

Research Area: Applications to Math-Biology

Weiqing Gu

May 11, 2006

One of my current projects is applying my knowledge of mathematics and computer science to the development and analysis of cancer and HIV models. This work is in collaboration with Prof. de Pillis, Renee Fister, and Helen Moore and again involves undergraduates.

For example, in the tumor modeling project, together with Professor de Pillis et al, we have been developing mathematical tools that have the potential to provide clinical guidance in the development of new *combination* treatment protocols through preliminary evaluations of simulated scenarios. In particular, we have been contributing to the emerging body of cancer treatment research as follows:

- In [GDR], we have developed and analyzed several population dynamics models governing cancer growth with combination vaccine and chemotherapy treatments. A dynamical systems analysis revealed stability points, limit cycles, and basins of attraction. These system characteristics can be used not only to gain understanding of the system dynamics, but also to guide the development of combination therapies.
- We have applied optimal control theory and use numerical techniques to reveal pathways to new optimally integrated chemoimmunotherapy protocols, please see[GDF1], [GDF2], and [GDF3].
- We are currently applying geometrical harmonic spherical techniques and level set methods to simulate and effect the volume reduction of vascularized tumors responding to chemotherapy and immunotherapy. We use harmonic spherical tumors to very closely approximate certain *in vivo* tumor geometries. As a starting point, we have done analysis of idealized tumor forms, such as spherical, cylindrical and elliptic. Please see [GCM].
- As with other projects, we have actively involved HMC students (many of them are women students) in the multiple facets of this research.
- We use computer technology in our research. With Prof. Lisette de Pillis et al, we are conducting the research project “Geometric Modeling and Computer Graphic Simulation of Tumor Growth and Shrink under mixed immuno-chemo therapy”, supported by our NSF grant (NSF 0414011).