Existence of Chapman-Jouguet detonation and deflagration waves

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Abstract

We study the existence of profiles for Chapman-Jouguet detonation and deflagration waves in the Navier-Stokes equations for a reacting gas. In the limit of small viscosity, heat conductivity, and diffusion, the profiles correspond to heteroclinic orbits of a system of singularly perturbed ordinary differential equations. The burned end state of the waves, however, is a nonhyperbolic equilibrium of the associated, purely gas dynamic layer problem, and standard methods from geometric singular perturbation theory hence fail. We show how to resolve this degeneracy by combining a center manifold reduction with the blow-up method. The main result is the existence of viscous profiles for various types of Chapman-Jouguet processes. In addition, we obtain results on the spatial decay rates of these waves which are expected to be relevant for the stability analysis of the waves.

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