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The FitzHugh-Nagumo equations on the surface of a warped cylinder. Stability of pulses

We study the FitzHugh-Nagumo system of equations on a long, thin cylinder that represents the outer membrane of the axon. This results in a system of partial differential equations in two spatial variables (plus time). Key questions are the existence of a pulse - a special solution that travels along the length of the axon - and its stability under small perturbations of the initial conditions and the geometry. These questions have been studied extensively for the simpler model where the axon of the neuron has no width.

We use classical and modern techniques from the theory of partial differential equations to address these issues in the more realistic geometric framework where the axon has the shape of a long, thin cylinder that varies along its length. To support and complement our theoretical results, we are also simulating the system numerically.