SAPIENZA
UNIVERSITÀ DI ROMA

INGEGNERIA INFORMATICA, AUTOMATICA E GESTIONALE "ANTONIO RUBERTI"
Control Engineering (LM-25) A.A. 2013/2014

Didactic Offer

First year

Denomination	A.F.	SSD	CFU	Hours	Type Activity	Language
Optional Group: Gruppo OPZIONALE:Lo studente deve scegliere 36 Cfu (l'acquisizione è da intendersi relativa a tutta la durata del corso di studi)	B					
1041424 - NONLINEAR SYSTEMS AND CONTROL	B	ING-INF/04	12	96	AP	ENG
1041425 - SYSTEM IDENTIFICATION AND OPTIMAL CONTROL	B	ING-INF/04	12	96	AP	ENG

Denomination	A.F.	SSD	CFU	Hours	Type Activity	Language
Optional Group: Gruppo OPZIONALE:Lo studente deve scegliere 36 Cfu (l'acquisizione è da intendersi relativa a tutta la durata del corso di studi)	B					
Optional Group: Gruppo OPZIONALE: Lo studente deve scegliere 18 cfu (l'acquisizione è da intendersi relativa a tutta la durata del corso di studi)	C					
1041424 - NONLINEAR SYSTEMS AND CONTROL	B	ING-INF/04	12	96	AP	ENG
1041425 - SYSTEM IDENTIFICATION AND OPTIMAL CONTROL	B	ING-INF/04	12	96	AP	ENG

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Second year

Denomination	A.F.	SSD	CFU	Hours	Type Activity	Language
Optional Group: Gruppo OPZIONALE:Lo studente deve scegliere 36 Cfu (l'acquisizione è da intendersi relativa a tutta la durata del corso di studi)	B					
Optional Group: Gruppo OPZIONALE: Lo studente deve scegliere 18 cfu (l'acquisizione è da intendersi relativa a tutta la durata del corso di studi)	C					
- - A SCELTA DELLO STUDENTE	D		12	96	AP	ENG

Denomination	A.F.	SSD	CFU	Hours	Type Activity	Language
Optional Group: Gruppo OPZIONALE:Lo studente deve scegliere 36 Cfu (l'acquisizione è da intendersi relativa a tutta la durata del corso di studi)	B					
Optional Group: Gruppo OPZIONALE: Lo studente deve scegliere 18 cfu (l'acquisizione è da intendersi relativa a tutta la durata del corso di studi)	C					
AAF1044 - TIROCINIO	F		6	48	I	ENG
AAF1022 - PROVA FINALE	E		24	192	I	ENG

Detail of optional units

Denomination	A.F.	SSD	CFU	Hours	Type Activity	Language
Optional Group: Gruppo OPZIONALE:Lo studente deve scegliere 36 Cfu (l'acquisizione è da intendersi relativa a tutta la durata del corso di studi)						
1041422 - PROCESS AUTOMATION	B	ING-INF/04	6	48	AP	ENG
1023235 - ROBOTICS I	B	ING-INF/04	6	48	AP	ENG
1041453 - ROBUST CONTROL	B	ING-INF/04	6	48	AP	ENG
1041426 - MULTIVARIABLE FEEDBACK CONTROL	B	ING-INF/04	6	48	AP	ENG
1021883 - ROBOTICS II	B	ING-INF/04	6	48	AP	ENG
1041428 - DIGITAL CONTROL SYSTEMS	B	ING-INF/04	6	48	AP	ENG
1041431 - VEHICLE SYSTEM DYNAMICS	B	ING-IND/13	6	48	AP	ENG
1041429 - CONTROL OF COMMUNICATION AND ENERGY NETWORKS	B	ING-INF/04	6	48	AP	ENG
1041454 - DYNAMICS OF ELECTRICAL MACHINES AND DRIVES	B	ING-IND/32	6	48	AP	ENG

Denomination	A.F.	SSD	CFU	Hours	Type Activity	Language
Optional Group: Gruppo OPZIONALE: Lo studente deve scegliere 18 cfu (l'acquisizione è da intendersi relativa a tutta la durata del corso di studi)						
1021883 - ROBOTICS II	C	ING-INF/04	6	48	AP	ENG
1041427 - CONTROL OF AUTONOMOUS MULTI-AGENT SYSTEMS	C	ING-INF/04	6	48	AP	ENG
1041428 - DIGITAL CONTROL SYSTEMS	C	ING-INF/04	6	48	AP	ENG
1041429 - CONTROL OF COMMUNICATION AND ENERGY NETWORKS	C	ING-INF/04	6	48	AP	ENG
1022775 - AUTONOMOUS AND MOBILE ROBOTICS	C	ING-INF/04	6	48	AP	ENG
1022858 - MACHINE LEARNING	C	ING-INF/05	6	48	AP	ENG

