	14/2	E 4	Adaptive Control
8	21/2	E 5	Model Predictive Control
9	28/2	E 6	Iterative Learning Control (ILC).
10	6/3	E 7	Stability. Robustness.

## Interaction

Use office hours, hand-ins, tutorials and lectures for interaction with the instructors.

## Computer Simulations

Computer simulation is an excellent way to explore predictive systems for development of insight and ideas for analysis. Simulation is also required for the problems you have to hand in and for several projects. An introduction to computer simulation is given in Exercise E1.

## Labs

Lab 1-3 are to be held in Lab B in the M building (M-huset). Sign up on the FRTN15 home page no later than one day before the first session.

Lab	Time	Contents	Responsible	Phone	Place
Lab PR1	w.6	Autotuning	Marcus Greiff	0766 322149	Lab A
Lab PR2	w.8	Adaptive Control	Marcus Greiff	0766 322149	Lab B
Lab PR3	w.9	Predictive Control	Julian Salt	2221570	Lab C

## Hand-ins and Project

There will be three home-work problems that you have to solve and hand in during weeks 6, 7 and 8.

HW	Time	Contents	Responsible	Phone	Place
HW1	w.6	Signals and Systems	M. Greiff	0766 322149	M:2156
HW2	w.7	Adaptive Control	M. Greiff	076 322149	M:2156
HW3	w.8	Model Predictive Control	J. Salt	2221570	M:2427

The projects will be done in small groups or individually. A list of projects will be handed out. You should sign up for a project no later than Friday, Feb 28. The project should be presented on Wednesday, April 29, at 10-12 in the seminar room M:2112B.

## Examination

The examination will be of a problem solving type. It is to be held on Tuesday, March 17, 14.00–19.00 in MA:10A-B. You may use the lecture notes and any textbook at the examination.