Mach 2 Wedge

Problem Description

This is a simulation of a symmetric 20^o wedge traveling through initially quiescent air at Mach 2.0. A shock forms at the leading edge of the wedge and an expansion fan over its top. Consultation of oblique shock tables, e.g. [1] (pp.308-309) reveals that the angle of the leading shock compares quite well with the expected value. In addition, this simulation demonstrates a few other useful features of the fluid-structure interaction capability. In this case, the structure is rigid, and as such, essentially provides a boundary condition to the compressible flow calculation. Furthermore, the geometry of the wedge is described via a triangulated surface, rather than the geometric primitives usually used. This allows the user to study flow around arbitrarily complex objects, without the difficulty of generating a body fitted mesh around that object.

Simulation Specifics

Component used: rmpmice (Rigid MPM-ICE)

Input file name: Mach2Wedge.ups

Command used to run input file: sus Mach2Wedge.ups
(Note: The files wedge40.pts and wedge40.tri must also be copied to the same directory as sus.)

Simulation Domain: 0.25 x 0.0375 x 0.001 m

Cell Spacing:
.0005 x .0005 x .001 m (Level 0)

Example Runtimes:
1.5 hours (1 processor, 3.0 GHz Xeon)

Physical time simulated: 0.64 milliseconds

Associate scirun network: Mach2Wedge.srn

Results

Figure 1 shows a snapshot of the simulation. Contour plot depicts pressure and reflects the presence of a leading shock and an expansion fan.

References

[1] M. A. Saad. *Compressible Fluid Flow.* Prentice-Hall, New Jersey, 1985.

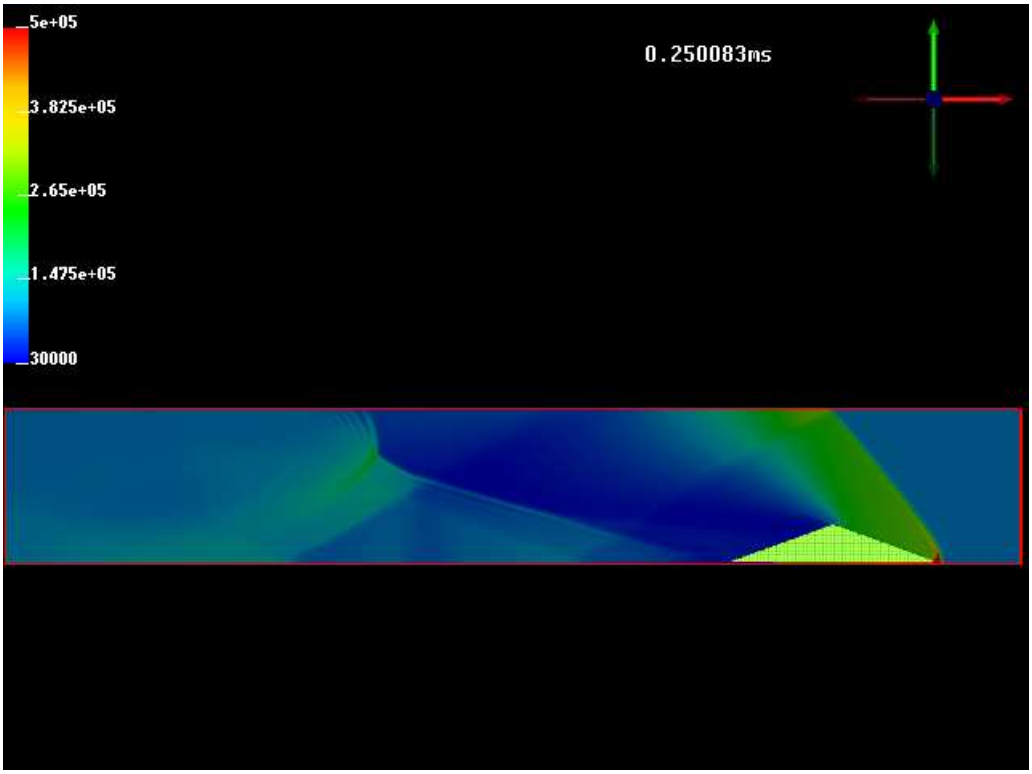

Figure 1: 20^o wedge moving at Mach 2.0 through initially stationary air. Contour plot depicts pressure.