Politecnico di Torino

Academic Year 2010/11 (first time established in A.Y.2007/08)

01LSHJA

Signal Theory

1st degree and Bachelor-level of the Bologna process in Electronic And Computer Engineering - Vercelli (III FACOLTA' DI INGEGNERIA)

Teacher	Status	SSD	Les	Ex	Lab	Years Stability
Poggiolini Pierluigi	PS	ING-INF/03	9	0	0	2

SSD	CFU	Activities	Area context
ING-INF/03	9	B - Caratterizzanti	Ingegneria delle telecomunicazioni

Objectives of the course

This course aims at providing the student with those theoretical and methodological tools that are essential for the description and the processing of i§signalsi¨, both of the deterministic type and of the stochastic type. This knowledge and such skills will then be applied to the context of data transmission, whose fundamental principles and elementary techniques will be dealt with.

Expected skills

Students will be capable of studying, analyzing and processing i§signalsi¨, both deterministic and stochastic, both in time domain and in frequency domain. They will also be capable of characterizing single-input/single-output linear time-invariant (LTI) systems. They will be able to compute the deterministic system output signal of an LTI system given a deterministic input signal. They will also be able to statistically characterize the stochastic output signals of an LTI system given stochastic input signals. Students will learn the basics of data transmission theory and the simplest data transmission systems. They will be able to study and analyze such systems and compute their performance.

Prerequisites

Students are expected to master the mathematical tools and skills provided to them by the math courses of the first year. Also, they have to be able to manipulate complex numbers with ease. Random variables theory and Fourier/Laplace transforms are also important pre-requisites.

Syllabus

- Time-continuous deterministic signals.
- Geometric representation of signals as elements of a Hilbert space.

- Time-frequency analysis:
a) finite-energy signals: Fourier transform, autocorrelation, cross-correlation, power spectra;
b) periodic signals: Fourier transform; power spectra;
c) signals with finite average power: power spectra and autocorrelation functions.

- Linear time-invariant systems: impulse response; transfer function; input/output laws in time and frequency domain; physically realizable systems and stability constraints.

- Digital signals: the sampling theorem, anti-aliasing filter, reconstruction filters, examples.

- An introduction to stochastic processes (random signals): joint random variables; first and higher-order statistical characterization of random variables; stochastic processes as collections of random variables; stochastic processes as random collections of signal instances; autocorrelation and auto-covariance functions; higher orde r moments; stationary processes; ergodic processes; power spectra of stochastic processes.

'{ Stochastic processes (random signals) as inputs to LTI systems; properties of Gaussian processes; white noise and filtered white noise.

'{ PCM: quantization noise, performance of a uniform quantizer.

'{ Analog transmission: DSB, AM, PM, FM

- Basics of data transmission systems: 2PAM, OOK, M-PAM, M-PSK. Transmitter and receiver structures, error probability, bandwidth.

Laboratories and/or exercises

Problem-solving sessions

Problems involving the theoretical notions imparted during classes will be assigned to students during the classes themselves; the teacher will show how to solve them and provide further problems for the students to practice at home. Problems will try and address real-world applications of the theory learned in class.

Bibliography

Regular classes will cover all the theory of the course. Several problems will be solved in class. As supplementary material, the following books can be consulted by the students.

A.V. Oppenheim, R.W. Schafer, "Discrete-Time Signal Processing", Prentice-Hall, 1989.

A. Papoulis, "Probability, Random Variables and Stochastic Processes", Mc Graw Hill, 1984.

W. Gardner,"Introduction to Random Processes with Applications to Signals and Systems", Mc. Graw Hill, 1990.

Revisions / Exam

No midterms are foreseen. Final exams take place as follows. The students are given a short problem to solve by themselves, with no books available. The allotted time is between half and a one hour. Following, the test is oral and includes a discussion of the problem solution as worked out by the student. Further questions may be asked on any of the topics dealt with in the course.

Programma definitivo per l'A.A.2010/11

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