CENTRE
DE RECHERCHES
MATHÉMATIQUES

Systèmes de branchement, équations de réaction-diffusion
et modèles de population
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Branching systems, reaction-diffusion equations and population models
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Modeling the evolution of populations undergoing selection using branching Brownian motion

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Understanding the evolution of populations undergoing natural selection is an important problem in biology. Questions of interest include determining the speed at which the fitness level of a population increases as a result of selection, determining the distribution of the fitness levels of individuals in the population at a given time, and describing the genealogy of a sample of individuals from the population. We will model populations undergoing selection using branching Brownian motion, in which particles independently move according to one-dimensional Brownian motion and occasionally split into two particles. The particles represent individuals in a population, and the position of a particle corresponds to the fitness of the individual. We will analyze in detail two different models based on branching Brownian motion. One model is branching Brownian motion with absorption, in which particles are killed at the origin, modeling the deaths of individuals whose fitness gets too low. The other model is branching Brownian motion with an inhomogeneous branching rate, in which the branching rate of a particle depends on its position, so that particles with higher fitness are more likely to produce offspring.