"Modelling evolutionary branching by a nonlocal Fisher equation"

Abstract:

Evolutionary branching, or adaptive speciation, is a feature that is hard to account for in usual mutation-selection systems. With some other features such as evolution towards extinction or evolutionary cycles, it is a privileged subject of adaptive dynamics. Adaptive dynamics makes a link between ecological and evolutionary theory. To the usual influence of the environment on the population through the fitness, it adds the reverse influence of the population on the environment by considering how the ecological interactions modify the fitness. In this framework adaptive speciation can become a robust and common phenomenon, even without geographical isolation. See e.g. [1,2,3]

The general evolutionary system is not the only one where darwinian-like theory have been developed. Other examples include the immune system, brain cortex or cell differentiation, see [4,5] and references therein.

In [5] Sergei Atamas presents a computer study of an abstract selective system where evolutionary branching can take place. This study is based on cellular automata simulations. The branching arises due to a competition between similar abstract "recognizers" to recognize some signals. In this framework, a monomorphic population may split into two distinct sub-populations in order to decrease this competition.

In the present work, we study an integro-differential equation similar in the spirit as the model in [5]. We investigate its pattern formation and branching capacity. It shares some similarities with Turing reaction-diffusion models for morphogenesis [6]. But Turing structures appear due to the competition between an activator and an inhibitor, whereas in the present model the structuration comes from the competition inside a single population.

This model can also be considered as an illustration of Darwin's divergence of character principle [7]. As such, it provides a mathematical framework to investigate in a more detailed manner this principle.


Ni Dieu ni gène. Pour une autre théorie de l'hérédité. 

Self-organization in computer simulated selective systems. 

Philosophical Transactions of the Royal Society B 237 (1952), 37-72.