Blunt-fin induced interaction of wall shear layers in supersonic flow

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The topic of this contribution is a numerical study of three-dimensional supersonic flow over a blunt fin mounted on a flat plate. The flow pattern is characterized by complex interaction of shock waves and the boundary layer along the plate surface. In this paper the steady-state results for two free stream Mach numbers $M=3$ and $7$ will be discussed and compared with experiments. For the numerical investigation a time-marching integration method has been applied based on a three-stage Runge–Kutta scheme. Several convergence acceleration techniques have been adopted. Since crisp shock fronts must be resolved for a proper computation of the interaction phenomena the mesh has been adapted in those regions where strong pressure gradients are expected. In addition, a special treatment of the artificial viscosity terms which enhances stability in regions with shocks has been introduced to achieve some upwind properties of the scheme which utilizes central differences for the spatial derivatives. For the simulation of turbulent flow algebraic models have been applied, namely, a Baldwin–Lomax model and a new turbulence model which is based on RNG-theory. The comparison with the experiments shows that for the case studied here the transitional character of the boundary layer has to be taken into account.

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