UCLouvain

linma2671

2019

Advanced control and applications

In view of the health context linked to the spread of the coronavirus, the methods of organisation and evaluation of the learning units could be adapted in different situations; these possible new methods have been - or will be - communicated by the teachers to the students.

5 credits	30.0 h + 30.0 h	Q1

Teacher(s)	Hendrickx Julien ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	Model-based control (pole placement control, predictive control, LQ control, robust control) ; Implementation aspects of digital control.
Aims	Contribution of the course to the program objectives : • AA1.1, AA1.2, AA1.3 • AA2.1, AA2.2, AA2.3, AA2.4 • AA3.1, AA3.2 • AA5.3, AA5.4, AA5.5, AA5.6 • AA6.4 1 The aim of this course is to present different methods of model-based control (pole placement control, predictive control, LQ control, robust control) and to study the implementation aspects of digital control. These methods will be supported by real life cases studies. The course also involves control design exercises (MATLAB), and a set of laboratory sequences during which the students will implement some of these methods on pilot processes at the laboratory. At the end of this course, the students will be able to : • Understand the major issues of digital control design. • Calculate, with specialized software, digital controllers with specified performances. • Implement numerical control laws on real processes (in the laboratory). • Present major aspects of a theory or an application in automatic control. - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled “Programmes/courses offering this Teaching Unit”.*
Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** The grades will be based on : • The seminar(s) presented by the students : their ability to convey the main ideas to the other students, their critical thinking and ability to synthetize information when preparing the presentation, and their knowledge of the topic presented. • The labs • The homework(s) • The reports written after every external activity or seminar The precise evaluation criteria and weights are specified during the first lecture each year, and are available on Moodle.

Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** 1. Lectures and exercices: Four or fives lectures and problem-based learning sessions on (i) preliminary notions necessary for the class, (ii) sampling linear systems, and (iii) dealing with constraints on input and output signals. 2. Seminars : Between 6 and 8 seminars prepared by students. Each student/group of student receives several documents on a topic novel for them. Based on these documents and on their own research, they understand the new topic, critically analyze it, prepare a synthesis of its essential aspects, and present this synthesis to the other students. Each group can interact with the professor before their seminar, and a constructive feedback is provided after the seminar. The precise size of the group depends on the number of registred students. 3. Homeworks : One or two homeworks about sampling problems, done alone or by groups of two students. 4. Labs : Three experiments in the laboratory (by groups of 2 or 3). The goal of each lab is to design a controler for a real and nontrivial dynamical system. They also allow students to face realistic (possibly unforeseen) practical problems. 5. External activities : these will change every year. They may include : • presentation of an advanced control method by a researcher • seminar about practical control issues by someone from working on control problems in the industry • relevant visit of a plant/other facility where control methods are used • each student writes a short report after each external activity.
Content	• Discretization of continuous models, Shannon's theorem, choice of sampling periods • Classical digital control (numerical PID) • Predictive control • Prediction compensation of measurable perturbations • Multivariable control, decoupling, linear quadratic control • Observers, Kalman filter • Delay compensation • Parameterization of Youla Kucera • Recursive model estimation • Robust control • Iterative controller design • Controller design with different methods using MATLAB and SIMULINK • Test of different control methods on pilot processes. The course comprises a set of lectures on theoretical aspects in control design or regarding industrial control applications developed by members of the Automatic Control Lab, as well as a set of compulsory exercises and laboratory sequences. Moreover, each student will have to make an oral presentation on a theoretical topic, or on results obtained in the laboratory or, finally, on an article describing an industrial application.
Inline resources	http://moodleucl.uclouvain.be/course/view.php?id=7955
Faculty or entity in charge	MAP

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Master [120] in Biomedical Engineering	GBIO2M	5		
Master [120] in Mathematical Engineering	MAP2M	5		
Master [120] in Electro-mechanical Engineering	ELME2M	5		