



FRTF01 Physiological Models and Computation

Welcome to the course *FRTF01 Physiological Models and Computation* given by the Department of Automatic Control, Lund University (WWW-address www.control.lth.se).

Personnel & Instructors

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 and labs are given by Martin Heyden (tel. 046-222 4287, Martin.Heyden@control.lth.se, Office hour M 11-12 (except Nov 13), F 13-14 M:2160A).

News are available on www.control.lth.se/course/FRTF01.

Prerequisites

FMAA01 Calculus, FMA420 Linear Algebra, TEK015 Physiology, ETI265 Signal Processing

Course Material

- R. Johansson, Physiological Cybernetics, Lund University, Dept. Automatic Control, Lund, Sweden, 2017 (Lecture notes distributed at lectures).
- Visit web site www.control.lth.se to download home-work assignments, exercises and solutions.

Alternative reading

- C. Cobelli & E. Carson, *Introduction to Modeling in Physiology and Medicine*, Academic Press, Amsterdam, 2008;

Lectures

Lectures will be held in M:B or M:E on Tuesdays 13.15–15.00, Thursdays 10.15–12.00, Thursday 8.15-12.00, and Monday 13.15–15.00, Dec 11 according to the schedule:

W.	Date	Nº	Contents
44	31/10	L1	Introduction. Physiological Complexity. (M:B)
	2/11	L2	Modeling in Physiology. (M:E)
45	7/11	L3	Control in Physiological Systems.(M:E)
	9/11	L4	Physiological Feedback, Adaptation, Learning (Pupil Dynamics). (M:E)
46	14/11	L5	Pharmacokinetics & Tracers. (M:E)
	16/11	L6	Metabolism, Glucose & Insulin Dynamics. (M:B)
47	21/11	L7	Biomechanics: Muscle Models, Postural Control, Gait.(M:E)
	23/11	L8	Electrophysiology. The Hodgkin-Huxley Model.(M:E)
48	30/11	L9	Blood Flow Control, Temperature Control, Concentration & pH Control. (M:E)
49	5/12		Project Presentation Seminar. (M:B)
50	11/12	L10	System Identification. Measurements & Data-based modeling. (M:E)

Problem Solving Sessions

Problem solving sessions are given on alternating days each week in M:INA3-4.

W.	Date	N°	Contents
44	31/10	E1	Introduction to computation and simulation in Matlab
	2/11	E2	Biochemical Reactions: Equilibrium, Steady state & Control
45	7/11	E3	Compartment models and simulation in Simulink
	9/11	E4	Linear systems and linearization
46	14/11	E5	Stability of linear systems & Pharmacokinetics
	16/11	E6	Feedback in linear systems & Tracer kinetics
47	21/11	E7	Metabolism & Glucose and insulin kinetics
	23/12	E8	State feedback & Biomechanics and Posture Control
48	28/11	E9	The Hodgkin-Huxley Model
	30/11	E10	Blood Flow Control & Heart-rate dynamics
50	12/12	E11	State estimation & System Identification.

Interaction

Use office hours, home-work assignments, tutorials and lectures for interaction with the instructors.

Computer Simulations

Computer simulation is an excellent way to explore physiological 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 #1.

Home-Work Assignments

There will be four home-work problems that you have to solve and hand in during course weeks 3, 4, 5, 6 (calender weeks 46, 47, 48 and 49) with deadlines as follows:

HW	Time	Contents	Responsible	Phone	Place
HW1	w.46—16/11	Enzyme Dynamics	M. Heyden	222 4287	M:2160A
HW2	w.47—23/11	Pupil Dynamics	M. Heyden	222 4287	M:2160A
HW3	w.48—30/11	Glucose & Insulin Dynamics	M. Heyden	222 4287	M:2160A
HW4	w.49—7/12	The Hodgkin-Huxley Model	M. Heyden	222 4287	M:2160A

You may undertake the assignments and send in your solutions in groups of two. Send your solution to <FRTF01@list.control.lth.se>. If you prefer, you may complete HW3-4 in the format of laboratory sessions without requirements on reports.

FRTF01 Project

The projects will be done in small groups or individually. You should sign up for a project no later than Monday, November 13. The project should be presented on Tuesday, December 5, at 13-15 in M:B. Submission of report on December 11.

Examination

The examination will be of a problem solving type. It is to be held on Monday, January 8, 8.00–13.00 in MA:9E, MA:9F. You may use the text book and lecture notes at the examination.