Cancer Treatment/Modeling - John Kemper and Mikhail Shvartsman

A small research group with proven results in modeling the development and treatment of cancer of the prostate will provide an expanded research agenda that incorporates the application of a number of computational tools along with opportunities for undergraduate students to apply those tools in support of project goals related to the treatment of various cancers. In [9,17,18,25], project faculty members (and, in the case of [25], former students) have developed both deterministic and stochastic models for the evolution and treatment of prostate cancer and other cancer systems that involve biomarkers. Their research is poised to move ahead in a number of directions which will be significantly enhanced by the careful application of computational methods and the involvement of undergraduate students. Specific aspects of the proposed cancer modeling research that will require computational support are:

Simulation to confirm bounds on treatment efficacy in discrete and continuous stochastic models.

The use of grid methods to take into account irregular tumor geometry and its implications for disease advancement and/or treatment.

The application of statistical methods to identify the relative importance of various model parameters.

Parameter estimation methods in stochastic models, particularly focused on intensity of treatment, tumor growth, decay characteristics of radiological or other treatments and distance modulation of treatment effects but, also, possibly including effects of mutations and cell membrane failure.

Numerical solution of ODE and/or PDE systems that arise in deterministic models or that identify means or other moments of stochastic solutions.

The use of virtual populations to compare the effectiveness of various treatment strategies.

In addition to these proposed areas for student involvement with computational methods that may contribute to the advancement of the group's research in cancer modeling, other mathematical and statistical problems may arise, sometimes dependent on available data, that would benefit from a computational approach.