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Tutorial Proposal Title

High Performance Linear Induction Machines and Drive Systems

Presenter(s):

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Abstract:

The main subject of the tutorial is linear induction motors (LIMs). Starting from a brief structural description of such motors, their main applications will be exposed in the tutorial with specific reference to MAGLEV (Magnetically Levitation) vehicles, urban people movers (such as linear metro, light railway, *etc.*), launchers, actuators for industry and automotive, *etc*. As a first step, the main differences between rotating and linear induction motors will be highlighted, focusing on the aspects of static and dynamic end effects as well as transversal edge effects. The typical structure of LIMs will be treated, with specific reference to secondary sheet and primary winding configurations.

Single-sided LIMs (S-LIMs) and Double-sided ones (D-LIMs) will be described in detail, focusing on normal force effects. Design criteria of LIMs will be specifically exposed, emphasizing the main differences with the classic rotating induction motor design, caused by the presence of large air-gaps, high leakage inductances as well as the end effects. Both static and dynamic models of LIMs will be introduced, including the so-called end-effects, magnetic saturation, non-linear traits influenced by PWM modulation, and so on. Suitable parameter estimation methods will be then described. Afterwards, control techniques specifically devised for LIMs, like field-oriented control, input-output feedback linearization control, active disturbance rejection control, model predictive control, efficiency optimization control, etc., will be introduced in detail. Finally, sensorless techniques with strong robustness capability specifically developed for LIMs will be shown.

Outline schedule of delivery (headings) and expected duration (Totally 2.5 hours)

- Introduction on Linear Motors (LMs)
  - History and categories of LMs — 10 minutes
  - Potential applications of LMs — 15 minutes
- Design of LIMs
  - Key points/characteristics of LIMs — 15 minutes
  - Equivalent circuits of LIMs — 10 minutes
  - Design and performance of LIMs — 10 minutes
  - Several LIM prototypes — 15 minutes
- Parameter Estimation of LIMs — 10 minutes
- Control Techniques for LIMs
  - Loss minimization control — 20 minutes

- Model predictive control — 20 minutes

- Sensorless Techniques for LIMs
  - Challenge and opportunity — 5 minutes
  - Model reference adaptive system — 5 minutes
  - Full-order Luenberger observer — 5 minutes
  - Robust Kalman filter — 5 minutes
- Conclusions — 5 minutes