

Topology and Biology: Persistent Homology of Aggregation Models

Speaker: Chad Topaz

Abstract:

There are three fundamental questions typically asked about biological aggregations. (1) What movement rules do individuals obey? (2) What are the macroscopic dynamics of the group? (3) How do individual movement rules relate to the emergent macroscopic behavior? This tutorial-style focuses on the second question. We apply techniques of topological data analysis to two seminal agent-based models. We construe position and velocity data from numerical simulations as point clouds varying over time. Using a method called persistent homology, we measure topological features that persist over multiple spatial scales, and see that the topological analysis detects dynamical events that are undetected by more commonly used methods. This tutorial talk assumes no prior knowledge of topology and aims to explain the utility of persistent homology in nontechnical terms.