Lib-ICE: a C++ object-oriented library for ICE simulation

F. Piscaglia	Dipartimento di Energia, Politecnico di Milano, via Lambruschini 4, 20156 Milano (Italy)
A. Montorfano	Dipartimento di Energia, Politecnico di Milano, via Lambruschini 4, 20156 Milano (Italy)
A. Onorati	Dipartimento di Energia, Politecnico di Milano, via Lambruschini 4, 20156 Milano (Italy)

Abstract

A set of applications, solvers and utilities for the simulation of intake and exhaust systems of Internal Combustion Engines (ICE) developed in the OpenFOAMR technology was embedded by the authors into LibICER. In this work, applications for the multi-dimensional acoustic simulation of silencers by a non-linear approach will be presented first.

High-order differentiation schemes have been used with ad-hoc developed boundary conditions of common acoustic excitation sources (frequency sweep, white noise and impulse) and a partially reflecting outlet boundary condition to predict transmission losses and transfer functions on different silencer's geometries.

In the second part of the work, new classes to add explicit sink terms depending on flow velocity, for the calculation of pressure jumps across cell surfaces in the momentum equation, will be presented. Code validation has been performed on test cases available from the literature by porousJumpPisoFoam, a new multidimensional parallel FV PISO compressible solver. Classes to model pressure jump have been used to develop dpfPisoFoam, a new solver to simulate the Diesel Particulate Filter (DPF) hydrodynamics, the transport of the soot and its filtration through the filter's porous walls. A comprehensive methodology based on specific algorithms for efficient full-scale DPF simulation has been developed to favor automatic mesh generation and case setup.

Finally, the early development of a fully 1D two step Lax-Wendroff solver coupled with implicit intra-pipe 1D boundary conditions for typical engine devices, will be presented. The derived application 1dEngineFoam has been expressly though for fast engine simulation and it makes use of a specific 1D grid that is generated through a derived class of fvMesh.