Recent Developments of the EM-Module in LS-DYNA

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Since 2017, TAILSIT maintains a close collaboration with Ansys/LST. Our partnership focuses on the enhancement of LS-DYNA's electromagnetic (EM) solver module which is based on a coupling between Finite Element (FEM) and Boundary Element Methods (BEM).
A significant speed increase was achieved with the implementation of the monolithic FEM-BEM coupling solver, which has served as a basis for all the following improvements:

- modeling of ferromagnetic materials,
- permanent magnets,
- the evaluation of electromagnetic forces and
- voltage driven simulation.

All these enhancements of the EM solver make LS-DYNA highly suited for Multiphysics problems, e.g., the design of magnetic latches, haptic engines and motors as well the simulation of metal forming or inductive heating processes.

The latest development for LS-DYNA's EM module relates to the latter application, where alternating currents (AC) are used in the process of induced heating. Until now it was necessary to model at least one sinewave of the excitation using a large amount of time steps. To this end, such a simulation required either using very small timesteps or the concept of micro (resolving the AC current) and macro (resolving the model's dynamics) time steps. The newest enhancement allows it to represent AC sources directly in the frequency domain. Using this feature and the fact that no air needs to be meshed, the modeling of, for example, translational or rotational hardening processes or the dimensioning of flux concentrators is now possible in LS-DYNA in a more efficient way.

In this presentation, we give an overview of TAILSIT's contributions to the EM module with emphasis on the latest frequency domain implementations. We present benchmark results (Fig. 1) and discuss potential improvements for the near future.

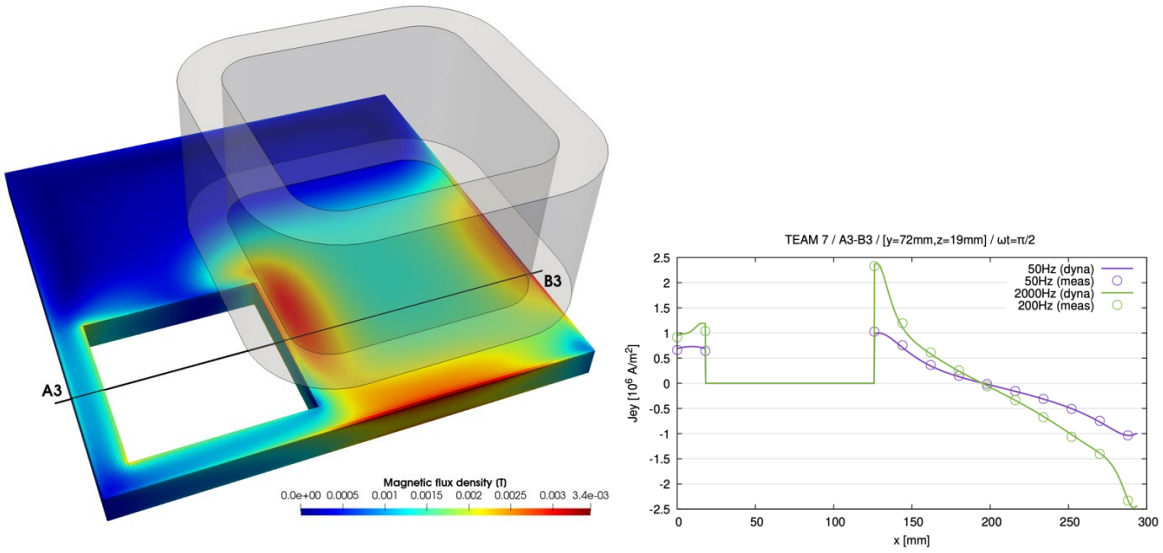

Fig.1: COMPUMAG TEAM 7 problem - magnetic flux density and measure line A3-B3 (left), comparison of the calculated (dyna) induced currents with measurements (meas) along the line A3-B3.