Instituto Universitario de Investigación
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XIII JORNADA DE JÓVENES INVESTIGADORES/AS DEL I3A

Modeling and Design of Induction Heating Systems

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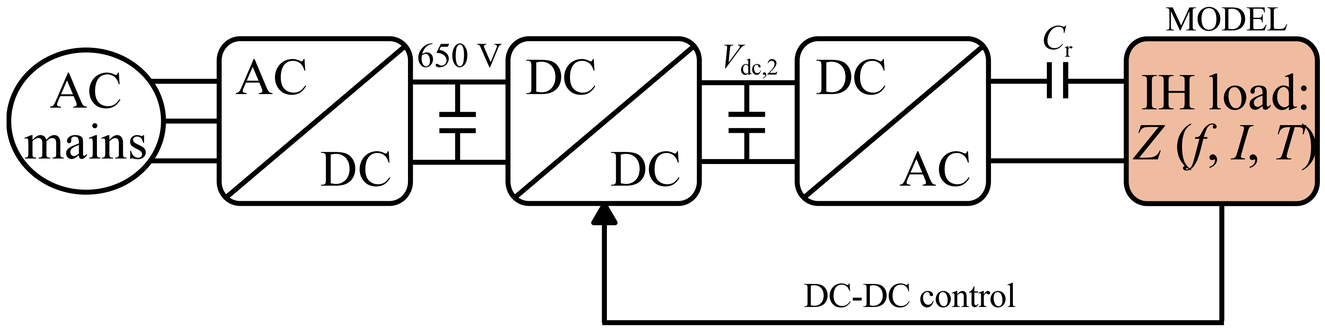
ABSTRACT

This thesis is based on a specific industrial application of induction heating technology: induction hardening. The main objective is to create a simulation model that predicts the whole heating process, combining the electrical simulation with the electromagnetic-thermal analysis, employing electrical simulation software and finite element tools, respectively. This proposed model will be called a dynamic model in the following lines.

EQUATION-BASED REDUCED DYNAMIC MODEL

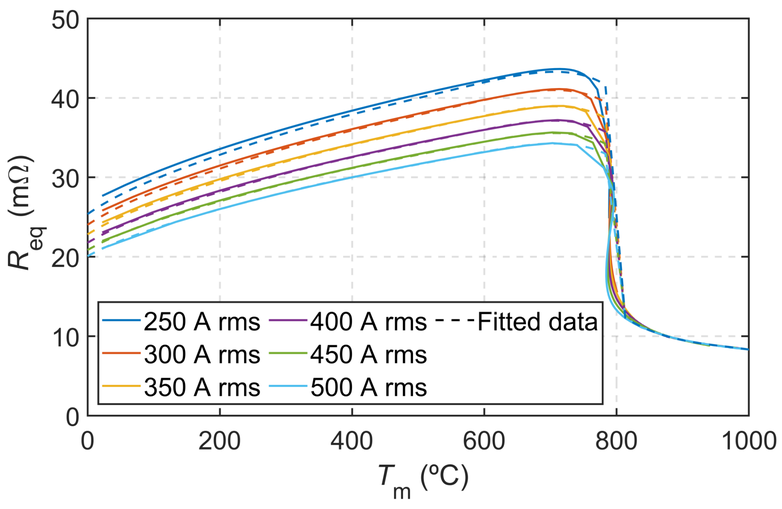
MATLAB® & SIMULINK®

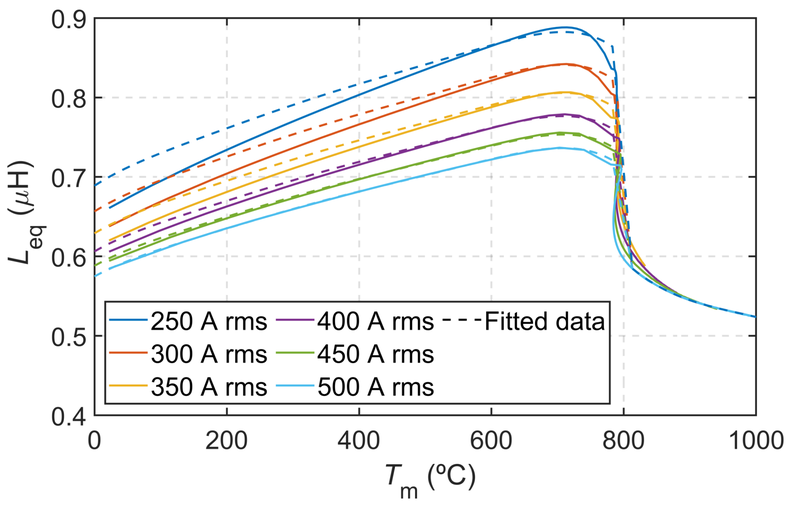
- **Equations fitted** for impedance computed by FEM, for temperatures below and above Curie, to be employed in the **electrical simulation** tool.

