USEES2 - Control System Theory and Engineering

Mis à jour le 25-02-2026

Code : USEES2

Unité spécifique de type cours

6 crédits

Responsabilité nationale :
EPN05 - Informatique / Stefano SECCI

Présentation

Prérequis

- Fundamentals of higher mathematics, especially linear algebra
- Fundamentals of signals and systems
- Basic design methods for LTI systems in frequency domain
- Description of linear, time-invariant systems in time and frequency domain,
- Laplace transform, analysis of LTI systems (Bode and Nyquist plots)

Objectifs pédagogiques

Students are able to discuss control theory in time domain. They are capable of applying the methods of model-based control theory of linear and non-linear systems. To an increasing degree, requirements on safety, sustainability and economic feasibility of technical products and production plants call for modern approaches of control-theory-based methods. Especially in the environment of control theory, simple and heuristically designed controllers have been reaching their limits. Systematic design of model-based controllers in the time domain allows considering of non-linearities and has the potential to achieve significantly improved controller results. Students are able to describe the necessary mathematics and system-theory basics. They are able to analyze time-continuous systems in the time domain. They are able to categorize systems according to system-theoretic properties. Further, they have the ability to apply formal methods in order to design controllers in time domain. They are also able to apply methods for designing controllers for non-linear systems and are capable of managing its operation.

Programme

Contenu

Topics include:

- Linear and non-linear time-continuous systems in state space
- Linearization and general solution of linear differential equations of states
- Structural properties of LTI systems in state space (stability, controllability, observability
- Design of state controllers and state observers for linear systems
- Analysis of non-linear systems (Lyapunov-stability)
- Control and feedback control of non-linear systems

Modalités de validation

- Contrôle continu
- Examen final

Description des modalités de validation

Oral exam.

Bibliographie

Titre	Auteur(s)
Regelungstechnik 1: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen. 4 Auflage Springer-Verlag, Berlin, 2006	J. Lunze
Regelungstechnik 2: Mehrgrößensysteme, Digitale Regelung. Springer- Verlag, Berlin, 2004	J. Lunze
Linear Systems. Prentice Hall, Upper Saddle River, 1980	T. Kailath
Linear System Theory, Prentice Hall, 1996	W.J. Rugh

Nonlinear Systems. Prentice Hall, Upper Saddle River, 2002	H.K. Khalil
Nonlinear Systems. Springer, New York, 1999	S. Sastry
Nonlinear Control Systems. Springer, Berlin, 3rd edition, 1995	A. Isidori