State space

Component
École Nationale Supérieure d'Électrotechnique d'Électronique d'Informatique d'Hydraulique et des Télécommunications

In brief

- **Ametys Code:** N8EE13A
- **Open to exchange students:** Yes

Presentation

Objectives

1) Model continuous-time and discrete-time dynamic systems in state space,
2) Analyze the dynamic behavior of these systems based on their modeling in state space (poles, zeros, stability, controllability, observability, transfer functions, time response),
3) Synthesize state feedback control architectures and state feedback with continuous-time integral action,
4) Synthesize full-order and reduced-order observers,

Description

Using control architectures based on low-order linear controllers such as P, PI, or PID allows for the control of certain types of systems with very good performance, but what if the open-loop system is already of order 4, 5, 10, 100, etc., as is the case for the vast majority of systems around us and in industry (electrical systems such as converters, electric actuators, and networks, but also renewable energy production systems, vehicles, robots, production lines, heating systems, economic systems, etc.)? The correctors mentioned above are effective over a specific frequency range but have limited effectiveness when it comes to controlling the dynamic behavior of a high-order system, especially when its poles are scattered across the frequency spectrum. This course

introduces a modeling formalism known as “state space” modeling, which allows for the analysis and synthesis of appropriate control laws for such systems, regardless of their order, which we encounter on a daily basis.

Pre-requisites

Course “N7EE05C: Synthesis of Correctors and Control Architectures”
Course “N7EE05B: Sampled Systems”
Algebra and matrix operations (matrix product, eigenvalues and eigenvectors, determinant, matrix inversion, diagonalization)
Laplace transform, Integral calculus,