Recent Developments of the EM-Module in LS-DYNA – A Discussion

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Since 2017 TAILSIT has maintained a close collaboration with Ansys/LST, formerly LSTC. Our partnership focuses mainly on the enhancement of LS-DYNA's electromagnetic (EM) solver module which is based on a coupling between Finite Elements (FEM) and Boundary Element Methods (BEM). This approach makes the EM solver highly suited for multiphysics problems. Prominent examples are, e.g., the simulation of parts moved by electromagnetic forces as well as processes like metal forming, welding, and induction heating.

Amongst other things, TAILSIT has designed and implemented:

- A monolithic FEM/BEM solver,
- Support for ferromagnetic materials, permanent magnets and
- The calculation of EM forces

during these last four years. These new features considerably expand the range of applications in which LS-DYNA might be used nowadays.

One of TAILSIT's latest additions to the EM-solver module is the development of a robust and optimal scaling preconditioner for the system of equations that allows for the treatment of non-conducting regions in the FEM domain. In conjunction with LS-DYNA's mechanical capabilities, the preconditioner permits, e.g., the study of snapping and latching magnets (Fig. 1). Thanks to LS-DYNA's FEM/BEM coupling approach, the modeling of such phenomena can be done in an intriguingly simple fashion. This most recent development marks a vast improvement and truly represents a unique feature which is currently not available in any other commercial product.

In this talk we give a brief introduction to the theory and present some benchmark examples. The practical application of the new preconditioner is presented elsewhere.
Instead, we will address the capabilities and current restrictions of the EM module from our point of view and discuss some strategies on how to overcome them.

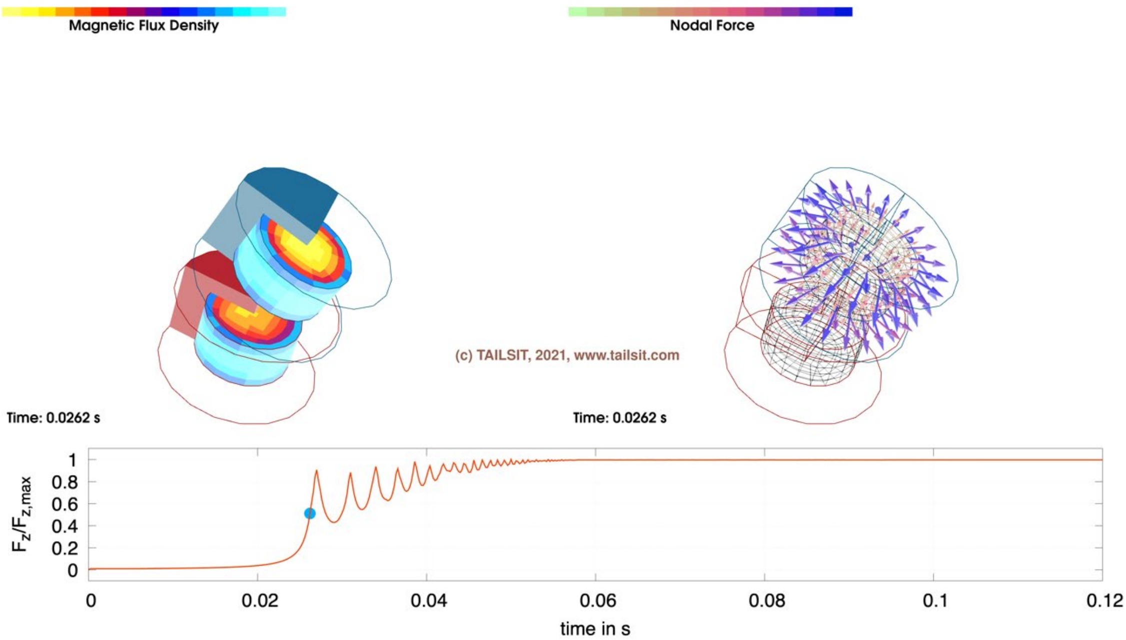

Fig.1: Two snapping magnets coated by non-magnetic material: magnetic flux density (left), nodal forces (right) and the total attracting force component (bottom)