

230668 - ACSA - Advanced Control of Sensors and Actuators

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering
Teaching unit: 710 - EEL - Department of Electronic Engineering
Academic year: 2015
Degree: DEGREE IN ELECTRONIC ENGINEERING (Syllabus 1992). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2009). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: MANEL DOMINGUEZ, VICENTE JIMÉNEZ

Degree competences to which the subject contributes

Transversal:

1. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
2. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Teaching methodology

- Lectures
- Application classes
- Laboratory classes
- Exercises
- Oral presentations

Learning objectives of the subject

Learning objectives of the subject:

The aim of this course is to train students in the design of control strategies of sensors and actuators for system performance optimization. The variables to optimize include sensitivity, reliability, speed, absence of cross-dependence with undesired variables, etc. Application examples will be provided in the field of thermal and inertial sensors.

Learning results of the subject:

- Ability to specify, design and analyze closed loop control strategies for sensors and actuators.
- Ability to design and analyze closed-loop strategies aimed at optimizing sensor speed, sensitivity and/or reliability.
- Ability to design, analyze and implement advanced control techniques for sensor and actuators systems.



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Study load

Total learning time: 125h	Hours large group:	26h	20.80%
	Hours medium group:	0h	0.00%
	Hours small group:	13h	10.40%
	Guided activities:	0h	0.00%
	Self study:	86h	68.80%

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Content

<p>1. Introduction</p>	<p>Learning time: 8h Theory classes: 2h Self study : 6h</p>
<p>Description:</p> <ul style="list-style-type: none"> - Introduction to the design of sensor and actuators - Closed-loop control of sensor variables 	
<p>2. Data conversion</p>	<p>Learning time: 30h Theory classes: 6h Laboratory classes: 4h Self study : 20h</p>
<p>Description:</p> <ul style="list-style-type: none"> - Introduction to data conversion - ADC and DAC characteristics - Noise and dithering - Oversampling - ADC/DAC Topologies - Coupled converter-sensing methods 	
<p>3. Thermal Feedback Sensors</p>	<p>Learning time: 29h Theory classes: 6h Laboratory classes: 3h Self study : 20h</p>
<p>Description:</p> <ul style="list-style-type: none"> - Thermal definitions - Hot wire sensors in open and closed loop - Sensors based on digital feedback - Thermal Sigma-Delta Loops 	

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<p>4. Application of Sigma-Delta modulation to the control of sensors and actuators</p>	<p>Learning time: 29h Theory classes: 6h Laboratory classes: 3h Self study : 20h</p>
<p>Description:</p> <ul style="list-style-type: none"> - Oversampling principles. Noise Transfer function. - First-order sigma-delta: <ul style="list-style-type: none"> - exact solution for the bitstreams. Analysis of the effects of leaky integration. - Existence of limit-cycles of finite number of points in piecewise contrative dynamical systems - Application to thermal sensors: closed-loop control of sensors - Application to inertial sensors - Second-order modulators. Higher order modulator topologies. Multi-stage and Multi-bit S-D modulators. Stability and performance. - Pulsed actuation of MEMS resonators (Pulsed Digital Oscillators). - Gravimetric sensors. - Example of application of sigma-delta modulation: control of dielectric charging in electrostatic MEMS (RF switches, etc.). 	

<p>5. Introduction to compressed sensing</p>	<p>Learning time: 29h Theory classes: 6h Laboratory classes: 3h Self study : 20h</p>
<p>Description:</p> <ul style="list-style-type: none"> - Sampling beyond Nyquist: sparse signals - L1 minimization optimization - Application to A/D conversion. 	

Planning of activities

<p>LABORATORY</p>
<p>Description: Simulation with Matlab or PSPICE of different circuit topologies and control strategies for sensors and actuators</p>
<p>ORAL PRESENTATION</p>
<p>Description: Presentation of a work group.</p>

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Qualification system

Exercises: 66%

Laboratory assessments: 33%

Bibliography

Basic:

Bourdopoulos, G.I. [et al.]. Delta-Sigma modulators: modeling, design and applications [on line]. London: World Scientific Publishing Company, 2003 [Consultation: 28/09/2015]. Available on:
<<http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10255883>>. ISBN 978-1860943690.

Complementary:

Eldar, Y.C.; Kutyniok, G. (ed.). Compressed sensing: theory and applications [on line]. Cambridge: Cambridge University Press, 2012 [Consultation: 28/09/2015]. Available on:
<<http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10578314>>. ISBN 9781139339995.