École Polytechnique Fédérale de Lausanne
Distributed Electrical Systems Laboratory
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Student project proposal

Project title

Control Algorithm Design for Electromagnetic Levitation of a Hyperloop Pod

Project type ☒ MSc thesis ☐ BA semester project ☐ MSc semester project

Project responsible and e-mail
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Project description

The proposed project is part of the epfloop team's research into the electrification of transport, and more specifically into the propulsion of high-speed levitated vehicles (named pods).
The goal of the project is to design, implement, and test a control algorithm for the electromagnetic levitation system of a Hyperloop pod. The levitation is based on the electromagnetic attraction between two magnetised components, resulting in a highly nonlinear system that requires precise control to maintain stability.
The control algorithm should be capable of stabilizing the pod in mid-air and tracking a desired trajectory. The final phase of the project involves implementing the controller on a real prototype and validating its performance through real-time testing.

Tasks of the student

- Become familiar with the levitation units of the Hyperloop pod.
- Review existing control strategies for electromagnetic levitation systems.
- Model the mechanical and electrical behaviour of the system.
- Derive the open loop transfer function in the Laplace domain.
- Design and tune a suitable control algorithm.
- Implement and test the controller in Simulink (or an equivalent simulation environment).
- Deploy the algorithm on the prototype and conduct real-time levitation experiments.

Requirements

- Background on control theory.
- Proficiency in programming languages (MATLAB Simulink, LabVIEW is a real plus).
- Basic knowledge in electronics and embedded systems.

This project offers the opportunity to combine theoretical control design with hands-on experimentation on a real prototype.

Literature

[1] S. Rametti, L. Pierrejean, A. Hodder, and M. Paolone, 'Decoupled Levitation and Propulsion Control of Single-Sided Linear Induction Motors', in 2024 IEEE International Conference on Electrical Systems for Aircraft, Railway, Ship Propulsion and Road Vehicles & International Transportation Electrification Conference (ESARS-ITEC), Naples, Italy: IEEE, Nov. 2024, pp. 1–6. doi: 10.1109/ESARS-ITEC60450.2024.10819927.