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Fast and slow traveling wave solutions of the modified FitzHugh model.

In this work we explore a modified version of the Fitzhugh-Nagumo equations to model the spatial propagation of neuron firing; we assume that this propagation is (at least, partially) caused by the cross-diffusion connection between the potential and recovery variables. Using the methods of bifurcation theory we show that the cross-diffusion version of the model, besides giving rise to the typical fast traveling wave solutions exhibited in the original "diffusion" Fitzhugh-Nagumo equations, additionally gives rise to a slow traveling wave solutions. We analyze all possible traveling wave solutions of the model and show that there exists a threshold of the cross-diffusion coefficient (for a given speed of propagation), which bounds the area where impulse propagation is possible. The results can be interpreted as follows. If, by any reasons (e.g., due to the effect of a generic drug) the speed of transmission of a signal along the axon is reduced, then the "normal" neuron firing propagation in the form of a traveling spike is impossible. (Received September 20, 2007)