

Thesis proposal in collaboration with COMAU about electronic topics

Master degree in Electronic Engineering - curriculum in
Electronics for Industrial Applications
Master degree in Mechatronic Engineering

Proposal E1: Development of a Matlab Model for the Main Hardware Components of a Robot Controller

Abstract:

This thesis aims to develop a comprehensive Matlab model representing the key hardware components of a robot controller, including drives, power supplies, and other relevant elements. The primary goal is to create a Matlab/Simulink simulator that accurately reproduces the entire electromechanical operational chain, encompassing DC bus Voltage/Current, current control using FOC Field Oriented Control (including field weakening), PWM modulation, and a three-phase permanent magnet synchronous electric motor. The resulting simulator has the potential to serve dual purposes: supporting the ongoing development of a Multi-Input Multi-Output (MiMo) simulator and replicating electro-mechanical dynamics currently approximated with $T = Kt I$.

Objectives:

1. Matlab Model Development:
 - Design and implement a Matlab/Simulink model that encompasses the primary hardware components of a robot controller, such as drives, power supplies, and more.
 - Ensure the model accurately reflects the entire electromechanical operational chain, from DC bus voltage/current to the three-phase permanent magnet synchronous electric motor.
2. Simulator Integration:
 - Integrate the developed Matlab/Simulink model with existing simulation tools, particularly those used in the ongoing MiMo simulator project.
 - Assess the compatibility and synergy between the electro-mechanical simulator and the broader MiMo simulation framework.
3. Functionalities for Field Weakening:
 - Implement functionalities within the model to account for field weakening in the FOC current control process.
 - Verify the accuracy of the model in reproducing dynamic behaviors associated with field weakening.

4. Dynamics Reproduction:

- Validate the model's ability to replicate electro-mechanical dynamics that are currently simplified with $T = Kt I$.
- Compare simulated results with real-world measurements or established benchmarks to ensure model accuracy.

5. Usability for MiMo Simulator:

- Evaluate the contribution of the developed model in enhancing the capabilities of the MiMo simulator, particularly in the realm of electrical simulations.

Summary:

This thesis endeavors to provide a valuable Matlab-based tool for simulating the complex interactions within the hardware components of a robot controller. The resulting simulator not only aids the ongoing MiMo simulator project but also stands as a versatile platform for investigating and understanding the intricacies of electromechanical systems in robotic applications.

Requirements:

24V DC based controls automation architecture knowledge
Industrial robot control hardware architecture basic knowledge
Servo motor controls hardware knowledge (IGBT-based servo drives)
C/C++ and Matlab development basic knowledge

Duration:

6-9 month

For further info refer to:

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Send a SINGLE email to marina.indri@polito.it and enrico.civitelli@comau.com, with a complete CV in attachment (including the full list of exams with scores and all the information about competences, experiences and software skills useful for the thesis)