Boundary conditions and subgrid scale models for LES simulation of Internal Combustion Engines

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

Abstract.
The implementation and the combination of advanced boundary conditions and subgrid scale models for Large Eddy Simulations are presented. The goal is to perform reliable cold-flow LES simulations in complex geometries, such as cylinder engines. In the paper, an inlet boundary condition for synthetic turbulence generation is combined with a fully non-reflecting Navier Stokes Characteristic Boundary Condition (NSCBC) for the outlet and with a Wall-Adapting Local Eddy-viscosity (WALE) subgrid scale model. The WALE model is based on the square of the velocity gradient tensor and it accounts for the e ects of both the strain and the rotation rate of the smallest resolved turbulent fluctuations and it recovers the proper y3 near-wall scaling for the eddy viscosity without requiring dynamic pressure; hence, it is supposed to be a very reliable model for ICE simulation. Model validation has been performed separately on different test cases; naturally, uncompressible LES simulation of in-cylinder cold flows has been performed. The code developed has been included into LibICE®, a set of applications and libraries for multi-dimensional engine modeling based on the OpenFOAM® technology.