# NONLINEAR AND NONLOCAL MULTISCALE MODELS

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## ABSTRACT

Most of the models of interest for applied mathematics can be described at different scales, according to the case under investigation. For instance, many phenomena in collective behaviors in mathematical biology, social sciences, traffic flows, pattern formation, neural networks are investigated both from a microscopic and a macroscopic point of view. In particular, three levels of description are largely adopted: an agent-based level, a kinetic level, and a population-based level. In the first case, one describes the dynamic of each individual, while in the other two cases the density of the population is taken into account.

Nonlocal terms are useful to describe many effects in a population dynamic, for instance nonlocal interactions extend the influence of individual agents over wider spatial regions, allowing the modelling of long-range dependencies that are crucial in systems where local effects are insufficient to describe the overall dynamics. At the same time, nonlinearity introduces complexity such as bifurcations, and emergent patterns that cannot be anticipated by linear models alone, and it is a crucial ingredient to have interaction between scales. This duality reflects more realistic behavior in complex systems and provides a versatile toolkit for addressing multi-scale phenomena in many areas.

In recent years this type of model has received considerable attention and many mathematicians are interested in studying systems involving many species and investigating the so-called dynamics of "structured populations", since these models are closer to reality.

This Minisymposium will explore contemporary approaches to nonlinear and nonlocal models across scales. Discussions will include advances in existence and uniqueness theory, regularity properties of solutions, scale limits and numerical techniques that capture the multiscale behavior of these processes.