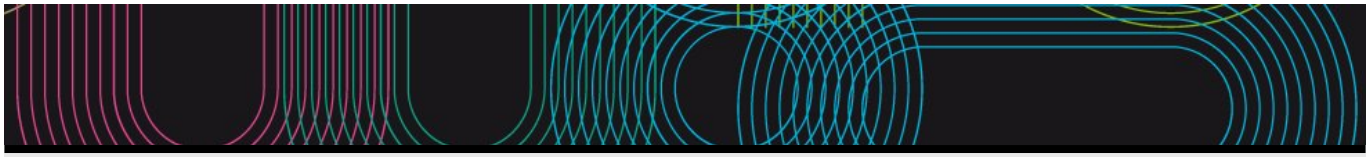
Universidade Vigo

Subject Guide 2017 / 2018



IDENTIFYING DATA				
Statistical Signal Processing				
Subject	Statistical Signal Processing			
Code	V05M145V01303			
Study programme	Telecommunication Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	English			
Department				
Coordinator	López Valcarce, Roberto			
Lecturers	López Valcarce, Roberto			
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General description	Statistical Signal Processing, encompassing both estimation and detection theory, can be found at the core of many decision-making and information-extracting systems, including communications, audio and image processing, biomedicine, radar, and big data systems, just to name a few. In this course an introduction to the basics of estimation and detection theory is provided. Since the course is targeted to electrical engineering students, the focus is on the development of practical estimation and detection algorithms amenable to implementation in digital processing systems.			

Competencies	
Code	
B4	CG4 Capacity for mathematical modeling, calculation and simulation in technological centers and engineering companies, particularly in research, development and innovation tasks in all areas related to Telecommunication Engineering and associated multidisciplinary fields.
B8	CG8 Ability to apply acquired knowledge and to solve problems in new or unfamiliar environments within broader and multidiscipline contexts, being able to integrate knowledge.
C23	CE23/PS3 Ability to apply methods of statistical processing of signal communications systems and audiovisual.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Ability to apply statistical estimation techniques in communications and multimedia systems	C23
Ability to apply statistical detection techniques in communications and multimedia systems	C23
Ability to determine and interpret fundamental limits in estimation and detection problems	B4 C23
Ability to evaluate the performance of estimation and detection techniques, by analytical as well as by Monte Carlo simulation methods	B8 C23

Contents	
Topic	
Part 1: Parameter Estimation	- The statistical estimation problem. Performance metrics: bias, variance, MSE. Minimum Variance Unbiased Estimator (MVUE). - Fisher Information and Cramer-Rao bound. Slepian-Bangs formula. - Best Linear Unbiased Estimator (BLUE) and Maximum Likelihood Estimator (MLE): definition, properties, and examples. - LMMSE estimation and Kalman filtering
Part 2: Detection Theory	- Hypothesis tests: types. Performance metrics: false positives and false negatives. ROC curves. - Neyman-Pearson theorem: likelihood ratio. - Detection under the Bayesian philosophy: probability of error, risk, optimum detector. - Examples: deterministic and random signals

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	21	23	44
Practice in computer rooms	7	0	7
Autonomous troubleshooting and / or exercises	0	28	28
Autonomous practices through ICT	0	25	25
Jobs and projects	0	21	21
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Master Session	Presentation of main topics, possibly with audiovisual aids. Skills involved: CG4, CG8
Practice in computer rooms	Computer-based simulation in the lab of statistical signal processing applications to communications and multimedia, via Monte Carlo methods. Performance analysis. Skilss involved: CG8, CE23
Autonomous troubleshooting and / or exercises	Students will be given a series of short homework assignments throughout the course that they should turn in by the set deadline. Skills involved: CG4, CG8, CE23
Autonomous practices through ICT	Computer-based simulation of statistical signal processing applications to communications and multimedia, via Monte Carlo methods. Performance analysis. Skills involved: CG8, C23

Personalized attention	
Methodologies	**Description**
Master Session	Student aid will be provided during office hours as well as on-line (email).
Practice in computer rooms	Student aid will be provided during lab hours and office hours, as well as on-line (email).

Assessment				
	Description	Qualification	Training and Learning Results	
Autonomous troubleshooting and / or exercises	Students will be given a series of short homework assignments throughout the course that they should turn in by the set deadline.	40	B4 B8	C23
Jobs and projects	Development of an individual final project in which students will apply the acquired tools and techniques to a practical problem.	60	B4 B8	C23

Other comments on the Evaluation

Students may choose one of the following two assessment options:

1) Continuous assessment: Final grade will consist of:

- final project (up to 6 points)

- homework assignments (up to 4 points)

A minimum grade of 30% in the final project is required in order to pass the course. Otherwise, the overall grade will directly be that of the final project.

Homework grades from the first call will be kept for the second call, in which the student will be allowed to resubmit the final project.

2) One-shot assessment: The final grade is the one achieved in the comprehensive test, for both the first and second call.

Any kind of plagiarism will result in automatically failing the course.

Sources of information

Basic Bibliography

S. M. Kay, **Fundamentals of Statistical Signal Processing, vol. I: Estimation Theory**, 1,

S. M. Kay, **Fundamentals of Statistical Signal Processing, vol. II: Detection Theory**, 1,

Complementary Bibliography

L. L. Scharf, **Statistical signal processing: detection, estimation and time series analysis**, 1,

T. K. Moon, W. C. Stirling, **Mathematical Methods and Algorithms for Signal Processing**, 1,

IEEE, **http://ieeexplore.ieee.org/**,

Recommendations

Subjects that are recommended to be taken simultaneously

Communication Advanced Systems/V05M145V01302

Subjects that it is recommended to have taken before

Advanced Digital Communications/V05M145V01204
Signal Processing in Communications/V05M145V01102