

Geometry and topology in collective dynamics models

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1. Abstract

Collective dynamics arises in systems of self-propelled particles and plays an important role in life sciences, from collectively migrating cells in an embryo to flocking birds or schooling fish. It has stimulated intense mathematical research in the last decade. Many different models have been proposed but most of them rely on point particles. In practice, particles often have more complex geometrical structures. Here, we will consider particles as rigid bodies whose body attitude is described by an orthonormal frame. Particles tend to align their frame with those of their neighbours. A hydrodynamic model will be derived when the number of particles is large. It will be used to exhibit solutions having non-trivial topology. We will investigate whether topology provides enhanced stability against perturbations, as observed in other systems such as topological insulators. This talk is based on recent results issued from collaborations with Antoine Diez, Amic Frouvelle, Sara Merino-Aceituno, Mingye Na and Ariane Trescases.