UNIVERSITY OF PERUGIA_DICA

A.D. 1308 unipg

DIPARTIMENTO DI INGEGNERIA CIVILE E AMBIENTALE

CIVIL AND ENVIRONMENTAL ENGINEERING

DOCTORAL PROGRAM 2022-2023

STOCHASTIC PROCESSES AND EXTREME RARE EVENTS

MODULE 1
MODELING AND SIMULATION OF STOCHASTIC PROCESSES

Instructor

Massimiliano Gioffrè, Ph.D., Associate Professor, UniPG
Chiara Pepi, Ph.D., Assistant Professor, UniPG

Course Description

This module is aimed to provide the fundamentals of modeling and simulation of stochastic processes and fields. The module is organized in four Sections where practical work and lessons in theory are alternated. It covers both introductory and advanced topics in random variables, vectors and functions, including stationary and non-stationary models, Gaussian and non-Gaussian models, Monte Carlo simulation, polynomial chaos. Classroom practical work using programming software is proposed to deepen inside the proposed theory.

Chiara Pepi is Assistant Professor at the Department of Civil and Environmental Engineering of the University of Perugia (DICA). She received her PhD with summa cum laude in Civil Engineering with a dissertation on the suitability of dynamic identification for damage detection in the light of uncertainties on a cable stayed footbridge. She was visiting scholar at the "Institute of Scientific Computing" at TU Braunschweig (Germany) from 2016 to 2018. As a member of DICA Structural Mechanics research group, She collaborated to research projects about the structural performance assessment of confined masonry buildings and about the development of novel bio composite materials for strengthening of masonry structures. She teaches Structural Mechanics and Computational Mechanics. She received the best paper presentation award at AIMETA 2019.

Module Schedule (18 hours, 3 CFU)

April, 13th 2023 - 14:30-16:30
Review of Random variables and vectors. Random vector functions. Stochastic processes. Finite dimensional distributions. Stationary and weakly-stationary stochastic processes. First and second order moments.

April, 14th 2023 - 14:30-16:30
Second moment characterization of stochastic processes. Linear transformation of random variables. Generation of samples of random variables: uniform model, Gaussian model. Hands-on MATLAB numerical examples.

April, 17th 2023 - 10:30-13:30 and 14:30-16:30
Vector stochastic processes. Second moment properties. Second moment characterization of vector stochastic processes. Time averages. Ergodic processes. Statistical inference. Histograms, probability density function, cumulative distribution function estimates from data. Model parameters estimation. Hands-on MATLAB numerical examples.

April, 18th 2023 - 10:30-13:30 and 14:30-16:30
Translation model. Generation of random vector samples. Gaussian vectors simulation. Generation non-Gaussian vectors samples using the translation model. Simulation of stationary Gaussian stochastic processes. Autoregressive models. Time domain stochastic process samples generation. Frequency domain stochastic process samples generation. Hands-on MATLAB numerical examples.

April, 21st 2023 - 11:30-13:30 and 14:30-16:30
Global framework for uncertainty quantification, direct integration methods, surrogate models, polynomial chaos expansion, post processing for engineering applications (i.e. sensitivity analysis). Global framework for inverse problem solution using noisy measurements, Bayesian inference, computational methods of posterior Hands-on MATLAB numerical examples.

Location

Campus of Engineering of University of Perugia
Latitude: 43.118177 Longitude: 12.357942

Room 6 and Room 1 (CEEPhD Team)

Timetable

from April 13th to April 21st, 2023

Registration information

Teams platform - CEEPhD Team (Room 1)
There is no registration fee for the course.

For more info Mrs. Teresa Nocera, Ph.D. Program Secretariat (teresa.nocera@unipg.it)
Prof. Dr. Filippo Ubertini, Ph.D. Program Coordinator (filippo.ubertini@unipg.it)

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