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Investigation of the invasion front in heterogeneous environments to study the geometry of tumor border

Y Azimzade and A A Saberi

Department of Physics, Faculty of Physics, Tehran University, Tehran, Iran

E-mail ab.saberi@ut.ac.ir

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Abstract

We develop a model to study how invasion front depends on the relevant properties of a cellular environment. To do so, we use a nonlinear reaction-diffusion equation, the Fisher equation, to model the population dynamics. Our study is intended to understand how heterogeneity in the cellular environment's stiffness, as well as spatial correlations in its morphology, given that the existence of both has been demonstrated by experiments, affects the properties of the invasion front. It is demonstrated that three important factors affect the properties of the front; these are the spatial distribution of the local diffusion coefficients, the correlations between them, and R/D , the ratio of the cells' duplication rate R to the cells' average diffusion coefficient D . Analyzing the scaling properties of the Fisher equation invasion front, we show that, contrary to several previous claims, invasion fronts, including those of tumors and cancerous cells colonies, cannot be described by the well-known model of kinetic growth, such as the Kardar-Parisi-Zhang equation.

Keywords: invasion front, stochastic fisher's equation, tissue stiffness, tumors

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