UCLouvain

linma2875

2023

System Identification

5.00 credits	30.0 h + 30.0 h	Q2

Teacher(s)	Bianchin Gianluca ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	This courses assumes familiarity with transfer functions, as taught in LINMA1510 (Linear Control) or LEPL1106 (Applied mathematics : Signals and systems)
Main themes	This class is an introduction to system identification, which consists in finding an appropriate representation of a dynamical system using appropriate measurements. It will cover some of the main parametric and nonparametric methods for identifying dynamical systems, including in closed loop. It will also cover the properties of signals and model classes that are relevant for system identification. A realistic identification project will give students the opportunity to apply and implement the techniques that they will have learned.
Learning outcomes	**At the end of this learning unit, the student is able to :** With respect to the L.O. framework, this class contributes to the developpement of the following learning outcomes • AA1.1, AA1.2, AA1.3 • AA2.1, AA2.4 • AA3.2 • AA5.3, AA5.5 More precisely, by the end of the class, the student will be able to : 1 • recognize a problem of system identificaiton • propose and implement solutions to simple identification problems • identify a dynamical systems using input-output data • validate a model of system that has been identified, and compare different simple models • design an experiment to identify a simple system • develop a deeper understanding of system identification by him/herself if necessary in order to solve more complex problems Transversal learning outcomes : • Handling unforeseen technical issues that appear when treating a real-world problem • Making reasonable hypothesis for a given problem, and evaluating them a posteriori • Taking part to a technical class in English
Evaluation methods	• Written or oral exam (75% of the final grade) • Laboratory reports, quizzes, and homework exercises (written or oral) during the course semester (25% of the final grade) In case the written exam is taken in the second session, the lab/quiz/homework part of the grade cannot be retaken and the grade remains unchanged. The lab/quiz/homework grade cannot be carried over from previous years.
Teaching methods	• Regular lectures • Resolutions of problems under the supervision of a teaching assistant • Laboratory sessions to be realized in the laboratory room using the available equipment and Matlab or Python The activities will mainly take place in person but may be organized partly or entirely remotely if required by the sanitary situation or by practical constraints.
Content	The following topics will be covered • Nonparametric methods: temporal analysis, frequential analysis, including Fourier and spectral analysis • Main classes of LTI systems and their properties, including the notions of identifiability and predictors • Certain parametric methods: linear regression, instrumental variables, prediction errors, and some statistical methods including the maximum likelihood method

	• The properties of (input) signal, including the notion of information content of the signals and the level of persistence of excitation. • The convergence of the method seen • Identification techniques for systems controlled in closed loop
Inline resources	https://moodleucl.uclouvain.be/course/view.php?id=9007
Bibliography	The course will mainly use notes made available on Moodle. Suggested readings are listed below. 1. L. Ljung System Identification - Theory for the user, Prentice Hall, 1999. (disponible en bibliothèque) 2. T. Soderstorm and P. Stoica, System Identification (http://user.it.uu.se/~ts/sysidbook.pdf) 3. P. van Overschee and B. de Moor - Subspace Identification for Linear Systems: Theory, Implementation, Applications, Springer, 2011.
Other infos	The main language used during lectures, exercise sessions, and the laboratory is English. Examinations can be made French-friendly, upon request. Students are expected to be familiar with dynamical systems and transfer functions.
Faculty or entity in charge	MAP

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Biomedical Engineering	GBIO2M	5		
Master [120] in Mechanical Engineering	MECA2M	5		
Master [120] in Electrical Engineering	ELEC2M	5		
Master [120] in Electro-mechanical Engineering	ELME2M	5		
Master [120] in Mathematical Engineering	MAP2M	5		
Master [120] in Data Science Engineering	DATE2M	5		
Master [120] in Data Science: Information Technology	DATI2M	5		
Master [120] in Energy Engineering	NRGY2M	5		