

# Space State



## Component

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

## In brief

- > **Ametys Code:** N8AE14A
- > **Open to exchange students:** No

# 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 integral action in continuous time,
- 4) Synthesize integer-order and reduced-order observers,

## Description

Using control architectures based on low-order linear controllers of type P, PI, or PID allows for the control of a certain class of systems with very good performance, but how can this be done if the open-loop system is already of order 4, 5, ..., 10, ..., 100, ..., as is the case for a large majority of the systems around us and in industry (electrical systems such as converters, electric actuators, or networks); but also renewable energy production systems, vehicles, robots, production lines, heating systems, economic systems, etc. The controllers mentioned earlier 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 spread across the frequency spectrum. This course introduces a modeling formalism called "state-space" modeling, which allows for the analysis and synthesis of appropriate control laws for such systems, regardless of their order, which we encounter daily.

---

## Pre-requisites

Synthesis of controllers and control architectures

Sampled systems

Algebra and matrix operations (matrix multiplication, eigenvalues and eigenvectors, determinant, matrix inversion, diagonalization)

Laplace transform, Integral calculus