Statistical Signal Processing 2013/2014

Code: 42845
ECTS Credits: 6

Degree	Type	Year	Semester
4313797 Enginyeria de Telecomunicacions / Telecommunication Engineering	OB	1	1

Contact

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Use of languages

Principal working language: espanyol (spa)

Prerequisites

For students who have been admitted indirectly to the master (e.g. those who must attend complementary courses), they should have already passed the course on "Tratamiento Digital de la Señal" (TDS).

Objectives and Contextualisation

The goal of this course is to introduce advanced techniques in statistical signal processing with applications in the domain of telecommunication systems.

Skills

Enginyeria de Telecomunicacions / Telecommunication Engineering

- Capacity for applying theory of information methods, adaptative modulation and channel coding as well as advanced techniques for digital signal processing in telecommunications and audiovisual systems.
- Capacity for critical reasoning and thought as means for originality in the generation, development and/or application of ideas in a research or professional context.
- Capacity for designing radionavegation, positioning systems and radar systems.
- Capacity to integrate new technologies and systems developed within telecommunications engineering in general and in broader, multidisciplinary contexts such as bioengineering, photovoltaic conversion, nanotechnology, telemedicine.
- Possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas, often in a research context
- Student should possess the learning skills that enable them to continue studying in a way that is largely student led or independent
- Students should know how to apply the knowledge they have acquired and their capacity for problem solving in new or little known fields within wider (or multidisciplinary) contexts related to the area of study
- Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously

Learning outcomes

1. Analyse the implications at system level of the use of statistical signal processing techniques.
2. Apply advanced mathematical methods for the resolution of problems related to statistical signal processing.
3. Capacity for critical reasoning and thought as means for originality in the generation, development and/or application of ideas in a research or professional context.
4. Develop and evaluate signal detection techniques with applications in positioning and radar systems.

5. Develop statistical filtering systems aimed at synchronisation, equalisation and detection in communications receivers
6. Make a statistical classification of signals and random processes of telecommunications systems.
7. Possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas, often in a research context
8. Student should possess the learning skills that enable them to continue studying in a way that is largely student led or independent
9. Students should know how to apply the knowledge they have acquired and their capacity for problem solving in new or little known fields within wider (or multidisciplinary) contexts related to the area of study
10. Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously

Content

Part I. Introduction to statistical signal processing

- Statistical characterization of signals.
- Avanced mathematical tools for signal processing.

Part II. Bayesian filtering theory

- Fundamentals of Bayesian estimation.
- Kalman filtering.

Part III. Detection theory

- Detection of completely characterized signals.
- Detection of partially characterized signals.

Part IV. Applications

- Digital speech processing.
- Digital SAR image processing.

Methodology

Activities at class:

- Theoretical classes: development of the theoretical contents of this course.
- Exercises solved by the instructor with participation of the students.
- Written evaluation tests.

Student self-learning activities:

- Study of the theoretical and practical contents of this course.
- Preparation of exercises and other homework.
- Preparation of the evaluation tests.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Theory classes	39	1.56	1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Type: Supervised			
Appointments	13	0.52	9, 10
Type: Autonomous			
Study	90	3.6	1, 2, 3, 4, 5, 6, 8

Evaluation

The marks in the two exams will lead to the following average mark for the theoretical part of the course:

TheoryMark = (mark Exam1 + mark Exam2) / 2

and based on this result, the final marks for this couse will be computed as follows:

if **TheoryMark >= 4** ---> Final mark = (0.8 x TheoryMark) + (0.2 x Homework)

if **TheoryMark < 4** --> Final mark = Theory mark

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Exam 1	40%	3	0.12	1, 2, 5, 6, 7, 9, 10
Exam 2	40%	3	0.12	1, 2, 3, 4, 5, 6, 7, 9, 10
Exercises and other homework	20%	2	0.08	1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Bibliography

Basic bibliography:

- S. Kay, "Fundamentals of statistical signal processing. Estimation theory", vol. I, Prentice-Hall, 1993.
- S. Kay, "Fundamentals of statistical signal processing. Detection theory", vol. II, Prentice-Hall, 1998.
- M. S. Grewal, A. P. Andrews, "Kalman filtering: theory and practice using Matlab", John Wiley & Sons, 2001.
- Rabiner, L.R., Schafer, R.W. "Theory and applications of digital speech processing". Pearson International Edition, 2011.