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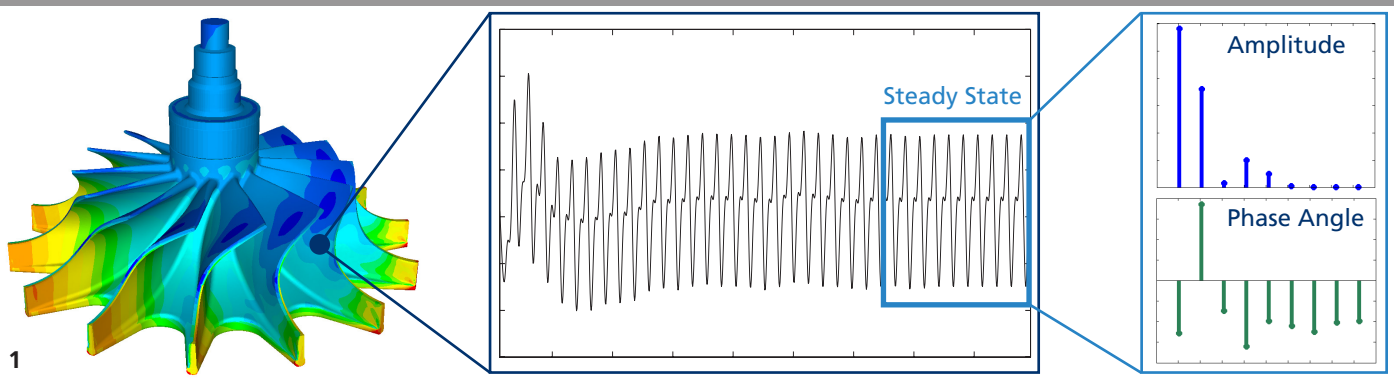

1 *Fourier transformation of transient pressure field.*

SIMULATION OF FLOW-INDUCED VIBRATIONS IN TURBOMACHINERY

Fraunhofer Institute for Algorithms and Scientific Computing SCAI

Schloss Birlinghoven
53754 Sankt Augustin, Germany

Contact
Klaus Wolf
Phone +49 2241 14-2557
mpcci@scai.fraunhofer.de
www.mpcci.de

Distributed by
scapos AG
Phone +49 2241 14-2820
www.scapos.com

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MpCCI FSIMapper

Vibrations in Turbomachinery

Due to the interaction between rotating and stationary turbomachinery components, the transient fluid flow is characterized by periodic pressure fluctuations. Those oscillations excite vibrations of the blades.

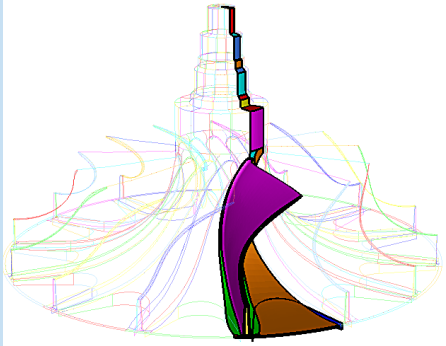
MpCCI FSIMapper

The tool MpCCI FSIMapper transfers the pressure excitation from the CFD calculation to a (not necessarily matching) structural mesh.

Since structural vibration analyses work in the frequency domain, the exciting pressure fluctuations need to be given as frequency dependent data. In this context, both conceivable CFD simulation scenarios – transient or harmonic – are supported.

In the case of **Transient CFD** results, the pressure fluctuations can be automatically transformed by the Fourier decomposition (see Figure 1) in order to create the frequency dependent loading for the vibration analysis.

Harmonic CFD results meet by definition the demands on the loading for vibration analyses. For periodic source models, they are mapped in consideration of the inter-blade phase angle.



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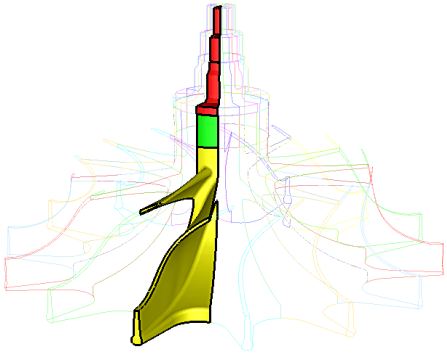

2

1 *Periodic source mapping surface (CFD).*

2 *Valid target surfaces (FEM), periodic and full.*

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 two EM result formats (see table below). The supported EnSight Gold format can be exported by diverse CFD tools (e.g. ANSYS Fluent, ANSYS CFX, STAR-CCM+, STAR-CD, OpenFOAM, etc.) which enlarges the practicability.

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 turbomachinery 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 (see Figure 1 and 2). Also, the mapping to a full target model is possible.

In order to create the complex loading for structural vibration analyses, MpCCI FSIMapper is able to perform a Fourier transformation (including windowing) of **transient** pressure data.

Here, the EnSight Gold format (.case) is supported. The tool offers features as windowing, time range filtering and frequency truncation for the export.

Moreover, MpCCI FSIMapper is able to map complex pressure excitation amplitudes resulting from **harmonic** CFD simulations as the NonLinear Harmonic method of FINE/Turbo (.cgns) or the Harmonic Balance method of STAR-CCM+ (supported via EnSight Gold '.case'). As the harmonic loading of cyclic symmetric components exhibits a special periodicity – described by a temporal inter-blade phase angle – MpCCI FSIMapper considers this angle when mapping between different source and target sections.
The included "Harmonic" Wizard allows to map several harmonic loadings at once.

CFD		EM	Structural Simulation	
• ANSYS Fluent (.cas, .dat) • ANSYS IcePak (.cas, .dat) • ANSYS CFX (.csv) • EnSight Gold (.case) • FINE/Turbo (.cgns) • FloTHERM (.flofea) • FloTHERM XT (.txt) • FloEFD (.efdfea)	pressure heat flux temperature film temp. heat coeff.	• MagNet (.vtk) • JMAG (.nas)	• Abaqus • ANSYS Mech. APDL • MSC.Nastran • LSDYNA*	deformation stress heat transfer fatigue noise vibration harshness
		force		

* Only for Fourier transformed transient data