INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

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Control Engineering

Control of Linear Systems

IDENTIFICATION

CODE : GM-3-S2-EC-CSL
ECTS : 3.0

HOURS

Lectures :	10.0 h
Seminars :	22.0 h
Laboratory :	8.0 h
Project :	0.0 h
Teacher-student contact :	40.0 h
Personal work :	40.0 h
Total :	80.0 h

ASSESSMENT METHOD

"Final exam: 2h
Mid-term examination: 30min
Mini-project and lab session grades."

TEACHING AIDS

Lecture notes
Exam session documents
Lecture slides
Summary cards

TEACHING LANGUAGE

French

CONTACT

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AIMS

Control engineering concerns the representation, analysis and manipulation of the dynamical response of systems. This discipline has become central to the design of any guided system and, in particular, of mechanical systems. Its purpose is to improve the performances of a system with respect to several criteria, such as stability, speed or accuracy, and ensure repeatability in the behaviour of industrial processes even in the presence of uncontrolled disturbances in the work environment. The goal of this course is to introduce, within a linear framework, the basic tools required to represent and analyse these systems then design suitable control laws.

CONTENT

To achieve the aforementioned objectives, the course aims to cover the following topics:
1) Representations and characterization of linear systems:
- Input/output approach, transfer functions, state approach, state representation, block diagrams
- Time-domainresponse and analysis: harmonic, step, and impulse responses
- Frequency-domain response and analysis: Bode plots
- Elementary linear models (gain, integrator, 1st order, 2nd order, pure delay, differentiator)
- Controllability and observability

2) Performance analysis
- Stability: input/output stability (analysis of transfer function poles), internal stability, Nyquist criterion, stability margins
- Performance criteria of closed-loop systems: settling time, overshoot, accuracy, bandwidth

3)Controller synthesis:
- Robustness
- Frequency synthesis of linear controllers (P, PI, PD, PID, lead-lag controllers)
- State feedback control and pole placement
- Practical aspects of linear system control: sampling, instrumentation, software sensors

The course also includes:
- A mini-project (6h supervised work) to get acquainted with some software tools (Matlab) for modeling, simulation and analysis of linear systems and development of control laws.
- Two practical lab session (4h) introducing the problem of closed-loop control (feedback) on a real system.

BIBLIOGRAPHY

[1] Automatique appliquée Tome 1, E. Dieulesaint, D. Royer, Masson 1987.
[2] Théorie et calcul des asservissements linéaires, J.Ch. Gille, P. Decaulne, M. Pelegrin, Dunod 1992.
[3] Commande des systèmes linéaires, Ph. De Larminat, Hermès 1993.
[4] Asservissement, régulation, commande analogique, Tome 2, M. Rivoire, J-L. Ferrier, Eyrolles 1990.
[5] Automatique : systèmes linéaires et continus, S. Le Ballois, P. Codron. Eyrolles, 2006.
[6] Systèmes Automatiques : Commande des processus, J.P. Hautier, J.P. Caron. Ellipses, 1997.
[7] Feedback control of dynamics systems. G. F. Franklin, D. Powell, A. Emami-Naeini. Addison-Wesley, Reading, MA 1994.
[8] Modern control systems. R. C. Dorf, R. H. Bishop, 1998.
[9] Modern control engineering. K. Ogata. Prentice Hall, 5th Ed. 2009.

PRE-REQUISITE

Ordinary differential equations (linear systems of equations),
Laplace Transform