INVESTIGATION OF THE TURBULENT TRANSPORT IN AN ACCELERATED TURBULENT FLOW

Abstract

by

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This research investigated the turbulent transport of heat and momentum in an accelerated and highly turbulent flow with large density gradients. Both experimental and numerical data were acquired to study this phenomenon. Experimental measurements were obtained at the inlet and exit of an annular nozzle with two different inlet total temperature distributions. The two cases included a nominally uniform total temperature distribution and a non-uniform total temperature distribution where the total temperature at the walls was lower than the center of the span by \( \approx 10\% \). In order to evaluate various turbulence models and quantify the turbulent Prandtl number, numerical solutions were obtained in a computational domain similar to the experimental geometry. A theoretical model for turbulent Prandtl number was developed based on the intermediate mixing length concept. This model correctly predicted the turbulent Prandtl number required for the computation to closely match the experimental data for the nozzle flow rig. This model was then also validated against independent experimental measurements of turbulent Prandtl number in jet flow, flat plate boundary layer, and turbulent pipe flow.