

Weakly Nonlinear Evolutions in a Solid Combustion Model

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Abstract

A simple model of solid combustion in a semi-infinite two-dimensional strip of width l is considered. The free boundary problem that describes the model involves initial and boundary conditions, including a nonlinear kinetic condition at the interface. First, To show the onset of linear instability, the linear problem governing perturbations to a basic solution is solved by the method of images with the reaction front perturbation satisfying an integro-differential equation. Using Laplace transforms, a linear stability analysis is carried out by studying the solution of the reaction front perturbation. Secondly, the method of multiple scales is used to study the weakly nonlinear evolutions of small initial disturbances in the case where the basic solution is (marginally) linearly unstable. Slowly varying behavior of the amplitudes for typical terms of the weakly nonlinear solution is described. Finally, the result is compared with the numerical integration of the original problem to show that our multiple scale solution is accurate for large time.