UCLouvain

lbrti2102

2023

Process-based modelling in bioscience engineering

5.00 credits	30.0 h + 15.0 h	Q1

Teacher(s)	Hanert Emmanuel ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	Basic courses in mathematics (LMAT1111, LBIR1200) and some knowledge of Matlab (LBIR1204, LBIR1305).
Main themes	This module will help students to develop a thorough knowledge of the different steps required to setup a model and learn how to use simulation tools. The students will be able to setup a complete modelling approach in order to forecast and anticipate the behaviour of complex systems. This module considers the propagation of errors and uncertainties in models and hence allows estimating the risk associated to a particular decision.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 a. Contribution de l'activité au référentiel AA (AA du programme) 1.2 2.1, 2.2, 2.3, 2.4 3.1, 3.2, 3.3, 3.4 6.1, 6.2, 6.3, 6.5, 6.8 b. Formulation spécifique pour cette activité des AA du programme By the end of the LBRTI2102 module, students will be able to: · Name, describe, explain the theoretical concepts related to the mechanistic approach to analyse and model environmental processes; · Explain mathematical concepts and use computational tools to model the space-time dynamics of these processes; · Use these concepts and tools in an operational fashion in order to model the processes that drive realistic environmental systems in the context of an individual project; · Present a detailed justification of the methodological choices that have been made to analyse the system under study; · Write a brief report, with a solid discussion based on the modelling results and appropriately illustrated with graphs and charts, using accurate and appropriate scientific vocabulary.
Evaluation methods	Individual report on a personal project to be handed in by the end of term (or on 15 Aug. if exam taken taken in August) and an oral exam during the exam session.
Teaching methods	Teaching is based on a two-hour lecture each week. The lecture format is very "hands-on" with many practical examples and illustrations. Students are encouraged to take their laptop in the classroom. Practical sessions with a research assistant are also scheduled to help the students apply the concepts presented during the lectures.
Content	The course covers the following elements and illustrates them with examples modelled with Python: 1. Application of mathematical models in ecology : logistic growth - predator-prey models and general Lotka-Volterra models applied to multi-populations systems. 2. Applicatioin of mathematical models in epidemiology: compartments models - population dynamics (epidemics vs endemic states) - reproduction number (*R0*). 3. Transport models in 1D and 2D, and numerical discretization of the advection, diffusion and reaction terms. 4. Application of transport models in ecology, epidemiology and hydrodynamics. 5. Cellular automata models and their application to simulate outbreaks and invasive species.
Inline resources	Moodle course site with all the lecture notes and many Python scripts.
Bibliography	All the lecture notes and the Python scripts used during the lectures are made available on Moodle. There is a list with recommended books and scientific papers on Moodle
Other infos	Lecture notes are written in English. The course is taught in English.

Faculty or entity in charge	AGRO

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Forests and Natural Areas Engineering	BIRF2M	5		🔍
Master [120] in Environmental Bioengineering	BIRE2M	5		🔍
Master [120] in Chemistry and Bioindustries	BIRC2M	5		🔍
Master [120] in Agricultural Bioengineering	BIRA2M	5		🔍