Last update: 06-05-2019

230685 - ASPTA - Advanced Signal Processing: Tools and Applications

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 739 - TSC - Department of Signal Theory and Communications

Academic year: 2019

Degree: MASTER'S DEGREE IN ADVANCED TELECOMMUNICATION TECHNOLOGIES (Syllabus 2019). (Teaching unit Optional)
MASTER'S DEGREE IN TELECOMMUNICATIONS ENGINEERING (Syllabus 2013). (Teaching unit Optional)

ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: Rey Micolau, Francesc

Others: Villares Piera, Nemesio Javier
Pascual Iserte, Antonio
Morros Rubio, Josep Ramon

Prior skills

The student must have skills on mathematics, and knowledge of statistics and basic signal processing techniques.

Requirements

The student must have skills on mathematics, and knowledge of statistics and basic signal processing techniques.

Degree competences to which the subject contributes

Specific:

CE1. Ability to apply information theory methods, adaptive modulation and channel coding, as well as advanced techniques of digital signal processing to communication and audiovisual systems.

Transversal:

CT4. 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.

CT5. 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
Individual work (distance)
Exercises
Oral presentations
Other activities (project)
Extended answer test (Final Exam)

Learning objectives of the subject

Learning objectives of the subject:
The course introduces the student to important statistical signal processing techniques and their application in digital

230685 - ASPTA - Advanced Signal Processing: Tools and Applications

communications and speech and image processing. The course is organized into three modules covering the main aspects of the estimation, tracking and detection theories and their application to practical problems. For every module, classes are divided into classroom lectures, exercises and presentation of illustrative applications.

Learning results of the subject:
(i) To achieve a solid background on Statistical Signal Processing (estimation theory, detection theory and adaptive filtering) from the theoretical and applied perspectives.
(ii) Ability to design optimal and suboptimal estimators following classical and Bayesian approaches, as well as to evaluate the theoretical Cramér-Rao Lower Bound.
(iii) Ability to solve problems in which the unknown parameter (to estimate) evolves in time according to a dynamic or state model requiring the design of adaptive filters to track its value.
(iv) Ability to formulate simple binary and multiple hypothesis testing problems including the realistic situation in which there are some unknowns in the signal model (the pdf associated to the different hypotheses is not completely known).
(v) Gain experience reading and understanding published journal and conference articles related with the topic.

Study load

Total learning time: 125h	Hours large group:	39h	31.20%
	Self study:	86h	68.80%

Last update: 06-05-2019

230685 - ASPTA - Advanced Signal Processing: Tools and Applications

Content

Estimation Theory and Applications

Learning time: 43h 30m

Theory classes: 13h 30m
Self study : 30h

Description:
1.1 Minimum Variance Estimation and Crámer-Rao Lower Bound
1.2. Maximum Likelihood Estimation
1.3. Bayesian Estimation
1.4. Applications in communications, speech processing and/or image processing

Adaptive Filtering and Tracking

Learning time: 31h

Theory classes: 1h
Self study : 30h

Description:
2.1. Recursive Least Squares
2.2. Kalman filter
2.3. Sequential Monte Carlo Methods
2.4. Applications in communications, speech processing and/or image processing

Detection Theory and Applications

Learning time: 38h

Theory classes: 12h
Self study : 26h

Description:
3.1. Detection theory when the pdf is known
3.2. Detection of deterministic signals
3.3. Detection of random signals
3.4. Detection theory when the pdf is not completely known
3.5. Applications in communications, speech and/or image processing

Qualification system

Final examination: 50%
Individual assessments: 50%

Last update: 06-05-2019

230685 - ASPTA - Advanced Signal Processing: Tools and Applications

Regulations for carrying out activities

Exercises:
Each chapter proposes a set of exercises to strengthen the theoretical knowledge. The exercises will be solved in class or proposed as individual work.

Individual project:
Students will develop a supervised project consisting in programming, simulating and evaluating some of the signal processing algorithms presented in the course using some language as C or MATLAB.

Oral presentation:
The project described above will be presented in class. This project (development and presentation) constitutes the 50% of the qualification.

Extended answer test (Final examination):
Final examination (written examination). The exam constitutes the 50% of the qualification.

Bibliography

Basic:

Kay, S.M. Fundamentals of statistical signal processing, v.1, Estimation theory. Englewood Cliffs: Prentice-Hall, cop. 1993-2013. ISBN 0130422681.

Kay, S. M. Fundamentals of statistical signal processing, v.2, Detection theory. Englewood Cliffs: Prentice-Hall, cop. 1993-2013. ISBN 013504135X.

Anderson, B. D. O; Moore, J. B. Optimal filtering. Englewood Cliffs, NJ: Prentice-Hall, 1979. ISBN 0136381227.

Haykin, S. S. Adaptive filter theory. 4th ed. Upper Saddle River: Prentice Hall, cop. 2002. ISBN 0130901261.

Huang, X.; Acero, A.; Hon, H-W. Spoken language processing: a guide to theory, algorithm and system development. Upper Saddle River: Prentice Hall, 2001. ISBN 0130226165.

Complementary:

Scharf, L.L. Statistical signal processing : detection, estimation, and time series analysis. Readig, MA: Addison-Wesley, 1990. ISBN 0201190389.

Others resources:

Hyperlink

Slides and Exercices

Resource in Atenea