High Resolution Central Schemes for Multi-Dimensional Non-Linear Acoustic Simulation of Silencers in Internal Combustion Engines

F. Piscaglia, A. Montorfano, A. Onorati, G. Ferrari
Dipartimento di Energia - Politecnico di Milano, via Lambruschini 4, 20156 Milano (ITALY)

Abstract

Central schemes may serve as universal finite-difference methods for solving non-linear convection-diffusion equations, because they are not tied to the specific eigenstructure of the problem. Because of their small numerical viscosity even when very small time steps are enforced, they look very suitable for acoustic simulations of silencers in internal combustion engines. In this work, a high resolution central scheme has been used with ad-hoc developed boundary conditions for the generation of different acoustic perturbations (white noise, sweep, impulse) in the OpenFOAM® technology.

The temporal solution, carried out by a fourth order explicit integration of the conservation laws by the Runge-Kutta method, has been first transferred into the frequency domain using FFT and then it has processed to evaluate the transmission loss (by the two-microphone technique) and the transfer function of different geometries of silencers for internal combustion engines. The results obtained from the simulations have been compared with experimental data.

Corresponding author: Tel. (+39) 02 2399 8620, Fax (+39) 02 2399 3863, e-mail: federico.piscaglia@polimi.it
†Tel. (+39) 02 2399 3909; e-mail: andrea.montorfano@polimi.it
‡Tel. (+39) 02 2399 8416; e-mail: angelo.onorati@polimi.it
§Tel. (+39) 02 2399 3915; e-mail: giancarlo.ferrari@polimi.it