Macroscopic description of nonlocal movement of biological systems in R^n and in networks

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Abstract

In the presence of sparse attractants, the movement of both cells and large organisms has been shown to be governed by long distance runs, according to an approximate Levy distribution. In this talk we clarify the form of biologically relevant PDE descriptions for such movements. Motivated by experiments we consider a microscopic velocity-jump model in which the motion of the individuals is characterized by long runs and long waiting times, according to a heavy-tailed distribution. From the kinetic equations obtained from the microscopic movement we derived nonlocal Patlak-Keller-Segel equations and fractional diffusion equations in the appropriate limit. We shed light on the extent to which Levy flight behaviour impacts on the average time taken for cells to locate the sparsely distributed infected targets.

Furthermore, this nonlocal movement of individuals has been observed in more complex geometries, e.g., the brain. We propose to study the (nonlocal) diffusion using a network of subdomains, corresponding to the nodes of a graph. I will introduce metaplex networks which are networks with internal structure, and we will extend our analysis to two real world examples: a brain and a landscape network.