Master's Department of Engineering Sciences

Name of the unit: Random signals processing

Lecturer: Kieu NGO (kieu.ngo@sorbonne-universite.fr)
Course code: UM4EET12
Student workload: 12h of lectures, 10h of tutorial sessions, 6h of lab sessions@
Credits: 3 ECTS

Specialization tracks:	- **E3A** :	☒ CIMES	☒ Syscom	☒ IPS
	- **AR** :	☐ ROBOT	☒ SI	☐ MeDH
	- **MECA** :	☐ MS2	☐ MF2A	☐ CompMech
		☐ ACOU	☐ EE	☐ EE APP

Semester offered: ☒ S1 ☐ S2 ☐ S3 ☐ S4
Language of instruction: ☒ French ☐ English
Targeted audience: ☒ Engineering Sciences students ☐ Other (specify):
Localization : ☒ PMC Campus ☐ Other (specify):

Course Overview

The objective of this course is to introduce solid bases on the fundamental concepts and tools of random signal processing since most signals of interest in physics and engineering have a random component (notion of noise). After a reminder on the probabilities which is essential for the understanding of the course, we will introduce random variables and random processes. Several tools for the characterization and analysis (mathematical expectation, variance, power spectral density...) as well as the detection, filtering and estimation of random signals will be introduced.
Keywords: Probability, Random signals, Stationnarity, Moments, Ergodicity, Prediction, Power spectral Density

Prerequisites

Students should have previously acquired the following prerequisites to follow this course:

- Basics of signals and systems, notions of probabilities
- Basics of analog and digital electronics
- Basics of deterministic signal processing (usual transforms, spectral analysis, correlation, and convolution)

Intended Learning Outcomes

By the end of this course, students will be able to:

1. Characterizing and analyzing random signals in the time domain as well as in the frequency domain
2. Proposing a linear model of prediction for random signals
3. Determining the characteristics of random signals after filtering
4. Deciding if a specific signal is present or not (simple detection) and in which category a signal belongs (multiple detection)

Indicative Teaching Sequence and Methods

Week	C/TD/TP*	Content	Preparation	Learn. outc.
S1	C1	Basics of probabilities		
S2	C2	Moments of ordrer 1 and order 2		AAV1
S3	C3	Stationnarity		AAV1
S4	TD1	Probability		
S5	C4	Prediction, Intercorrelation		AAV2
S6	TD2	Moments, Stationnarity, Prediction		
S7	ER1			
S8	C5	Ergodicity, Filtering, Spectral analysis		AAV3
S9	TD3	Autocorrelation, ergodicity, Stationnarity		
S10	C6	White noise, Power sepectral density, Detection		AAV3+AAV4
S11	TP1	Anaysis of random signals, Prediction		
S12	TD4	PSD, filtering		
S13	TD5	Filtering, detection		
S14	TP2			

* C/TD/TP respectively corresponds to lectures, tutorials and lab sessions.

Indicative Assessment of Intended Learning Outcomes (1st session)

Week	Individ./group	In-person/remote	Type of exam	Evaluated outcomes	Scale %
S7	Collective	In-person	Written		40 %
S15	Collective	In-person	Written		45 %
S15	Collective	In-person	Practical		15 %

2nde session of exam

Session	Individ./group	In-person/remote	Type of exam	Evaluated outcomes	Scale %
2	Collective	In-person	Written		85 %
1	Collective	In-person	Practical		15 %

Bibliographic references

- Frédéric de Coulon, Théorie et Traitement des signaux, Edition Dunod, 1984
- Hwei Piao Hsu, Signaux et communications, Série Schaum, Édiscience , Dunod, 2004
- Charbit, Eléments de théorie du signal : aspects signaux aléatoires, Ellipses, 1996
- Shaila Dinkar Apte, Random Signal Processing, CRC Press, 2017

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