Thermoelectric simulation of induction heating in forge applications

M.J. Arenas[†], A. Bermúdez[†] and P. Salgado*

[*†] Departamento de Matemática Aplicada, Universidade de Santiago de Compostela
15782 Santiago de Compostela, Spain
e-mail: manueljesus.arenas@usc.es, alfredo.bermudez@usc.es, mpilar.salgado@usc.es

ABSTRACT

The objective of this work is to describe the mathematical models and numerical tools developed to simulate the thermoelectric behavior of induction heating furnaces used for hot forging applications [2]. Namely, we are interested in heating steel cylinders which are used later to forge automotive pieces.

To determine the evolution of the temperature in the steel during the heating cycle we must solve a coupled termal-electromagnetic model which takes into account the motion of the piece inside the furnace and the fact that the materials properties of the steel strongly depend on temperature. Taking into account the specific geometry of the furnace we will develop axisymmetric and 1D models [1] and we will compare the results obtained with both methodologies. The electromagnetic model, based on the eddy current approximation, is written in terms of the magnetic vector potential and is non-linear due to the non-linear ferromagnetic behavior of the steel. The termal model includes the translational motion of the steel and computes the temperature in a steady-state. The numerical solution of the coupled model is performed by means of finite element methods in the axisymmetric case and by means of finite difference approximations and ODE solvers in the one-dimensional case. We will present some numerical results corresponding to the simulation of an industrial furnace.

REFERENCES

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