COMPUTATIONAL ANALYSIS OF SHOCK WAVE LAMINAR BOUNDARY LAYER INTERACTIONS IN NON-EQUILIBRIUM HYPERSONIC FLOW

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In this paper we report and discuss the results of the computational analysis of the flowfield past the test bed shown in Fig.1. It consists of a double wedge model with L_1=50.8 mm, θ_1=30 deg, L_2=25.4 mm; θ_2=55 deg, and with width 101.6 mm long (see Fig.1) that has been used in a test campaign performed in the Hypervelocity Expansion Tube (HET) at the University of Illinois. Along with the center of the model 19 coaxial thermocouple gauges at 16 different streamwise locations are mounted. Therefore, several experimental data are available for numerical-to-experimental comparisons, reported in the present work, to address the Shock Wave Laminar Boundary Layer Interactions and resulting heat transfer in hypervelocity double wedge non-equilibrium flow.

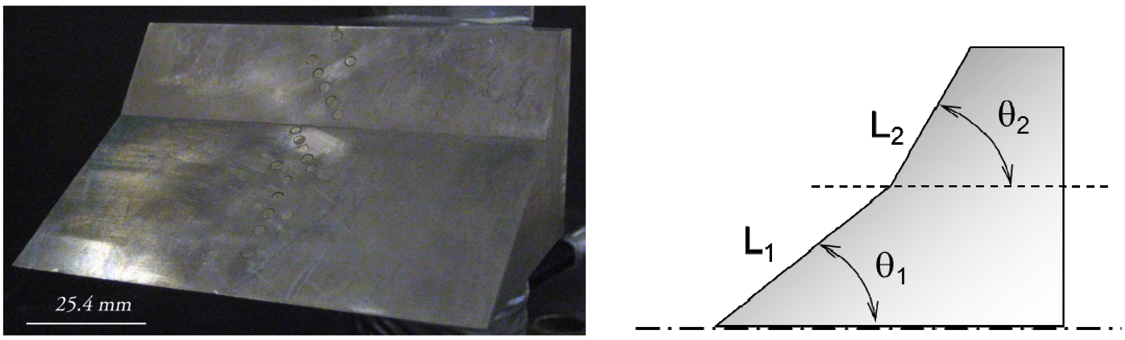

Figure 1. Test bed configuration with quotes.

The flow over a double wedge model is a canonical problem in the study of hypersonic shock wave-boundary layer interactions. In fact, flowfield computations are very sensitive to the choice of thermochemical model, and thus make the problem ideal for model verification. Moreover, the flowfield contains complex, but coupled phenomena, including: boundary layer separation, shock and shear layers interaction, and shock impingement.

Finally, the double wedge model is also important to address the complex flow phenomena that take place in the flowfield past a deflected aerodynamic control surface of hypervelocity re-entry vehicle.

As an example of preliminary CFD results, Fig. 2 shows the Mach number contours field that takes place past the test bed compared to a Schlieren image of the experiment in the wind tunnel.

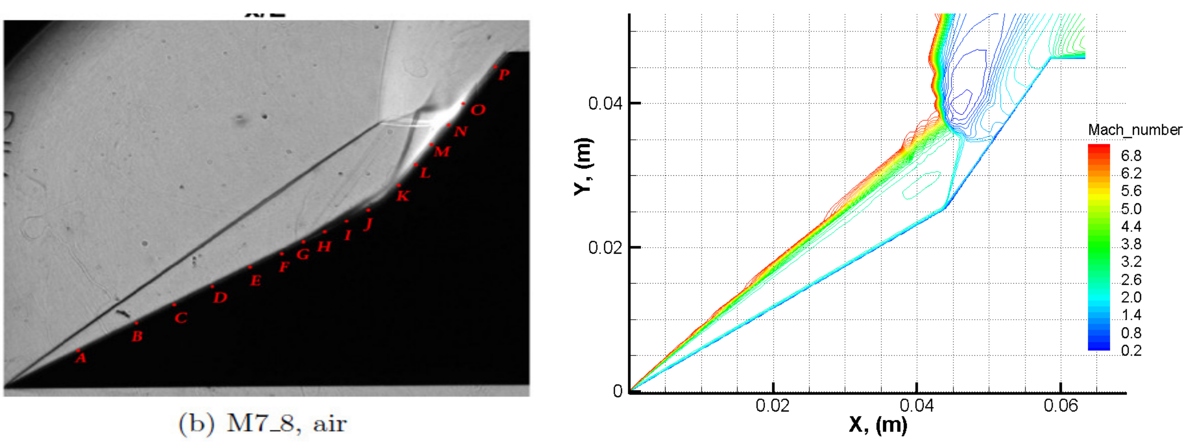

Figure 2. Mach number contours field and a Schlieren image of the experiment in the wind tunnel [1].

This research results have been obtained in the framework of **RTO AVT 205: "Assessment of predictive capabilities for Aerothermodynamic Heating of Hypersonic Systems". Report No. 2 .**

Reference

[1] Swantek, A.B., Austin, J. M., "Heat Transfer on a Double Wedge Geometry in Hypervelocity Air and Nitrogen Flows", **50th AIAA Aerospace Sciences Meeting including the New Horizons Forum and Aerospace Exposition. 09 - 12 January 2012, Nashville, Tennessee.**
AIAA 2012-0284.