Mathematical Biology Seminar

Monday, January 30, 2023

3 pm MST (In person)

457 CAB

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Mathematical models for glioma migration and invasion in the brain

Gliomas are the most prevalent, aggressive, and invasive subtype of primary brain tumors, characterized by fast cell growth, strong invasion capability, and well-developed tumor vasculature. Their growth and migration in the brain is a highly complex phenomenon, influenced by a multitude of intrinsic and extrinsic factors at different spatial and temporal scales. We exploit the inherently multiscale nature of tumor evolution to propose mathematical models studying different aspects of the cell invasion process. In particular, this process is analyzed in relation to the microscopic and macroscopic scales characterizing it and paying attention to the integration of biological and clinical data into the mathematical descriptions.

In this seminar, we firstly focus on a multiscale framework that analyzes the role of microenvironmental acidity and vasculature on tumor evolution. The corresponding macroscopic model is capable of reproducing the emergence of specific hypoxia-related features, which are hallmarks of glioma progression. Moreover, we use this setting to compare the effects of various therapeutic approaches on the progression of the neoplasia and provide some insights into the problem of treatment planning [1, 2]. Then, we focus on a different integrated framework, developed on the basis of experimental data on protein distributions in glioma cells. It allows us to investigate the role of cell protrusions in the heterogeneous evolution of tumor fronts and in relation to specific environmental changes [3].

COLLABORATIVE MATHEMATICAL BIOLOGY GROUP
MATHEMATICAL & STATISTICAL SCIENCES
UNIVERSITY OF ALBERTA

References

[1] Conte, M., and Surulescu, C. 2021. Mathematical modeling of glioma invasion: acid- and vasculature mediated go-or-grow dichotomy and the influence of tissue anisotropy. Appl. Math. Comput., 407, 126305.
[2] Conte, M., Dzierma Y., Knobe S., and Surulescu, C. 2022. Mathematical modeling of glioma invasion and therapy approaches via kinetic theory of active particles. Accepted in Math. Models Methods Appl. Sci.
[3] Conte, M., Casas-Tint`o, S.,and Soler J. 2021. Modelling the invasion patterns in the glioblastoma battlefield. PLoS Comp. Biol., 17(1), e1008632.