Pulse patterns in singularly perturbed reaction-diffusion systems

Frits Veerman

The University of Edinburgh

We construct stationary pulse solutions for a general class of singularly perturbed reaction-diffusion systems, using geometric singular perturbation theory. This geometric approach is extended to construct periodic pulse patterns. The (linear) stability of the pulse solutions is determined using Evans function techniques, yielding an explicit leading order expression for the Evans function. The generality of the geometric analysis allows one to go beyond the canonical model systems, entering a realm of new far-from-equilibrium pulse structures with previously unobserved dynamical properties. Taking breathing pulses as an example of the latter, we show that this phenomenon can be analysed explicitly using a centre manifold approach, obtaining analytical grip on the weakly nonlinear stability of pulses in this fully general setting.