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Title

Numerical and experimental investigation of the shockwave boundary layer interaction of laminar/transitional flow past a sharp fin

Authors

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Abstract

The effects of shock impingement and interference on local aerodynamic heating have been and still are a key issue for the design of hypersonic flight vehicles[1]. At this time DLR is involved in continuous series of sounding rocket flight experiments studying hot structures. One of these experiment is the STORT flight experiment which focuses on aerothermal loads on fins as well as other structures[2]. One essential flown experiment is the fins experiment on the third stage. The fins were investigated both on the vehicle, in windtunnels in Cologne and Göttingen but also numerically. For the windtunnel experiment in the HEG (High Enthalpy Shock Tunnel Göttingen) the object of investigation is a plate mounted fin which scales 1:2 to the flight hardware. The fin induced shock boundary layer interaction (SWBLI) on the plate leads to increased thermal loads. The heat flux on the flat plate and fin are investigated using temperature sensitive paints (TSP[3]). In a previous study first experimental and numerical results for a sharp fin on a flat plate for two freestream HEG conditions at Mach 7.4 were presented [4]. CFD calculations at both 0 deg AoF and 15 deg AoF were performed and compared for flow topology and turbulence model influence. While the XIII condition compared well between experiment and CFD, the XV condition which showed clear signs of transitional flow exhibits rather complex physical phenomena which require further investigation, both experimentally and numerically. In the current study we extend the investigation to the other conditions/configurations studied and supplement the studies using RANS turbulence modelling by using Detached eddy simulation(DDES) for select cases in order to gain a better understanding of the complex flow field found in the experiment.

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