A new model for self-organized dynamics: from particle to hydrodynamic descriptions

Eitan Tadmor, University of Maryland

Self-organized dynamics is driven by "rules of engagement", which describe how each agent interacts with its neighbors. They consist of long-term attraction, mid-range alignment and short-range repulsion. Many self-propelled models are driven by the balance between these three forces, which yield emerging structures of interest. Examples range from consensus of voters and traffic flows to the formation of flocks of birds or school of fish, tumor growth etc.

We introduce a new particle-based model, driven by self-alignment, which addresses several drawbacks of existing models for self-organized dynamics. The model is independent of the number of agents: only their geometry in phase space is involved. We will explain the emerging flocking behavior of the proposed model in the presence of non-symmetric interactions, which decay sufficiently slow, and discuss the difficulties of tracing graph connectivity otherwise.
The methodology is based on the new notion of active sets, which carries over from particle to kinetic and hydrodynamic descriptions, and we discuss the unconditional flocking at the level of hydrodynamic description.