

Examples of Non-local Interactions in Biomathematical Models: Some Properties from Analysis and Simulation

Abstract: Biology returns something of value to mathematics via new classes of mathematical problems to study. In this talk I will discuss two topical areas leading to nonlinear partial differential-integral equations, where the defining characteristic is non-local interactions between dynamic populations of one sort or another. My first topic concerns a neural field involving populations of nerve cells organized in layers. As one example question, I will discuss, for a two-layer model, dependence of the shape of traveling wave solutions on a network parameter and a cellular parameter. As a second topic, I will introduce ‘degeneracy’ into population dynamics. Numerous biological interactions, such as interactions between T cell receptors with antigens, interactions between enzymes and substrates, or interactions between predators and prey are not strictly specific. This less specific, or “sloppy”, specificity is called ‘degeneracy’. I will investigate the concept through generalizing the Lotka-Volterra and Verhulst population models, and highlight some effects of the degeneracy. I will also briefly mention other problems and questions to explore.

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