

AME 60636
Prof. J. M. Powers
Homework 12
Due: Monday 30 April 2012

1. Consider the one-dimensional analog of the model given by Powers and Gonthier.¹ Use as a starting point Equations (1-8) taking $v = 0$, and take all parametric constants to be those given in the paper.
 - (a) Reproduce the scaling arguments to get the proper one-dimensional analog of Equations (12-17).
 - (b) Select a wave speed which generates an eigenvalue detonation. For this wave speed, numerically determine and plot $\lambda_1(x)$, $\lambda_2(x)$, $P(x)$, $\rho(x)$, $u(x)$, and $M^2(x)$.
 - (c) Consider the H_2 -air detonation described by Powers and Paolucci.²
 - (d) By calculating the shock state, then integrating the steady ordinary differential equations from the shock state to the equilibrium state, reproduce the results presented in Figs. 1 and 2.
 - (e) Via spatial eigenvalue analysis, determine at the equilibrium state the length scales of reaction.

¹Powers and Gonthier, 1992, "Reaction zone structure for strong, weak overdriven, and weak underdriven oblique detonations," *Physics of Fluids A*, Vol. 9, pp. 2082-2089.

²Powers and Paolucci, 2005, "Accurate spatial resolution estimates for reactive supersonic flow with detailed chemistry," *AIAA Journal*, Vol. 43, No. 5, pp. 1088-1099.