Temple University Mathematics Colloquium

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will speak on

Mathematical modelings and simulations of tumor growth and angiogenesis

ABSTRACT: Mathematical modeling and computer simulations play increasingly important roles in the cancer research, and the most important one is providing a framework to capture various mechanisms underlying tumor growth and angiogenesis (new blood vessel formation). A tumor develops through avascular, angiogenesis and vascularized stages to be malignant. Initially a tumor utilizes nutrient diffusing from parent vessels to grow but only up to a limited size ($\sim$ 2 mm in diameter). The key to reach the malignant stage is the angiogenesis process, where new blood vessels penetrate the tumor and the tumor cells obtain extra source of nutrient and begins to grow out of control. In this talk, I will present a mathematical model serving as a framework for cancer research which combines the tumor growth and angiogenesis processes. First, I will describe the reaction-diffusion model of solid tumor growth with necrosis, which is a system of Darcy–Stokes (Brinkman) equations. To accurately capture the complex morphological evolution involving pinch-off and reconnection of interfaces, an adaptive mesh finite element and level-set method was developed. Second, I will present the angiogenesis model and its numerical difficulties, which can be solved by Local Discontinuous Galerkin Method in unstructured meshes. Finally, a complete simulation integrating tumor growth and angiogenesis processes will be shown and analyzed, which uncovers some important mechanisms underlying tumor growth and transition to the malignant stage.

Monday, 26 January 2009
Lecture at 4:00 pm
Coffee, tea, and refreshments from 3-5 pm
Room 617, Wachman Building
Department of Mathematics