AAE 519 Prof. Schneider, Fall 2007
Problem Set 7
Handed Out: Friday, 9 November
Due: Friday, 30 November

For a sample trajectory in altitude-velocity space, compute the properties behind a normal shock in equilibrium air, and compare to the properties for a perfect gas.

Section 14.3 in the text works through the normal-shock relations, which should be familiar to you. Study this section, and subroutine `eqashksi`, which implements the algorithm to solve for the normal-shock flow. Correlations for the thermodynamic properties of equilbrium air are provided in subroutines `tgas` and `hgas`; see Anderson section 11.13 for a description. The properties of the atmosphere are given in subroutine `atmo76`, which was also supplied.

Examine Anderson Figure 9.13 (2nd ed.). Arbitrarily select a curve which passes through this altitude-velocity space, from an orbital velocity of your choice, down to landing. A straight line would be an acceptable preliminary curve. At intervals along this trajectory, compute the static and stagnation temperature behind the shock, along with the static and stagnation pressure. When computing the stagnation conditions, make the elementary inviscid assumption that all of the energy and momentum is conserved between the conditions behind the shock and the stagnation conditions (thus neglecting heat transfer, etc.) Perform these computations both for equilibrium air, and for a perfect gas with $\gamma = 1.4$. Compare the results. Generate a number of plots similar to Anderson Fig. 1.18.

Your results should be presented in the form of a brief informal report, describing your methods and results. Include descriptions of the subroutines provided, and of the basis for their algorithms. Include listings of the source code in an appendix. How significant are the high-enthalpy effects for your trajectory? What is the difference between the static and stagnation conditions behind the shock? What does this difference depend on?