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A sinthetic model of evolution: an aspect space approach

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Resumo

Reaction-diffusion models are a well-known mathematical tool used to analyze the behavior of natural systems. Pattern formation in animal coats spatial distribution of slime molds, ecological invasion by alien species and chemical signalization are some examples of the wide range of applications of that type of models. Given the undisputable relevance of evolution theory in the field of the biological sciences, the author believes that its formulation in a well-known form could add to the comprehension of evolutionary dynamics. Evolutionary dynamics is a booming field and, since before and after the neo-Darwinian synthesis, distinct approaches have been used to describe evolutionary processes. Many mathematical models describe the variation of gene frequencies in the population, while some others work implicitly with the concept of phenotype frequencies. Our approach is based on frequencies in a phenotype space. In this work we present a reaction-diffusion model for a process of evolutionary dynamics, hoping that both the experience and methods of research with this type of model may prove useful in the analysis of the real phenomenon of evolution. The fundamental concept present in the formulation of the model is that of an aspect space, inspired in the seminal works of Levin and Segel. In reaction-diffusion models of spatial dispersion the aspect space is, in many cases, simply a physical space with one, two or three dimensions. In the case of evolution, we will picture a population dispersed in an abstract phenotype space, subject to the forces that drive the process of evolution. This approach leads to a reaction-diffusion model very similar to others used to describe biological processes in mathematical ecology. One of the objectives of this work, besides presenting the model and its generalizations, is to provide a preliminary analysis of its behavior. To achieve this, we studied some of its properties, as the selection of the fittest individuals and quasi-species selection. The results indicate that the reaction-diffusion

model is coherent with well-established models in the field of evolutionary dynamics, satisfying a fundamental condition for further developments and applications.