Last update: 19-07-2019

270216 - IPA - Introduction to Audiovisual Processing

Coordinating unit: 270 - FIB - Barcelona School of Informatics

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

Academic year: 2019

Degree: BACHELOR'S DEGREE IN DATA SCIENCE AND ENGINEERING (Syllabus 2017). (Teaching unit Compulsory)

ECTS credits: 6 Teaching languages: Catalan

Degree competences to which the subject contributes

Basic:

CB5. That the students have developed those learning skills necessary to undertake later studies with a high degree of autonomy

Specific:

CE5. Design and apply techniques of signal processing, choosing between different technological tools, including those of Artificial vision, speech recognition and multimedia data processing.

Generical:

CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.

CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.

CG5. To be able to draw on fundamental knowledge and sound work methodologies acquired during the studies to adapt to the new technological scenarios of the future.

Transversal:

CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

Teaching methodology

The subject is based on classroom theory classes, problems and laboratory. The theory classes follow the program defined in this teaching guide. Within the lectures, the dialogue between professors and students is promoted by proposing exercises and activities to be carried out jointly based on particular aspects of the topic being dealt with. The laboratory classes exemplify the contents developed in the theory classes.

Learning objectives of the subject

1.Know how to characterize stochastic processes
2.Understand and know how to use the most common signal transforms and their application
3.To obtain basic optimal and adaptive filtering background for audiovisual data applications

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Study load

Total learning time: 150h	Theory classes:	45h	30.00%
	Laboratory classes:	15h	10.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

Content

Statistical Signal modelling

Degree competences to which the content contributes:

Description:
Stochastic processes: Definition. Autocorrelation. Stationarity, Ergodicity. Power spectral density. Discrete processes. Process filtering. Estimation theory.

Transforms

Degree competences to which the content contributes:

Description:
Frequency analysis: (1) Discrete Cosinus transform (DCT), (2) Short-time Fourier Transform. Interpretation as a filter bank. Window effect. Reconstruction. Spectrogram. Time-frequency analysis. Multi-resolution analysis: Wavelets. Statistical analysis: (1) Periodogram. Estimation principles. (2) Karhunen-Loeve Transform (KLT). (3) Principal Component Analysis (PCA). (4) Independent Components (ICA). (5) Linear Discrimination (LDA).

Optimal filter and adaptive filter

Degree competences to which the content contributes:

Description:
Types of filters: System identification, equalization, cancellation, prediction and interpolation. Wiener filter. Linear regression and minimum squares. Adaptive filter

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Planning of activities

Unit 1	Hours: 42h 12m Theory classes: 10h 18m Practical classes: 3h 42m Laboratory classes: 2h 18m Guided activities: 2h 18m Self study: 23h 36m

Description:
Theory, exercise and laboratory classes corresponding to Unit 1

Specific objectives:
1

Unit 2	Hours: 63h 30m Theory classes: 15h 24m Practical classes: 5h 36m Laboratory classes: 3h 24m Guided activities: 3h 42m Self study: 35h 24m

Description:
Theory, exercise and laboratory classes corresponding to Unit 2

Specific objectives:
2

Unit 3	Hours: 42h 12m Theory classes: 10h 18m Practical classes: 3h 42m Laboratory classes: 2h 18m Guided activities: 2h 18m Self study: 23h 36m

Description:
Theory, exercise and laboratory classes corresponding to Unit 3

Specific objectives:
3

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Qualification system

The final mark is obtained from the partial marks:

- Mid-term exam: M (25%)
- Final exam: F (60%)
- Laboratory assigments: L (15%)

Mark = max (0.6F+0.25M+0.15L ; 0.85F+0.15L)

In the case of a re-evaluation exam (R), the final mark is

Mark = 0.85R+0,15L

Bibliography

Basic:

Hayes, M.H. Statistical digital signal processing and modeling. John Wiley, 1996. ISBN 0471594318.

Kay, S.M. Fundamentals of statistical signal processing. Prentice-Hall, 1993-2013. ISBN 0130422681.

Papoulis, A.; Pillai, S.U. Probability, random variables, and stochastic processes. 4th ed. McGraw-Hill, 2002. ISBN 0073660116.

Complementary:

Manolakis, D.G.; Ingle, V.K; Kogon, S.M. Statistical and adaptive signal processing: spectral estimation, signal modeling, adaptive filtering, and array processing. Artech House, 2005. ISBN 9781580536103.

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