OpenFOAM Simulation of Turbulent Flow Through T-Junction

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Abstract

In this migration project, a steady-state simulation of turbulent flow through a rectangular T-junction was carried out using OpenFOAM's simpleFoam solver with the standard k–ε turbulence model. The setup models a cross-flow and an incoming side jet, both at a bulk Reynolds number of 7500, to replicate conditions from a benchmark LES study. The primary focus was on validating the simulation by comparing the variation of non-dimensionalized axial velocity with respect to non-dimensionalized vertical distance at several axial locations along the T-junction, specifically at a momentum ratio (MR) of 2. Velocity profile comparisons were performed at five critical positions: the entrance, the T-junction center, and three downstream sections. The streamlines and contour plots obtained from the simulation showed flow patterns such as merging, reattachment, and symmetry that closely resemble those reported in the reference study. As the reference paper had used LES (Large Eddy Simulation) and current project is based upon RANS (Reynold's Average Navier Stokes) model due to which slight quantitative differences were observed. The overall trends in velocity profiles and streamline structures were in good agreement, confirming that the simulation effectively captures the essential flow dynamics in a T-junction configuration.

References

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