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A rescaling method for generating inflow conditions in simulations of supersonic boundary layers

***N. Hu[1] and H.D. Ma[1]**

[1]China Academy of Aerospace Aerodynamics, China.

*Corresponding author: h_ning@pku.org.cn

A method for generating turbulent inflow data for simulations of spatially developing boundary layers has been presented. The approach is based on solving for the turbulent mean velocity/temporature profile at the inlet station and mapping the fluctuations from a reference station to the inlet. The mean velocity profile is solved from the Favre-averaged mean momentum equation with the Reynolds stress calculated from a turbulent model proposed by Zhang et al. (Phys. Rev. Lett. 109, 054502). The mean temperature profile is obtained by applying a generalized Walz's law. LES of adiabatic zero pressure gradient flat plate boundary layer flows at Mach = 2.25 is carried out using fully spatial method with transition region from laminar to turbulent, and also using the inflow condition proposed herein. The boundary layer development and turbulent statistics obtained with the proposed method agree well with the fully spatial approach, with negligible transient section length.

Keywords: boundary layer, supersonic, turbulence, inflow condition