

Multi-scale modeling for a Premalignant Mutation Equation

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We study the stability or instability of the pre-malignant stage of mutation. The variables are $(U; V_i; W)$; $i = 1; 2; 3; \dots; n-2$ represent the densities of normal, intermediate mutant, and pre-malignant cells, as a function of, in general, time t and space variables $(x; y; z)$. For further study of carcinogenesis mutation, we impose a few other conditions on the parameters with the one dimensional nonlinear partial differential system of equations (PDE) system

$$(1) \quad \begin{cases} eU_t = e^2 U_{xx} + U(1-U) - a \frac{UV}{1+eU} \\ V_t = DV_{xx} + bV(1-V) + m \frac{UV}{1+eU} - n \frac{VW}{1+cV} \\ W_t = W_{xx} - W + b \frac{VW}{1+cV} \end{cases}$$

Where $D_0/D_2 = \varepsilon$ and $a_0/a_2 = 1/\varepsilon$.

The mathematical representations for the stages of mutant cells is a deterministic and macroscopic model representing the evolution of carcinogenesis mutations using parabolic PDEs has been solved. We look for more general case when the mutant cell may be non-deterministic.

The goal of the work is look for numerical solutions by using numerical computing software toolkit. The simulation of the traveling wave solutions over the variations of indicated parameters and initial data will be obtained. The dynamical system tools like Winpp(Windows version) or XTC(Unix version) have been used extensively and will be used to study the behavior of the solutions of the reaction diffusion systems mentioned above (These dynamic system tools have been developed by the math Department of the University of Pittsburgh and can be downloaded free: <ftp://ftp.math.pitt.edu/pub/hardware>). In present case, Mathematica and Winpp will be used. Simulation is conducted on the parameters of the system of equations (1). For every range of these parameters; $\varepsilon, D, b, \alpha, \beta, m$ and n , study of the analytical and numerical solutions of the system of equations are done to understand the chance of another mutation toward the malignant stage.