Lewis, Timothy J.; **Keener, James P.**
Wave-block in excitable media due to regions of depressed excitability. (English)
Zbl 0967.35067
SIAM J. Appl. Math. 61, No. 1, 293-316 (2000).

The authors present a geometrical method of analysis of propagation failure in a scalar reaction-diffusion equation motivated by models of propagation of electrical excitation in cardiac tissue (e.g. the AV node or infracted regions). The analysis mainly concerns the gap model,

$$u_t = u_{xx} + f(u, x), \quad x \in \mathbb{R}, \tag{1}$$

where $f(u, x) = 0$ if $x \in (0, L)$ and $f(u, x) = u(1 - u)(u - \alpha)$ otherwise. Here L is the gap length. The methods used by the authors also are shown to apply to extensions of (1) to more general forms of the excitable nonlinearity f and to equations in which the gap region has different diffusivity properties from the rest of the medium.

Using phase-plane methods, the authors prove that for $L > L^*(\alpha)$ (1) admits a monotone-increasing stationary solution which, by a comparison principle argument, is shown to block the propagation of the travelling wave. The saddle-node bifurcation event leading to the appearance of a blocking stationary solution is discussed as is the stability of such solutions.

Reviewer: Michael Grinfeld (Glasgow)

MSC:

35K57 Reaction-diffusion equations
35B05 Oscillation, zeros of solutions, mean value theorems, etc. in context of PDEs
34B15 Nonlinear boundary value problems for ordinary differential equations
35B40 Asymptotic behavior of solutions to PDEs
92C30 Physiology (general)
35K15 Initial value problems for second-order parabolic equations

Keywords:

inhomogeneous excitable media; propagation failure; comparison principle; gap model; gap region; phase-plane methods; saddle-node bifurcation; blocking stationary solution

Full Text: DOI