

Numerical simulation of turbulent incompressible and compressible flows over rough walls

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ABSTRACT

In this work, turbulent flows over rough walls are modelled numerically by solving averaged Navier-Stokes equations closed by different two-equation turbulence models. Turbulence models are eddy-viscosity SST [2] model and explicit algebraic Reynolds stress model [3]. Both models use k - ω system for turbulent scales. Boundary conditions for k - ω system on rough walls are prescribed directly on the wall according Hellsten, Laine [1]. Several incompressible and compressible flow cases are presented: constant pressure boundary layer, decelerated flow over a smoothly contoured ramp with flow separation, and compressible flow through a turbine cascade. Obtained numerical results are compared with experimental data.

The mathematical model is solved using implicit cell-centered finite volume method with quadrilateral finite volumes. In the compressible case, the AUSM upwind method for inviscid fluxes is used. In the incompressible cases, artificial compressibility method is used with upwind method similar to AUSM. The diffusion fluxes are approximated using central second order scheme on dual grid of quadrilateral volumes. The time discretization was carried out by the implicit backward Euler scheme with the Newton linearized system solved iteratively.

References

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