



UNIVERSITÀ DI PISA

TEORIA DELLA DECISIONE E DELLA STIMA

FULVIO GINI

Academic year

2016/17

Course

INGEGNERIA DELLE
TELECOMUNICAZIONI

Code

552II

Credits

6

Modules	Area	Type	Hours	Teacher(s)
TEORIA DELLA DECISIONE E DELLA STIMA	ING-INF/03	LEZIONI	60	FULVIO GINI

Obiettivi di apprendimento

Conoscenze

This course is on statistical signal processing, at a senior or first-year-graduate level. The goal is to provide the theoretical tools to study advanced topics in communication theory and digital signal processing such as: parameter estimation of a signal embedded in noise, correct retrieval of a signal message from data corrupted by disturbance sources, spectral analysis, parametric modeling, estimation of random processes, with applications to radar and digital communications.

Modalità di verifica delle conoscenze

During the written exam (2 hours), the student is asked to solve four exercises in order to demonstrate the ability to put into practice the basic principles of deterministic and statistical signal theory illustrated throughout the course. During the oral exam, the student will be assessed on his/her ability in discussing the main course contents with competence, critical awareness and propriety of expression.

Methods:

- Final oral exam
- Final written exam

Indicazioni metodologiche

Delivery: face to face

Learning activities:

- attending lectures
- participation in discussions
- individual study
- Bibliography search

Attendance: Advised

Programma (contenuti dell'insegnamento)

GEOMETRICAL REPRESENTATION OF SIGNALS - Projection theorem. Karhunen-Loeve expansion of random processes. ESTIMATION THEORY - Properties of estimators: unbiasedness, efficiency, consistency. Estimation of unknown deterministic parameters: maximum likelihood (ML) method. Estimation of random parameters: the Bayesian approach (Minimum Mean-Square Error and Maximum A Posteriori criteria). Cramér-Rao lower bound. Signal parameter estimation in white Gaussian noise. LINEAR MINIMUM MEAN-SQUARE ESTIMATION - Orthogonality principle: Yule-Walker equations. Innovation process. Filtering, prediction and smoothing. Wiener and Kalman filtering. LINEAR MODELS OF RANDOM PROCESSES – Autoregressive (AR), moving average (MA) and ARMA models. The Levinson-Durbin algorithm. SPECTRAL ANALYSIS – Non parametric direct (periodogram) and indirect (correlogram) methods. Bartlett, Welch and Blackman-Tukey approaches. Parametric estimation based on ARMA models.

Bibliografia e materiale didattico

L. Verrazzani: "La teoria della decisione e della stima nelle applicazioni di telecomunicazione", ETS, Pisa, 1996. Steven M. Kay, Fundamentals of statistical signal processing - Estimation theory, Prentice Hall, 1993. Steven M. Kay, Fundamentals of statistical signal processing - Detection theory, Prentice Hall, 1998 F. Gini: "Esercizi di teoria dei segnali II", ETS, Pisa, 1996

