Module Control Systems

Module Name: Control Systems

Module Number		Level Master	Short Name CS
Responsible Lecturers	Prof. Dr. Erhardt Barth Prof. Dr. Georg Schildbach		
Department, Facility	UzL, Institute of Neuro- and Bioinformatics and Institute for Medical Electronics		
Course of Studies	Biomedical Engineering, Master		
Compulsory/elective	Elective	ECTS Credit Points	8
Semester of Studies	1	Semester Hours per Week	8
Length (semesters)	1	Workload (hours)	240
Frequency	WiSe	Presence Hours	100
Teaching Language	English	Self-Study Hours	140
Consideration of Gender and Diversity Issues	☒ Use of gender-neutral language (THL standard) ☐ Target group specific adjustment of didactic methods ☐ Making subject diversity visible (female researchers, cultures etc.)		
Applicability	Biomedical Engineering		
Remarks			

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Module Machine Learning

Course 1: Machine Learning, Lecture and Exercise

Course Number		Short Name	ML
Course Type	Lecture and exercise	Form of Learning	Presence
Mandatory Attendance	X	ECTS Credit Points	4
Participation Limit	None	Semester Hours per Week	3
Group Size (practical training, exercises, …)	None	Workload (hours)	120
Teaching Language	English	Presence Hours	50
Study Achievements („Studienleistung“, SL)	None	Self-Study Hours	70
SL Length (minutes)	n. a.	SL Grading System	n. a.
Exam Type	Written or oral exam	Exam Language	English
Exam Length (minutes)	90 or 20	Exam Grading System	One-third Grades
Learning Outcomes	Learning from representations Statistical learning theory VC dimension and support vector machines Boosting Deep learning Limits of induction and weighting of the data		
Participation Prerequisites	None		
Contents	Students can explain different learning problems. You can explain different methods of machine learning and apply them exemplarily. You can select and test a suitable learning method for a given problem. You can recognize and explain the limits of automatic data analysis.		
Literature	None		
Remarks	None		

Module Control Systems

Module Model Predictive Control

Course 2: Model Predictive Control, Lecture and Exersice

Course Number		Short Name	MPC
Course Type	Lecture and exercise	Form of Learning	Presence
Mandatory Attendance	X	ECTS Credit Points	4
Participation Limit	n. a.	Semester Hours per Week	4
Group Size (practical training, exercises, …)	n. a.	Workload (hours)	120
Teaching Language	English	Presence Hours	50
Study Achievements („Studienleistung“, SL)	None	Self-Study Hours	70
SL Length (minutes)	n. a.	SL Grading System	n. a.
Exam Type	Written or oral exam graded exercises	**Exam Language**	English
Exam Length (minutes)	90 or 20	**Exam Grading System**	One-third Grades
Learning Outcomes	• LQ optimal control and Kalman filter • Convex optimization • Invariant sets • Theory of model predictive control (MPC) • Numerical optimization methods • Explicit MPC • Practical aspects (robust MPC, offset-free tracking, etc.) • Applications of MPC		
Participation Prerequisites	None		
Contents	• The students have a comprehensive overview of optimal control procedures. • The students have an insight into the basics of numerical optimization. • The students can design model predictive controllers for linear and non-linear systems. • The students master various tools to implement model predictive controllers. • The students can establish system-theoretical properties of MPC controllers. • The students have insights into possible areas of application for model predictive control.		

Module Control Systems

Literature	F. Borrelli, A. Bemporad, M. Morari: *Predictive Control for Linear and Hybrid Systems* - Cambridge University Press, 2017 (ISBN: 978-1107016880)
Remarks	2 weeks block seminar