Slow invariant manifolds for reaction-diffusion systems

JOSHUA MENGERS, JOSEPH POWERS, University of Notre Dame — Slow Invariant Manifolds (SIMs) are calculated as a reduction technique for isothermal closed reaction-diffusion systems. Reaction-diffusion systems are stiff infinite dimensional dynamical systems that are costly to simulate. These systems’ dynamics are reduced by using a Galerkin projection onto a finite-dimensional approximate inertial manifold, and then further reduced by projection onto a low-dimensional SIM. The Galerkin projection rigorously accounts for the coupling of the reaction and diffusion processes. The SIM accurately isolates the system’s long time dynamics. A robust method of constructing one-dimensional SIMs by calculating equilibria and then integrating to find heteroclinic orbits is extended to systems with weak spatial heterogeneity. Examples are demonstrated on simple physical reaction mechanisms.