Objectives of the course

VEHICLE SYSTEM DYNAMICS

A twofold approach is proposed. On one hand the vehicle is decomposed into sub-systems: (i) propulsion (ii) transmission (iii) thrust and directional components (iv) suspension systems (v) brake systems (vi) guidance and control. On the other hand a general model of the vehicle integrating the considered sub-systems is developed able to predict the different maneuvering ability of the vehicle. The theoretical foundation to approach vehicle dynamics is provided. The objective of this course is twofold: on one hand, the student is provided with the most advanced techniques of analysis in the field of vehicle's dynamics; on the other hand, the student is guided in applying these tools to the design of real devices and in the implementation of these concepts in computer programs.

CONTROL OF COMMUNICATION AND ENERGY NETWORKS

The course aims at applying advanced dynamic control methodologies to networks by adopting a technology-independent abstract approach that copes with the network control problem, leaving out of consideration the specific network technologies. The techniques dealt with in the course are suited for being applied in the network components lying above the virtualization layer, namely the layer which is being introduced in future networks in order to hide the underlying technology-specific network components. Such technology-independent approach can indeed be applied both to communication and energy networks. The students will be able to design network control actions suitable for communication and energy networks.

DYNAMICS OF ELECTRICAL MACHINES AND DRIVES

The course aims to guide the student in the understanding of the principles of operation of electrical drives and their components. The course provides the tools for analyzing the behavior of an electrical drive at steady state and during transients. The course is completed by some design fundamentals. At the end of the course the student will be able to understand the principle of operation and analyze the behavior of an electrical drive both at steady state and during transients. The acquired knowledge will allow to addressing design and control issues of electrical drives.

DIGITAL CONTROL SYSTEMS

The course provides methodologies for the analysis of linear and nonlinear discrete time and sampled dynamics, the design of digital controllers with a major focus on linear systems, and implementation on embedded microcontrollers. The student will be able to compute digital models of given discrete time systems as well as digital discrete time equivalent models of continuous dynamics, to design digital control laws both for discrete and for continuous systems and to use standard microcontrollers for their implementation.

MACHINE LEARNING

The objectives of this course are to present a wide spectrum of Machine Learning methods and algorithms,discuss their properties, convergence criteria and applicability. The course will also present many examples of successful application of Machine Learning algorithms in different application scenarios. The main outcome of the course is the capability of the students of solving a learning problem, by a proper formulation of the problem, a proper choice of the algorithm suitable to solve the problem and the execution of experimental analysis to evaluate the results obtained.

ROBOTICS I

This course provides the basic tools for the kinematic analysis, trajectory planning, and programming of motion tasks for robot manipulators in industrial and service environments. The student will be able to develop kinematic models of robot manipulators, to program motion trajectories realizing the robotic task, and to design simple kinematic or decentralized control laws, verifying performance based on simulation tools.

ROBOTICS II

This course provides tools for advanced kinematics and dynamic analysis of robot manipulators and for the design of feedback control laws for free motion and interaction tasks, including visual servoing. The student will be able to develop dynamic models of robot manipulators, to design control laws for motion and environment interaction tasks, and to verify the robot performance based on simulation tools.

CONTROL OF AUTONOMOUS MULTI-AGENT SYSTEMS

The course presents the basic methods for modeling, analyzing and controlling multi-agent systems, with special emphasis on distributed strategies. Applications will be presented in the control of communication and electrical networks as well as of multi-robot systems. The student will be able to analyze and design architectures, algorithms, and modules for controlling multi-agent systems.

SYSTEM IDENTIFICATION AND OPTIMAL CONTROL

The course illustrates the basic methodologies in estimation, filtering, prediction and optimal control. The student will be able to use the main estimation, filtering, and prediction techniques and to formulate, analyze, and search for solutions of optimization problems of different nature by an appropriate use of optimality conditions, with particular emphasis on optimal control problems.

MULTIVARIABLE FEEDBACK CONTROL

This course provides some basic tools for the analysis and control of multivariable linear systems. The student will be able state and solve control problems in a multi-input multi-output environment, with particular emphasis on robust stability and performance.

NONLINEAR SYSTEMS AND CONTROL

To provide a deeper understanding and to extend system analysis and control design methods proposed in the basic courses on linear systems and control to dynamical systems described by multivariable, nonlinear models that are affine in the input.

PROCESS AUTOMATION

The course aims at providing basic concepts and methodologies related to process automation. In particular, two application environments are considered, namely future communication networks and power systems.