Electric actuator control strategy

Component
École Nationale Supérieure d'Électrotechnique d'Électronique

In brief

- **Ametys Code:** N9EE29A
- **Open to exchange students:** Yes

Presentation

Objectives

The main objective is to develop expertise in the field of torque, speed and position control strategies for three-phase electric machines operating in their respective contexts (land transport, aeronautics, space, maritime, and industry, etc.). Operation in the four quadrants of the torque-speed plane is explored, with particular emphasis on the design of control laws and associated observers.

Description

Starting from a common foundation, highlighting the basic procedures for modelling electrical machines, the course branches into two equally important areas devoted respectively to synchronous machines and asynchronous machines – induction machines:

Synchronous machines:

Representation of synchronous electrical machines – Model
Equation formulation, assumptions
Three-phase and two-phase representation
Non-sinusoidal machine
Torque ripple (origins)
- Conventional synchronous machine control
Scalar control
Conventional control

- Advanced control of synchronous machines
  Improvement of torque quality
  De-fluxing of magnet machines
  Control without mechanical sensors

Asynchronous induction motor (AIM), direct and inverse models

o Power supply modes for a three-phase squirrel-cage asynchronous motor – specifications

o Modelling of the three-phase AIM, definition of parameters, simplifying assumptions

o Three-phase – two-phase transformations, power conservation vs amplitude conservation

Estimators, Observers – indirect sensors of a cage MAS

o Deterministic estimation/observation of flux

o Stochastic observations – Kalman flux filter

o Rotational speed observations, partial and global methods

Indirect and direct controls of a cage-type ASM

o Linear scalar and vector controls

o Non-linear controls with sliding mode and exact linearisation

Control of a doubly fed asynchronous machine (DFAM)

o Dual vector control – naval propulsion

Rotor control – turbomachinery/pumping

Pre-requisites

Electromagnetic modelling of machines: N7EE03B
Modulation and filtering of voltage inverters: N7EE04D
Synthesis of correctors and control architectures: N7EE05C
State space: N8EE13A
Converter control: N8EE15C
Machine control: N8EE15D
ZOE powertrain project: N8EE1