UCLouvain

linma1510

2024

Linear Control

5.00 credits	30.0 h + 30.0 h	Q1

Teacher(s)	Bianchin Gianluca ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	Notions of signals and systems as taught in LEPL1106.
Main themes	Development of mathematical models for linear dynamical systems (state-space representation, transfer functions) allowing to represent the dynamics in a unified way for a diversity of engineering applications (e.g. electromechanical, mechanical, electrical, chemical, biological, computer science) Design of control schemes that meet specifications related to stability, transient and steady state performance (accuracy), and robustness. PI and PID controllers, Linear Quadratic Control, Smith predictor, feedforward control, cascade control. Use of software to design controllers.
Learning outcomes	**At the end of this learning unit, the student is able to :** **With respect to the referentiel AA, this courses contributes to the development, the acquisition and the evaluation of the following learning outcomes :** • AA1.1, AA1.2, AA1.3 • AA5.3, AA5.4, AA5.5 **At the end of the course, the student will be able :** 1 1. Design control systems based on linear models; 2. Design of control schemes that meet specifications on related to stability, transient and steady state performance (accuracy), and robustness. PI and PID regulators, Linear Quadratic Control, Smith predictors, feedforward control, cascade control; 3. Use software to design controllers.; 4. Implement closed-loop control system in laboratory experiments under conditions similar to those in industrial applications.; 5. Use industrial PID controller; 6. Autonomously run automatic control experiments, from the design level to the actual implementation and performance evaluations;
Evaluation methods	• Exam (75% of the final grade) • Laboratory evaluation during the course semester (25% of the final grade) • Other activities, such as quizzes and homework exercises, can be taken into account to compose the final grade • In case the written exam is taken in the second session, the laboratory exam cannot be retaken and the grade remains unchanged. The laboratory grade cannot be carried over from previous years
Teaching methods	Learning will be based on lectures (in presence mode or in distance mode) interlaced with exercise sessions (offered in class with the support of TAs) and laboratory sessions (to be realized in the laboratory room by groups of 2-4 students using laboratory equipment and MATLAB Simulink).
Content	Part 1 - Analysis of systems using frequency-domain tools: Laplace transforms, dynamic response, transfer functions, system poles, block diagrams, stability, PID control, Bode and Nyquist diagrams, lead and lag compensators. Part 2 - Analysis of systems using time-domain tools: state-space models, matrix exponentials, linearization, linear time-varying systems, Lyapunov stability, controllability and observability, pole placement, advanced control via state feedback.
Inline resources	https://moodleucl.uclouvain.be/course/view.php?id=7834
Bibliography	J. P. Hespanha, "Linear systems theory," Princeton University Press, 2018 (available in the library) G. F. Franklin, J. D. Powell, E. Emami-Naeini, "Feedback control of dynamic systems," Prentice Hall, 2019 (available in the library)
Other infos	The main language used during lectures, exercise sessions, and the laboratory is English. Examinations can be made French-friendly, upon request.

Faculty or entity in charge	MAP

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Specialization track in Biomedical Engineering	FILGBIO	5		
Minor in Applied Mathematics	LMINOMAP	5		
Master [120] in Chemical and Materials Engineering	KIMA2M	5		
Specialization track in Applied Mathematics	FILMAP	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 Energy Engineering	NRGY2M	5		
Mineure Polytechnique	MINPOLY	5		