Multivariable Control, FRTN10, autumn 2012

Administration

Lecturer and responsible for the course is professor Anders Rantzer (046-222 87 78). Course administrator is Lizette Borgeram (046-222 87 85). Their offices are on the 5th floor of the Mechanical Engineering building, respectively.

Prerequisites

Recommended courses are Mathematics, Basic Course (FMA012), Complex and Linear Analysis (FMA030 or FMA035), Automatic Control, Basic Course (FRT010).

Course material

All course material is available in English. Most lectures are covered by the following book sold by KFS AB:

Torkel Glad and Lennart Ljung (2003), *Reglerteori — Flervariabla och olinjära metoder* (2nd ed.), Studentlitteratur, ISBN 9789144030036.
English edition: Torkel Glad and Lennart Ljung (2000), *Control Theory — Multivariable and Nonlinear Methods*, Taylor and Frances, ISBN 0748408789 (paperback)

Notes for the remaining lectures as well as excercises and laboratory assignments are provided on the course home page

`http://www.control.lth.se/Education/EngineeringProgram/FRTN10.html`

Lectures

The lectures (30 hours) are given by Anders Rantzer as follows:

Mondays Sep 3, 10, 24 and Oct 1, 8, 15	8.15–10.00 in M:E
Wednesdays Sep 5, 12, 26 and Oct 3, 10	13.15–15.00 in M:E
Thursdays Sep 20 and Sep 27	8.15–10.00 in M:E
Fridays Sep 7 and Sep 14	13.15–15.00 in M:B

Exercise sessions

There are two exercise sessions each week and we have planned for two groups:

Group 1	Mondays 13–15	Thursdays 13–15	lab B
Group 2	Mondays 15–17	Thursdays 15–17	lab B

The teaching assistants are Andreas Stolt, Jonas Dürango and Ola Johnsson. All sessions are held in lab B of Automatic Control LTH. The lab is located on the ground floor in the south-west part of the Mechanical Engineering building.

Laboratory experiments

The three laboratory experiments are mandatory and are given in connection to the different parts of the course. Booking lists where you need to sign up are posted on the course home page. Before the lab sessions some home assignments have to be completed. No reports are required after the labs.

Lab	*Week*	*Booking*	*Room*	*Responsible*	*Phone*	*Content*
1	39	Sept 10	Lab C	Andreas Stolt	222 9745	Flex-servo
2	41	Sept 24	Lab B	Jonas Dürango	222 8760	Quad-tank
3	42	Oct 1	Lab B	Ola Johnsson	222 8760	Crane

Exam

The exam is given on Wednesday Oct 24. A second occasion is on January 9, 2013. Lecture slides and the text book are allowed on the exam, but no exercise materials or extra hand-written notes.

Weekly plan, fall 2012

Week	*Date*		*Content*	*Relevant book sections*
36	Sep 3	**L1:**	**Introduction**	sections 1.1-1.5
		E1:	Control in Matlab	
	Sep 5	**L2:**	**System representations and stability**	sections 1.6, 2.1-2.5, 3.1, 3.4, 3.5
	Sep 6	E2:	System representations and stability	
	Sep 7	**L3:**	**Disturbance models and robustness**	sections 5.1-5.6, 6.1-6.3
37	Sep 10	**L4:**	**Control synthesis in frequency domain**	sections 6.4-6.6 8.1-8.2
		E3:	Disturbance models and robustness	
	Sep 12	**L5:**	**Case study**	
	Sep 13	E4:	Loop shaping. Prepare lab. 1	
	Sep 14	**L6:**	**Multivariable zeros, singular values, controllability/observability**	sections 3.2-3.3, 3.5-3.6
38	Sep 17	E5:	Controllability/observability, multivariable zeros	
	Sep 20	**L7:**	**Fundamental limitations**	sections 7.2-7.9
		E6:	Fundamental limitations	
39	*LAB SESSION 1: Loop shaping for resonant system*			
39	Sep 24	**L8:**	**Decentralized control**	sections 8.3, 8.5
		E7:	Controller structures, Prepare lab. 2	
	Sep 26	**L9:**	**Linear quadratic optimal control**	section 9.1-9.4
	Sep 27	**L10:**	**Optimal observer based feedback**	section 5.7
		E8:	Linear quadratic optimal control	
40	Oct 1	**L11:**	**More on LQG**	section 10.2
		E9:	Optimal Kalman filtering	
	Oct 3	**L12:**	**Youla parametrization, dead-time compensation**	section 8.4
	Oct 4	E10:	LQG control. Prepare lab. 3	
41	*LAB SESSION 2: Multivariable tank process*			
41	Oct 8	**L13:**	**Synthesis by convex optimization**	handout
		E11:	Youla parametrization, dead-time compensation	
	Oct 10	**L14:**	**Controller simplification**	section 3.6
	Oct 11	E12:	Synthesis by convex optimization.	
42	*LAB SESSION 3: Crane with rotating load*			
42	Oct 15	**L15:**	**Overview of the course**	
		E13:	Controller simplification	
	Oct 18	E14:	Old exam	
43	Oct 24		EXAMINATION	