

FRTN10 Multivariable Control, fall 2018

Administration

Course responsible is Anton Cervin (anton@control.lth.se, 046-222 32 70, M:5142). Course administrator is Mika Nishimura (mika@control.lth.se, 046-222 87 85, M:5141). Their offices are on the 5th floor of the M building.

Prerequisites

FRT010 Automatic Control, Basic Course or FRTN25 Automatic Process Control is required prior knowledge. It is assumed that you have taken the basic courses in mathematics, including linear algebra and calculus in several variables, and preferably also a course in systems & transforms or similar.

Course material

All course material is available in English. Lecture slides, lecture notes, exercise problems, and laboratory assignments are provided on the **course homepage**:

<http://www.control.lth.se/course/FRTN10>

Optional reading is provided in Glad & Ljung: *Control Theory: Multivariable and Nonlinear Methods*, Taylor & Francis (available as e-book through Lund University Libraries)

Lectures

The lectures (30 hours in total) are given by Anton Cervin on Mondays, Tuesdays, and Thursdays. See the LTH schedule generator for details.

Exercise sessions

The exercise sessions (28 hours in total) are supervised by Hamed Sedaghi, Martin Heyden and Martin Morin. They are arranged in two groups (free choice):

Group	Times	Room
1	Wednesdays 10–12, Fridays 10–12	M:M1 or Lab A
2	Wednesdays 13–15, Fridays 13–15	M:M1 or Lab A

The five computer exercises are held in the course lab of Automatic Control LTH, located on the ground floor in the southern part of the M-building. You can also do most of the computer exercises on your own computer if you have Matlab with Control System Toolbox installed.

Laboratory experiments

The three laboratory sessions (12 hours in total) are mandatory. A link to the booking system (SAM) will be posted on the course homepage. You must sign up before the first session starts. Before each session there are pre-lab assignments that must be completed. No reports are required afterwards.

Lab	Weeks	Booking opens	Room	Responsible	Process
1	38–39	Sep 6	Lab C	Hamed Sedaghi	Flexible linear servo
2	39–40	Sep 17	Lab C	Martin Heyden	Quadruple tank
3	41–42	Sep 27	Lab B	Martin Morin	MinSeg

Exam

The exam is given on Saturday October 27 at 08:00–13:00. Retake exams are offered in April and August, 2019. Lecture slide handouts (with markings/notes) are allowed on the exam. You may also bring *Automatic Control—Collection of Formulae*, standard mathematical tables (TEFYMA), and a pocket calculator.

Weekly plan, fall 2018

<i>Week</i>	<i>Date</i>	<i>Content</i>	<i>Glad & Ljung</i>
36	Sep 3	L1: Introduction	1.1–1.5
	Sep 4	L2: Stability and robustness	1.6, 2.1–2.5, 3.1, 3.4–3.5
	Sep 5	E1: Control basics	
	Sep 6	L3: Specifications and disturbance models	5.1–5.6, 6.1–6.3
	Sep 7	E2: System representations and stability	
37	Sep 10	L4: Control synthesis in frequency domain	6.4–6.6 8.1–8.2
	Sep 12	E3: Disturbance models and robustness	
	Sep 13	L5: Case study: DVD player	—
	Sep 14	E4: Matlab, loop shaping, preparations for Lab 1	
38	Sep 18	L6: Controllability/observability, multivariable poles/zeros	3.2–3.3, 3.5–3.6
	Sep 19	E5: Controllability/observability, poles & zeros, minimal realizations	
	Sep 20	L7: Fundamental limitations	7.2–7.9
	Sep 21	E6: Fundamental limitations	
38–39	<i>LAB SESSION 1: Loop shaping for a flexible linear servo</i>		
39	Sep 25	L8: Decentralized control	8.3
	Sep 26	E7: Decentralized control, preparations for Lab 2	
	Sep 27	L9: Linear-quadratic control	—
	Sep 28	E8: Linear-quadratic control	
39–40	<i>LAB SESSION 2: Decentralized control of quadruple tank</i>		
40	Oct 2	L10: Kalman filtering	5.7
	Oct 3	E9: Kalman filtering	
	Oct 4	L11: LQG control	9.1–9.4
	Oct 5	E10: LQG control, preparations for Lab 3	
41	Oct 8	L12: Youla parametrization, internal model control	8.4
	Oct 10	E11: Youla parametrization, internal model control	
	Oct 11	L13: Synthesis by convex optimization	—
	Oct 12	E12: Synthesis by convex optimization	
41–42	<i>LAB SESSION 3: LQG control of the MinSeg</i>		
42	Oct 16	L14: Controller simplification	3.6
	Oct 17	E13: Controller simplification	
	Oct 18	L15: Course review	
	Oct 19	E14: Old exam	
43	Oct 27	EXAM	