

عنوان مقاله:

GAME OF COORDINATION FOR BACTERIAL PATTERN FORMATION: A FINITE AUTOMATA MODELLING

محل انتشار:

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خلاصه مقاله:

In this paper, we use game theory to describe the emergence of self-organization and consequent pattern formation through communicative cooperation in *Bacillus subtilis* colonies. The emergence of cooperative regime is modelled as an n-player Assurance game, with the bacterial colonies as individual players. The game is played iteratively through cooperative communication, and mediated by exchange of information about the local environment between the different bacterial colonies comprising the system. The iteration causes the interactive system to grow and produce beautiful complex spatial patterns signaling the emergence of self-organization. In laboratory, we have the bacterial growth environment mimicked in Petri dish, where chemical stress is introduced in a three-fold manner: through modification of nutrition and substrate amounts and introducing an antibiotic in the system. In our model, bacteria colonies, treated as individual players, interact within the environment and grow according to a set of rules. The rules capture the biotic processes that allow bacteria to grow in the hostile environment, and cope with the stress. We find the effects of sophisticated communications and information-sharing between bacterial colonies to be a vital determinant for bacterial growth, which is manifested in the Petri dish as complex spatial patterns, often at fractal scales. As a formal description of the above game, we model the emergence of this cooperative behaviour as finite deterministic automata, whose transition function is informed by the Assurance game pay-off. Consequently, the exercise allows us to derive a grammar that provides the rules for describing the bacterial interactions leading to the emergence of the spatial structures.

کلمات کلیدی:

Stressed bacterial colony, Cooperation, Emergence, Pattern Formation, Assurance game, Deterministic finite automata, grammar

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