

# Electric actuator control strategy



Component  
École Nationale  
Supérieure  
d'Électrotechnique  
d'Électronique

## In brief

- > **Amety's Code:** N9EE29A
- > **Open to exchange students:** Yes

## Presentation

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### 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.

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### 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

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## 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