SPC 407: Supersonic and Hypersonic Fluid Dynamics

Project Sample

Due Date: 25 December 2016

Project Scope:

The project should include the simulation of a supersonic or hypersonic flow. Comparing the simulation data with experimental results is a must.

Project Requirements

- Project teams will be composed of 3 to 5 students
- Each group should choose a project (sample projects are provided below) and receive a written approval by the professor on the project by November 13, 2016.
- A written report should be written in a scientific paper format (you can download a word template from this link). The report due date is 8:20 am on Sunday, 25 December 2016.
- Two Follow up reports should be submitted by Dec 1 and 15. Each report grade weight is 15% of the project
- Oral Presentation will be conducted in the lecture by Sunday, 25 December 2016. Each group should present its project within 15 minutes in the lecture.

Three samples of the projects are shown in the following pages:

Sample Project 1

Simulation of Compressible flow around a biconvex arc airfoil and validation with available experimental data listed below:

1. AbdulHamida, Toufique Hasan, Compressible flow characteristics around a biconvex arc airfoil in a channel, Propulsion and Power Research Journal, Volume 3, Issue 1, March 2014, Pages 29–40
2. A.B.M.T. Hasan, S. Matsuo, T. Setoguchi, A.K.M.S. Islam, “Effects of condensing moist air on shock induced oscillation around an airfoil in transonic internal flows”, International Journal of Mechanical Sciences, 54 (2012), pp. 249–259

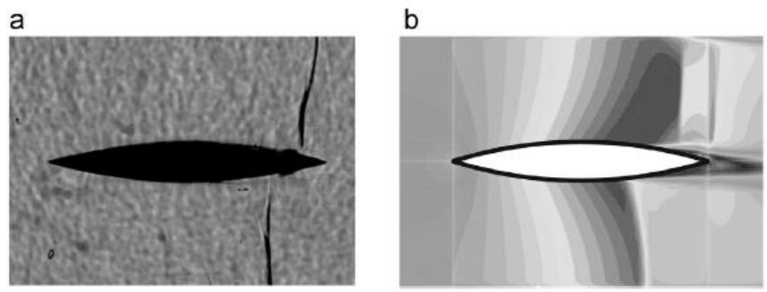

Figure 2 Instantaneous flow field with shock waves. (a) Experimental Schlieren photograph [14] for $p_{b0}/p_{01}=0.70$ and (b) Mach contour from present computation for $p_b/p_{01}=0.69$ (15% thick airfoil).

You can download the papers from the following links:

AbdulHamid Paper

Hassan Paper

Sample Project 2

Transonic Nozzle flow solution and validation with available experimental data of Back and Cuffel AIAA paper(“Transonic Flowfield in a Supersonic Nozzle with Small Throat Radius of Curvature”, AIAA Journal Vol. 7, July 1969 1364–1366).

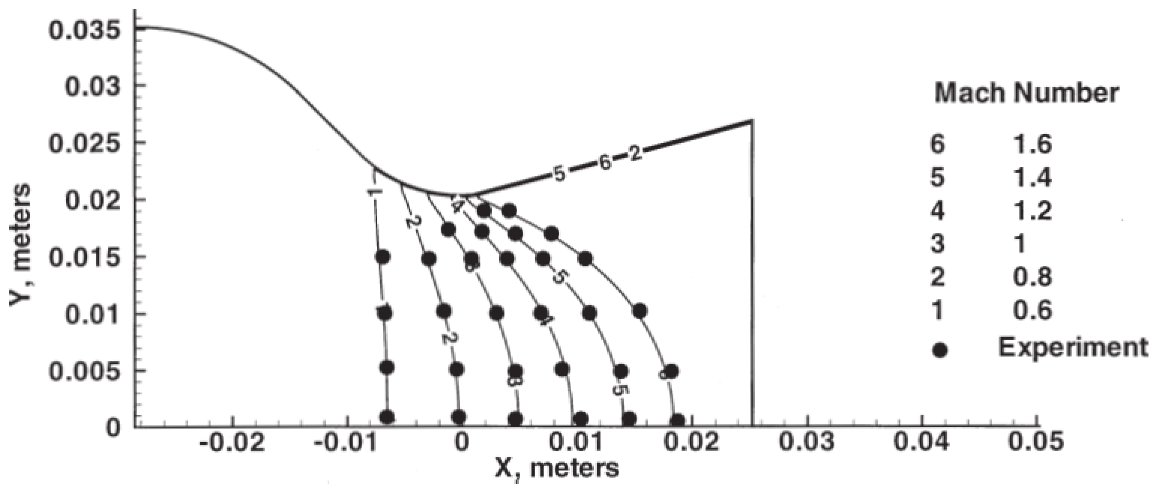

Fig. 1. (a) Mach number contours for back and cuffel nozzle.

You can download the Back and Cuffel paper from this link

[Cuffel Paper]

Sample Project 3

The simulation of a Supersonic flow over 5 and 30-deg half-angle sharp leading edge wedges at Mach numbers of 4 and 6 at different angle of attack. Compare the simulation results with the experimental data of Schaaf paper("Aerodynamic Characteristics of Wedges in Low Density Supersonic Flow", ARS Journal, Vol. 31, No. 2 (1961), pp. 194-200.).

