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CFD Performance of Turbulence Models for Flow from Supersonic Nozzle Exhausts

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This research compares the performance of several eddy-viscosity turbulence models for computing supersonic nozzle exhaust flows. These flows are of relevance in the development of future supersonic transport airplane. Flow simulations of exhaust flows from two supersonic nozzles are computed using ANSYS Fluent. Simulation results are compared to experimental data to assess the performance of various one- and two-equation turbulence models for accurately predicting the supersonic plume flow. Results show that the standard eddy-viscosity models can capture the shock structure and shear layer of the plume accurately when the thickness of the shear layer is small compared to plume diameter. However, when thickness of the shear layer is relatively large, a compressibility correction is required for accurate simulation. Compressibility corrections are implemented in simulations with SST k-ω, k-ε and low Reynolds versions of k-ε models which improved the results compared to the baseline models without compressibility correction.