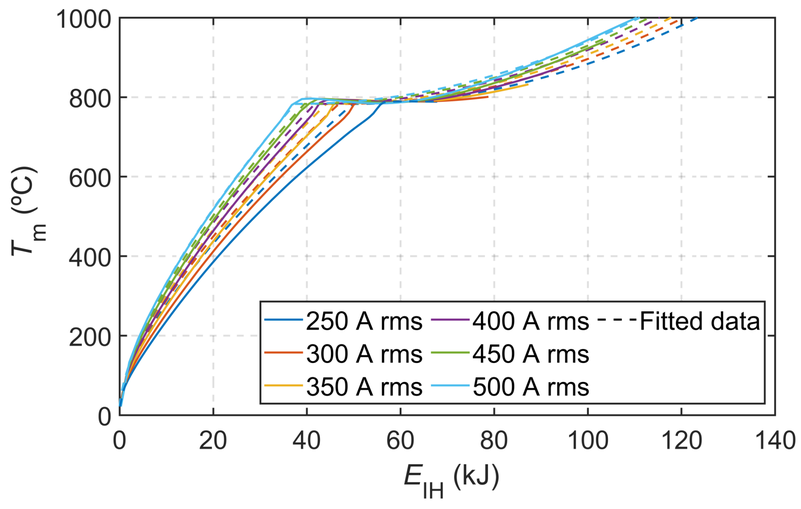


COMSOL MULTIPHYSICS®

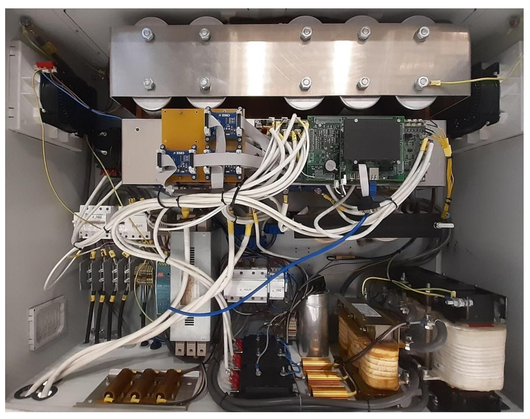
- **Electrical parameters** extracted from FEM EM-T simulations for **different current excitations**.







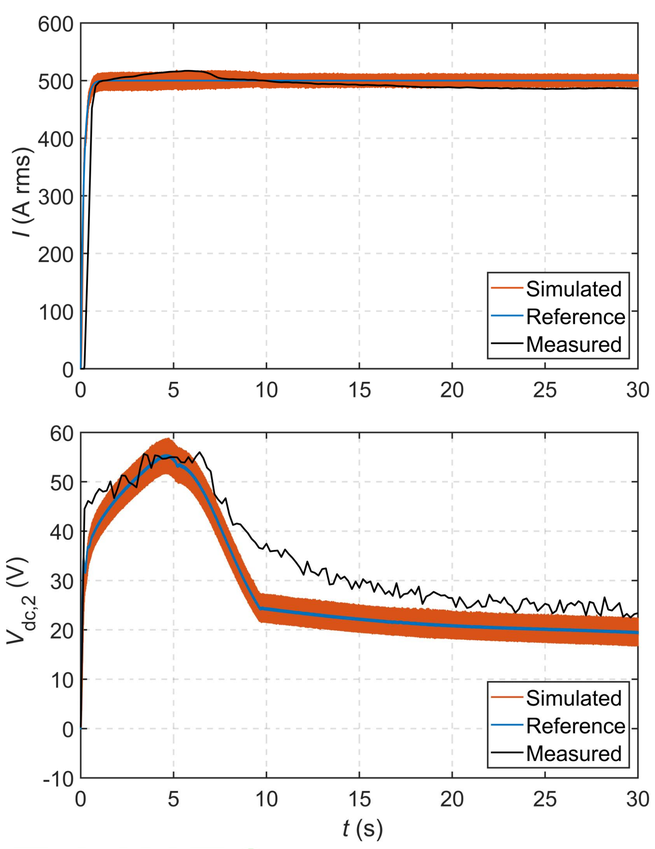
EXPERIMENTAL SETUP AND VALIDATION



IH load's geometry.

Parameter	Value	Unit
Coil's turn number	6	
Coil mean radius	15	mm
Turn inner diameter	4	mm
Turn outer diameter	6	mm
Distance between turns	9	mm
Billet radius	10	mm
Billet length	75	mm

- Induction hardening test bench:
  500 A rms @ 14,2 kHz.
- **Good agreement** comparing simulation results with experimental measurements.



CONCLUSIONS

- **Reduced-order dynamic model** of the IH process**.**
- **Dependence** of the material properties on the **field level and temperature**.
- **Complete simulation** of the industrial IH process.
- **Control dynamics** parameters are properly chosen.

FUTURE LINES

- Co-simulation between COMSOL and Simulink tools: complete dynamic model.
- 3D COMSOL simulation.
- More detailed experimental results.
- Dissertation.