

- 1 3D CFD mesh.
- 2 Visualization of coupled model.
- 3 Flowmaster network.

MpCCI FLOWMASTER ADAPTOR 1D-3D SIMULATIONS

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Market Demands

The increasing demand for shorter product development lifecycles and fewer physical tests while maximising quality is challenging organizations to bring together their 'best-in-class' simulation tools for each discipline and to enable them to work together in pursuit of virtual prototypes for entire systems.

Generic 1D-3D Solution

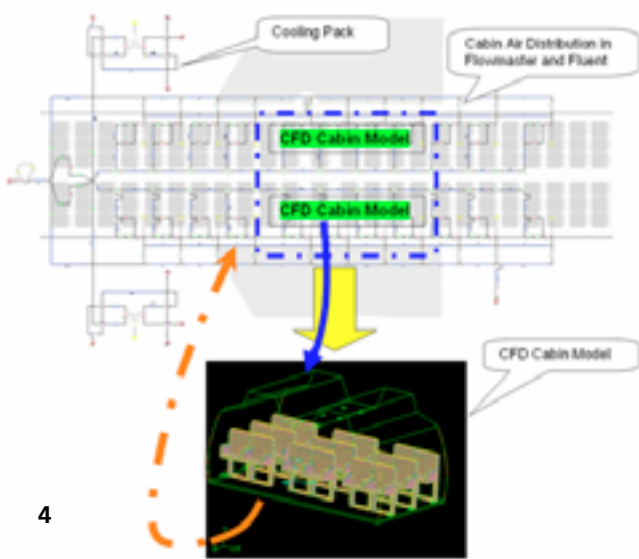
The MpCCI Flowmaster Adaptor is a 1D-3D coupling link which allows Flowmaster to co-simulate with 3D CFD applications including STAR-CD® (by CD-adapco), FLUENT® (by Ansys Inc.), FineHexa (by Numeca), or in house CFD-codes. It has been developed to give multidisciplinary, multifunctional project teams the ability to understand how various simulation models

interact with each other and to figure out the impact each sub system has on the overall system performance.

Technical Approach

MpCCI is a software environment which enables the exchange of data between Flowmaster and one or more other simulation codes in the coupling region. MpCCI allows the exchange of almost all types of data between the coupled codes, for example, energy and momentum sources, material properties, mesh definitions or global quantities. The details of the data exchange stay in the background of the MpCCI interface.

The MpCCI Flowmaster Adaptor is a code adapter, linked either statically or dynamically, to establish a direct connection between the MpCCI Coupling Server and Flowmaster using API's, which means that no modifications are required to Flowmaster V7.



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Flowmaster
in action

Setup of coupled 1D-3D Models

Running a 1D-3D co-simulation consists of the following stages:

1. Creating, verifying and validating a 3D CFD model.
2. Creating, verifying and validating a Flowmaster V7 model.
3. Building connections between Flowmaster and the 3D coupled code using MpCCI. Flowmaster V7 facilitates this by using COM controllers (gauges and controllers) which are able to send and receive data to and from MpCCI.
4. Run co-simulation to achieve convergence.

Application Areas

Obviously, the MpCCI Flowmaster Adaptor can be used anywhere you want to inspect the detailed flows and designs of particular components within complex networks:

- Virtual Prototyping of Gas Turbine Blades—CFD to model the interblade cavities, FE to model the blades and Flowmaster to model the in-blade cooling channels
- Engine cooling systems—Modelling the cylinder head and cylinder cooling-jacket with CFD and the external cooling circuit with Flowmaster
- Fuel systems (1D) coupled with carburetors (3D)
- Within engines (or any combustion process): Fuel (1D) and air (1D)
- Combustion chambers (3D)—Exhaust (1D)

Benefits and Impact

The MpCCI Flowmaster Adaptor brings together the speed and robustness of 1D system modelling with the complexity of 3D CFD, enabling Flowmaster V7 to be used for calculations of the entire flow system and CFD to perform detailed computational calculations.

For example developing a 3D CFD model for an entire system—such as an automotive cooling system—presents significant challenges. Creating the computational models and their meshes may take a long time and the total number of cells required may make the calculations intractable (i.e. they may take too long, if they can be done at all).

By co-simulating 1D with 3D CFD, more realistic boundary conditions and component models can be obtained, providing a deeper understanding of complex engineering systems.

Flowmaster Group

Flowmaster Group is an international organization with more than 18 years experience in providing industry leading fluid systems simulation software to the aerospace, automotive, marine, oil & gas, power generation, process, rail and water industries.

With its headquarters in the United Kingdom, the Flowmaster Group employs 70 people and has offices in the USA, Germany and India. Flowmaster system simulation software enables design engineers and analysts to understand the complex internal flow and thermal effects within fluid systems at the concept stage and throughout the development process. Flowmaster provides users with a greater understanding of fluid systems much earlier, increasing quality and performance while shortening the development cycle.

For more information on Flowmaster, please visit: www.flowmaster.com or send an email to: info@flowmaster.com



4 Top: Network model of an aircraft ECS system. Bottom: 3D CFD model of a part of the aircraft cabin.