Computations in Nonlinear Media

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1. Time stepping methods

2. Spatial discretization

3. Boundary conditions

4. Nonlinear equations

5. Software design and validation

Dynamics and Selection for Scroll Waves in Excitable Media

The selection of shape and rotation frequency for scroll waves in reaction-diffusion equations modeling excitable media is investigated. For scrolls with uniform twist about straight filaments, asymptotic methods are used to derive free-boundary equations at leading order and at first order in the small parameter of the problem. Both orders are validated against full solutions of the reaction-diffusion equations. Using these two orders and with no adjustable parameters, the shape and frequency of twisted scroll waves are correctly predicted for most cases of physical interest. This work also sheds new light on the Fife limit in models of excitable media and Keener's work on the dynamics of scroll waves.

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