Title: **Mathematical Model Growth and Treatment of Bladder Cancer**

Lector: Svetlana Bunimovich-Mendrazitsky

Authors: **Svetlana Bunimovich-Mendrazitsky, Helen Byrne, Eliezer Shochat, Eugene Kashdan, Israel Chaskalovic and Lewi Stone.**

Short description:
Bladder cancer (BC) is the most frequently occurring urological cancer and the fifth most common cancer among men, accounting for approximately 200,000 new cases worldwide annually. We developed a multi scale cellular automata (CA) model to study the growth of BC.
According to existing statistics, 80% of BC patients had occupational exposure to chemical carcinogens (rubber, dye, textile, or plant industry) or/and were smoking regularly during long periods of time. The carcinogens from the bladder lumen affect umbrella cells of the urothelium (epithelial tissue surrounding bladder) and then subsequently penetrate to the deeper layers of the tissue (intermediate and basal cells). It is a years-long process until the carcinogenic substance will accumulate in the tissue in the quantity necessary to trigger DNA mutations leading to the tumor development. We address carcinogen penetration (modeled as a nonlinear diffusion equation with variable coefficient and source term) within the cellular automata (CA) framework of the urothelial cell living cycle. Our approach combines both discrete and continuous models of some of the crucial biological and physical processes inside the urothelium and yields a first theoretical insight on the initial stages of the BC development and growth.

For the treatment, we present a modeling study of bladder cancer via pulsed immunotherapy with Bacillus Calmette-Gue´rin (BCG) - an attenuated strain of Mycobacterium bovis (M. bovis). Impulsive differential equations are used for studying periodic BCG instillations (pulsed BCG therapy). The mathematical relationships between schedule (pulsing frequency) and dose (therapy strength) are determined through appropriate mathematical analysis. The final goal in all this work is to determine the applicable treatment regime that prevent immune system side effects from BCG and enhance tumor destruction.