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Computations of Turbulent Boundary Layers Subjected to Various Localized Pressure Gradients RICARDO VINUESA MOTILVA, HASSAN NAGIB, IIT, Chicago — Four different localized pressure gradient configurations were computed using a commercially available code by means of four RANS turbulence models (SA, $k-\epsilon$, SST and RSM), and compared with experimental measurements of the mean flow quantities and the wall shear stress. The pressure gradients were imposed on high Reynolds number, 2-D turbulent boundary layer developing on a flat plate by changing the ceiling geometry. Two converging humps (at $x = 2m$ and $x = 5.5m$ from the leading edge of the plate) and two diverging humps at the same locations were considered. The SST model produced the best agreement with experiments. A complimentary study about how the models deal with numerical transition was done by solving a zero pressure gradient (ZPG) configuration. We find that the major differences between the results from the models when predicting mean flow quantities are essentially produced by the numerical transition process. This process does not belong to the models themselves, and it is a procedure by which the software transforms the simple laminar boundary conditions at the inlet into inflow conditions which characterize the turbulent flow when turbulence has already been developed. Therefore, models requiring the simplest inflow conditions lead to better results and consequently models such as the RSM suffer the most and ultimately lead to inferior results.

Hassan Nagib
IIT

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