École Polytechnique Fédérale de Lausanne
Distributed Electrical Systems Laboratory
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http://desl-pwrs.epfl.ch

Student project proposal

Project title

Design and Manufacturing of a Test Bench for Characterising a Linear Electric Motor

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. The purpose of the project is to adapt an existing test bench to study the performance of a linear electric motor.
A linear electric motor can be considered as the "flat counterpart" of a rotary electric motor. It converts electrical energy into linear movement and levitation force through magnetic field.
The test bench, developed at DESL, is equipped with a driving unit, a dedicated power electronic and a three-dimensional force sensor, allowing the forces generated by the motor to be measured at different set points in terms of speed and supply frequency (up to 300 km/h and 1kHz).
A dynamic numerical study of the stresses and strains in the structural elements is required to adapt the test bench topology and mechanical parts to the new design. A second part of the project will consist of designing the new components (mechanical electrical), manufacturing them and integrating them into the test bench. The final part will involve characterising the performance of the linear motor.
Several aspects of this topic could be further explored depending on the student's particular interests. This project is a good opportunity to merge theoretical and practical work, resulting in an operational device.

Tasks of the student

- Propose an adaptation of the existing test bench to study a new type of linear motor.
- Design and validate parts based on studies of stresses and strains in the components.
- Manufacture parts and / or order from suppliers.
- Assemble the new test bench.
- Run the test bench to characterise the linear motor.

Requirements

- Any CAD design tool (including analysis of stresses and strains).
- Finite element method analysis.
- Basic knowledge in electrical machines.

Literature

[1] Details about the existing test bench can be found in:
S. Rametti, L. Pierrejean, A. Hodder, and M. Paolone, "Pseudo-Three-Dimensional Analytical Model of Linear Induction Motors for High-Speed Applications," *IEEE Trans. Transp. Electrific.*, pp. 1–1, 2024, doi: 10.1109/TTE.2023.3348655.
[2] Past version of the test plateform: https://actu.epfl.ch/news/giant-wheel-used-to-test-a-linear-motor/

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