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Modeling Tumor Growth in an Evolving Organ: a Diffuse Domain Approach

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ABSTRACT:

Tumor growth at the macroscopic (tissue) scale is often characterized by emerging spatiotemporal patterns. The induced heterogeneity can have further impact on the interaction between tumor cells and their microenvironment, causing the tumor to develop infiltration behaviors. Many partial-differential-equation (PDE) models have been proposed to study tumor progression, describing the interaction between the tumor cells and the substrate concentrations as diffusion-reaction processes. In “Three-dimensional multispecies nonlinear tumor growth - I Model and numerical method” [Wise et al., J. Theor. Biol. 253, pp.524-543 (2008)], we used Cahn-Hilliard equations to model tumor progression, accounting for the differentiated cell adhesion that causes phase separation among cells. The model successfully connected the development of tumor infiltration patterns to the microenvironmental stress. Like many other PDE tumor growth models, the Cahn-Hilliard model was formulated on an unbounded domain. In living tissues, however, tumor growth is often bounded by the tissues within an organ, which may in turn evolve due to the pressure of tumor growth. To describe the growth of such tumors, we use a recently developed diffusion domain approach, which allows us to adapt a PDE model defined on an unbounded domain to an evolving confinement. In this talk, I will first describe our tumor growth model and review our recent applications and findings of the model. Then I will introduce the diffuse domain approach and show how we adapt the tumor growth model using lymphoma progression in a lymph node and breast tumors in a mammary duct as examples.

Host: Van Savage, Ph.D.

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