Fraunhofer SCAI

Coupling Environment – Vendor Neutral Interface for Coupled Simulation

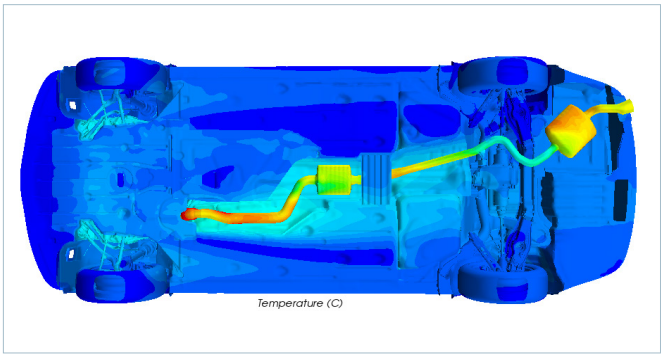
Multiphysics modelling

MpCCI is a vendor neutral and application independent interface for co-simulation. MpCCI offers advanced and proven features for multiphysics modelling:

- Accurate and robust neighbourhood calculation and mapping algorithms
- Various numeric stabilization methods
- Predefined setups for typical coupling types
- Open programming interface for in-house codes

New features in MpCCI 4.7 (May 2022)

- MpCCI GUI offers templates with predefined coupling specifications to simplify the determination of suitable settings.
- Smart configuration is introduced for fluid structure interaction (FSI) with Abaqus, FLUENT and OpenFOAM to obtain an optimal runtime compared to the default settings in MpCCI GUI.
- New tutorial has been added for biomedical FSI applications using smart configuration of MpCCI.



Automotive thermal management using TAITherm and STAR-CCM+

Supported codes

Structural analysis

- Abaqus
- ANSYS Mechanical
- MSC.Nastran
- MSC.Marc

Computational fluid dynamics

- FLUENT & ANSYS Icepak
- FINE/Open & FINE/Turbo
- OpenFOAM
- STAR-CCM+

Electromagnetic analysis

- ANSYS Emag
- JMAG

Radiation

- TAITherm

System models

- FloMASTER
- MATLAB
- MSC.Adams
- SIMPACK

Programming interface

Documented programming interface for adaptation to in-house codes

Smart automatic configurator for fast and robust fluid structure interaction co-simulations

Problem description

Without the MpCCI Configurator, the users had to set the parameters manually. This is a very convenient task for the experienced user. However, most of the end users are not fully trained to successfully carry out FSI co-simulations. Thus, an inappropriate choice of parameters leads to a divergent or a very time-consuming calculation with no useful results.

This led to the development of the MpCCI Configurator based on the smart coupling method to make the software usage simpler and more efficient.

MpCCI Configurator

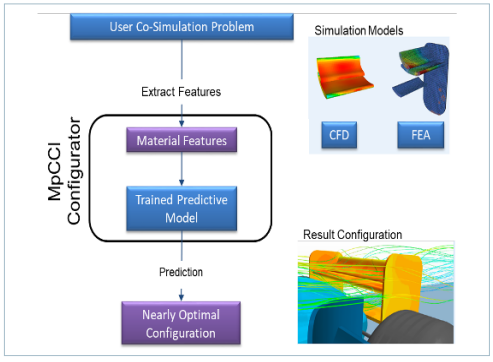
Within the smart coupling methodology, the runtime is considered as cost and the target for optimization. The following configuration parameters are used for optimization:

- Coupling scheme
- Coupling algorithm parameters
- Relaxation parameters
- Time step size

Along with these, some of the material features which have already been included are e.g. solid material density, ratio between the density of solid and fluid, solid stiffness and fluid compressibility. The MpCCI Configurator takes the features from the problem statement. Along with the relevant material features and the trained predictive model, the prediction process is carried out which provides the models with the least costs or the models with the valid configurations, whichever method is chosen at the beginning.

Benefits

The user gets optimal setting parameters based on our data knowledge from the trained models, which are a better working basis for the problem to be solved than the default values and thus lead faster to a stable solution. The scope of applications for the configurator is constantly expanding.



Steps involved in the new plug-in MpCCI Configurator

Analysis centered coupling definition

To simplify the determination of suitable settings for the user, the MpCCI GUI offers predefined coupling specifications for various coupling types corresponding to specific physical domains and a typical set of quantities which are exchanged. Below you will find the excerpts from some of the coupling specifications.

Category – General

General two-domain coupling

Coupling of two domains with no restriction to domain types, quantities or coupling parameters.

Category – FSI

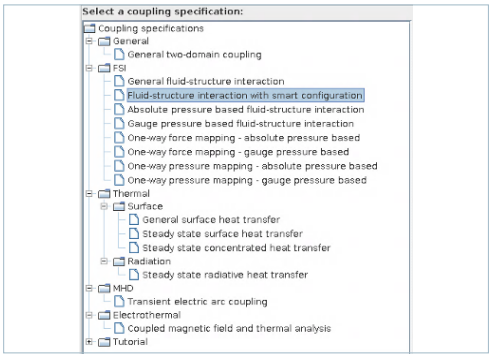
Fluid-structure interaction with smart configuration

The configuration depends on the used models and will be set automatically by MpCCI. It is currently only available for Abaqus, FLUENT and OpenFOAM.

Category – Thermal

Steady state surface heat transfer

The configuration is suited for heat transfer in conduction and convection effects for solid and fluid thermal domains.



The coupling specifications provided in v 4.7

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