Readers' Forum

Brief discussions of previous investigations in the aerospace sciences and technical comments on papers published in the AIAA Journal *are presented in this special department. Entries must be restricted to a maximum of 1000 words, or the equivalent of one* Journal *page including formulas and figures. A Discussion will be published as quickly as possible after receipt of the manuscript. Neither the AIAA nor its editors are responsible for the opinions expressed by the correspondents. Authors will be invited to reply promptly.*

Comment on "Conical Similarity of Shock/Boundary-Layer Interactions Generated by Swept and Unswept Wings"

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THE authors of Ref. 1 have used selected results of tests carried out in the Gas Dynamics Laboratory of Princeton University several years ago. The present authors have continued the studies over the past two years, re-examining *all* of the data generated for many years and some new results. The present authors have reached somewhat different conclusions than those presented in the subject paper. We believe that the concepts of conical flow and separation, stressed so strongly in the subject papers, are, at best, a rough approximation that may only be applied locally, if at all. In some cases, these are conjectures that are not definitively tested. The following key factors are the basis of our comments:

1) All of the experiments presented use only one upstream length scale, the boundary-layer thickness δ. δ is a constant only for two-dimensional interactions. As the sweep increases, δ varies considerably due to the longer boundary-layer run to the shock location furthest from the generator wing. For the thin boundary-layer cases, which are a significant part of the subject paper, the boundary-layer thickness varies by 50% over the interaction studied. As yet, the present authors have no way to specifically eliminate this effect in either the tests or in their scaling computations.

2) The subject paper makes a distinction between so-called inception and conical regions. There is, in fact, no clear definition of this boundary. The parameter L_s was chosen as 10×10^{-2} in the previous work of Lu[2] and Goodwin.[3] It is arbitrarily chosen as 16×10^{-2} in the subject paper. Figure 9 of Ref. 1 shows clearly the limited extent of the validity of the asymptotic conical assumption. It clearly depends on the definition of where the inception region ends, the limited extent of the experiments, and the effect of the δ variation noted in point 1 above for these highly swept interactions. In addition, it should be noted that the pressure distributions of Fig. 7, which are used to show that the flow is conical, are located within the defined inception zone.

3) Many of the details observed from surface flow visualization and local vapor screen are difficult to interpret and have not been supported by other more quantitative measurements. The widely used surface flow-visualization technique has not been characterized as to sensitivity, and we have found no way this technique takes into account unsteady effects that have clearly been found. The local flow-visualization pictures, Fig. 2 of Ref. 1, gives the impression that the flow lifts off the surface. This may be so but the picture must be interpreted in light of the strongly three-dimensional nature of the flow and the two-dimensional illumination. From the picture, no particle, at any point in the illuminated path, is connected with the motion of any other particle; that is, the particle at the surface to the left of the figure does not follow the same path as a particle at the upper part of the so-called separated flow. Each particle in the picture comes from an unknown area since the seeding is uncontrolled.

4) "Separation" in three dimensions is a difficult concept at best but, as defined in the subject paper, has yet to be revealed from flowfield measurements (although there have been considerable efforts to do so). Flow angles relative to the surface of only 6-8 deg have been found from both measurements and calculations, but only at a significant distance off the surface. This is a small fraction of that shown in the local vapor-screen pictures presented in Ref. 1.

5) Recent work has clearly shown an unsteadiness in some part of the interaction.[4,5] This has not been revealed by the previous instrumentation and has become clear only as new high-frequency instrumentation has been applied to this complex interaction.

The subject paper has much to contribute, but the strong conclusions regarding separation and conical flows are far from supported by our current studies.

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[3]Goodwin, S.P., "An Exploratory Investigation of Sharp Fin-Induced Shock Wave/Turbulent Boundary-Layer Interactions at High Shock Strengths," M.S.E. Thesis 1687-T, Mechanical and Aerospace Engineering Department, Princeton University, Princeton, NJ, Nov. 1984.

[4]Tan, D.K.M., Tran, T.T., and Bogdonoff, S.M., "Surface Pressure Fluctuations in a Three-Dimensional Shock Wave/Turbulent Boundary Layer Interaction," AIAA Paper 85-0125, Jan. 1985.

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