Conservation laws with source terms,
its attractors, zero-reaction time limits and multidimensional front motions

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Abstract: Governing equations for reactive flows and flows with phase transitions are typically combinations of inhomogeneous fluid dynamics equations and reaction-diffusion equations. The prototype equations for such systems are

$$u_t + f(u)_x = \frac{1}{\epsilon} g(u) \tag{1}$$

and

$$u_t + f(u)_x = \frac{1}{\epsilon} g(u) + A\epsilon u_{xx} \tag{2}.$$

These prototypes models can serve as test beds for ideas, techniques and numerical schemes for more complete systems for reactive flows.

Results on the qualitative and quantitative behavior of (1) and (2) will facilitate understanding of reactive flows.

In this talk, I shall present the results on the large time behavior and the convergence of the zero reaction time $\epsilon \to 0+$ limits of (1). Attractors of (1) is characterized. Explicit information on the structure of the $\epsilon \to 0+$ limit and a new type of waves are discovered.

The existence and nonexistence of traveling waves of (2) is obtained. The front motion of the mutidimensional case of (2) is found to relate to the mean curvature and derivative in tangential direction of the front thickness.