

1 *Transient electro-magnetic forces.*

2 *Resulting noise.*

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## SIMULATION OF ELECTRO-MAGNETIC INDUCED VIBRATIONS

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### Vibrations in Electric Motors

The rotating electro-magnetic field in electric motors produces periodic forces which excite vibrations of the structure and generate noise in the surroundings. On the one hand the electro-magnetic forces are computed in an EM-code. On the other hand the vibrations are computed in Computational Structural Dynamics (CSD) codes.

### MpCCI FSIMapper

The tool MpCCI FSIMapper builds the link between both simulation disciplines: it maps the electro-magnetic forces from the EM-simulation as boundary condition to the structural vibration simulation.

The simulation meshes in EM and CSD can be built independently since the mapping

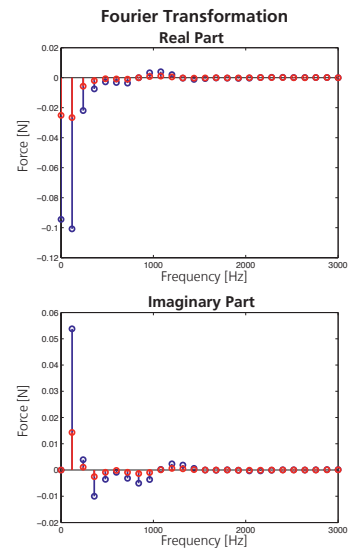
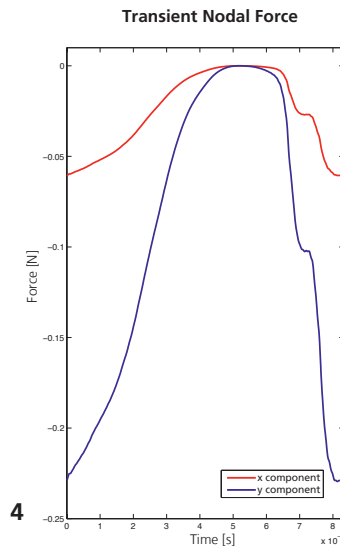
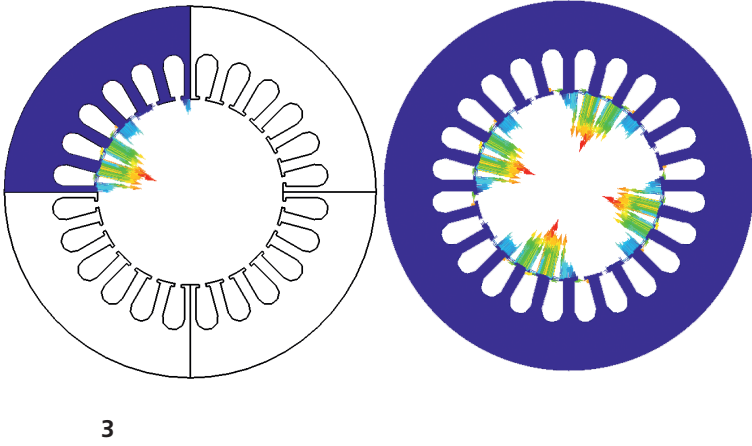
algorithms can handle different mesh discretization and element types.

As the structural vibration analysis is performed in the frequency domain, MpCCI FSIMapper automatically transforms the transient electro-magnetic forces by Fourier to fit the simulation requirements.

### Vibro-Acoustic Analyses

Using the mapped and transformed electro-magnetic forces in NVH (Noise Vibration Harshness) simulations, the resulting vibration amplitude or noise level can be determined, cf. Figure 2.





### Software Solution

MpCCI FSIMapper is a vendor-neutral mapping software, building a unidirectional file-based interface between simulation tools. It offers different spatial interpolation algorithms in order to transfer simulation results to a structural simulation mesh. The mapping algorithms handle different source and target mesh discretization, element types, geometries and unit systems.

MpCCI FSIMapper allows to read data of various CFD result formats as well as the two EM result formats of MagNet (.vtk) and JMAG (.nas), see table below.

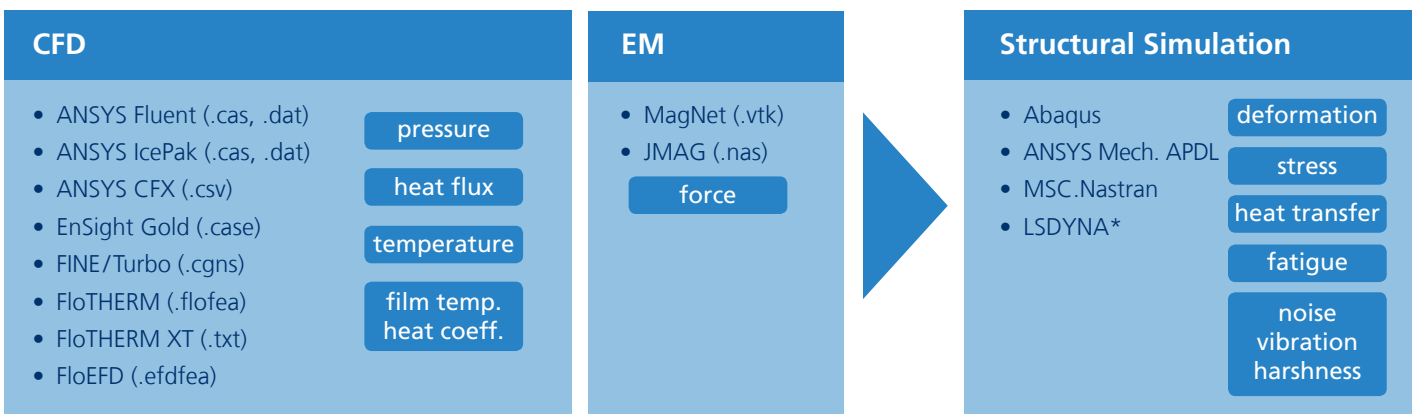
The mapped data is exported into the native target simulation syntax of Abaqus, ANSYS Mech. APDL or MSC.Nastran which allows the direct inclusion as load, boundary or initial condition. Here, static, transient and harmonic load cases are supported.

### Special Features

Often, periodic models are used in electro-magnetic simulations. In order to facilitate a straightforward mapping to a structural model, MpCCI FSIMapper offers the possibility to map data between differently shaped source and target sections. Also, the mapping to a full target model is possible (see Figure 3).

In order to create the complex loading for structural vibration analyses, MpCCI FSIMapper is able to perform a Fourier transformation (including windowing) of the transient electro-magnetic force data, cf. Figure 4. The tool offers features as windowing, time range filtering and frequency truncation for the export.

- 3 Mapping between a quarter stator section and the corresponding full model.
- 4 Fourier transformation of the transient force at a certain node.



\* Only for Fourier transformed transient data