The paper can be downloaded from the following link

Schaaf Paper

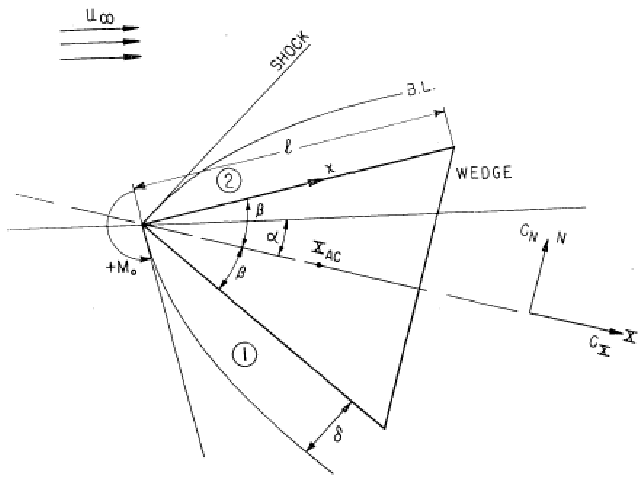

Fig. 3 Wedge airfoil at angle of attack

The drag and lift coefficients has been calculated experimentally at different angle of attacks as shown below

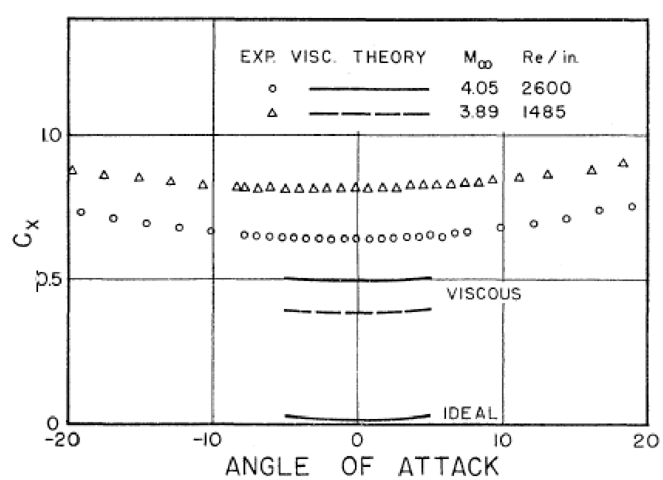

Fig. 4 5-deg half-angle wedge, axial force coefficient, Mach 4

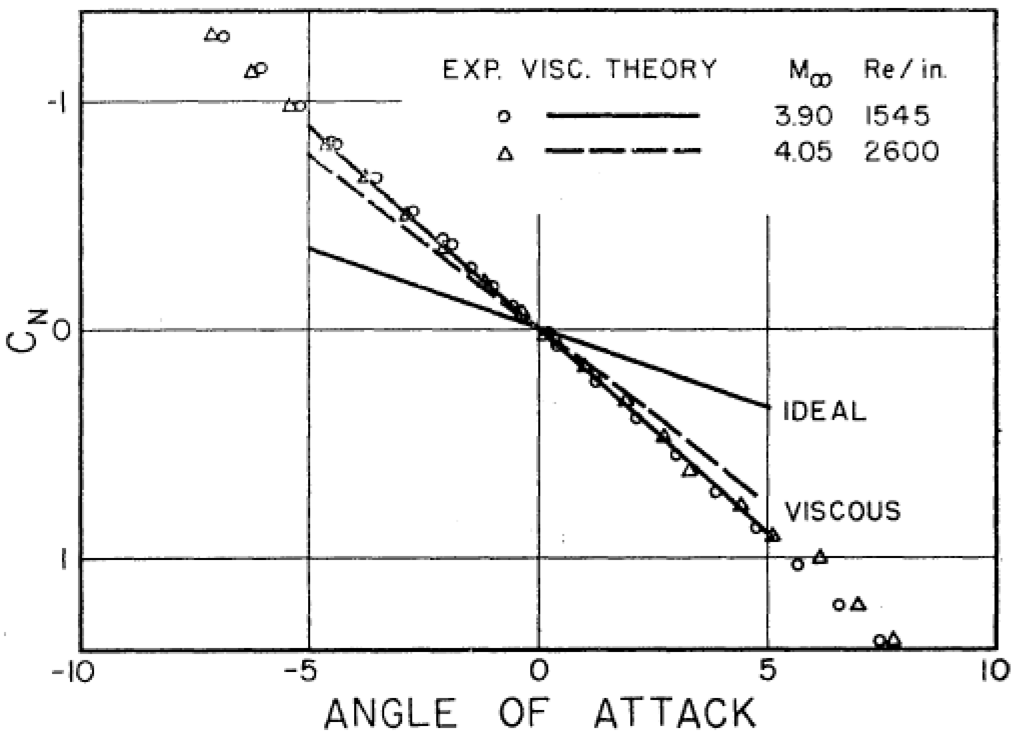

Fig. 8 5-deg half-angle wedge, normal force coefficient, Mach 4

The two models were 5-deg and 30-deg half angle wedges. The width was 0.750 in. for both models, and the slant length along one flat surface was 1.211 and 0.865 in. for the 5- and 30-deg half-angle wedges, respectively. There was no afterbody attached to the wedge. The internal, cross stream sting was centered 0.612 in. behind the vertex of the 30-deg half-angle model and 1.091 in. behind the vertex of the 5-deg half-angle model.