Automatic Tutorials

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

In brief

- **Ametys Code:** N8EE13D
- **Open to exchange students:** Yes

Presentation

Objectives

The aim of this series of practical exercises is to illustrate the fundamental concepts of automatic control, with an emphasis on modelling, stability analysis, and the synthesis of control laws for dynamic systems. The exercises are designed to develop practical skills in simulation and experimentation, while reinforcing understanding of theoretical concepts.

Description

This series of practical assignments will focus on the concepts of
(i) State Feedback Control and Observers for an Unstable System,
(ii) Lyapunov Stability and Non-Linear Control of a Non-Linear System, and
(iii) Study of Self-Oscillations in Non-Linear Systems. The work carried out will enable students to acquire the following skills:

Process modelling: Identification of dynamic equations and physical parameters;
Stability analysis: Calculation of equilibrium points of a nonlinear system, local stability analysis in the sense of Lyapunov, estimation of the stability domain and visualisation of system trajectories using a graphical tool (pplane);
State feedback control law synthesis: Ensuring accuracy and transient behaviour compatible with the operating domain;

Design of an observer-based control system: Reconstruction of unmeasurable or poor-quality system states using a state observer, then insertion of the observer into a control loop;

Design of sliding mode control laws for a highly non-linear system;

Simulation of different solutions on Matbal/Simulink;

Experimental validation on different models: pendulum-type device (crane or inverted pendulum), characterised by high order (4°) and the presence of unstable poles, non-linear ball-on-rail system, synchronisation of the position of three discs connected by torsion wires driven by a brushless motor.

Pre-requisites

N8EE13A – State Space

N8EE13B – Nonlinear Systems

N8EE13C – Nonlinear Control