Modelling the movements of organisms: Movement ecology meets active particles and anomalous diffusion

Rainer Klages[1]

[1]Queen Mary University Of London, London, United Kingdom

Organisms living at very different spatio-temporal scales, from migrating in the microworld to foraging across the earth, display random-looking movement paths. Understanding these complex patterns by constructing mathematical models from data provides a fundamental challenge. In this talk I review fundamental stochastic models for understanding movement data, like (correlated) random walks, (generalised) Langevin equations and active Brownian particles. On this basis experimental data for the movement paths of foraging sea turtles, migrating cells and bumblee flights is analysed. For all three examples generalised overdamped Langevin equations are constructed from data revealing active and anomalous diffusive properties. I then put forward a generalised underdamped Langevin equation for modelling organismic movements, which blends key ingredients of the three fields of movement ecology, active particles and anomalous diffusion. I illustrate the application of this equation for constructing a stochastic model of bumblebee flights from experimental data and outline its theoretical foundation.