Phase diagram of self-propelling particles in two dimensions

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Motivated by intriguing flocking behaviors of biological species such as birds, fish and bacteria, we present particle-based simulations for the flocking of self-propelling particles in two dimensional spaces. The particles are under self-propelling motion in a viscous environment. Depending on the inter-particle distance, they attract, repel and align their direction of motion with respect to each other. We focus on the phases for finite-size flocks at different amplitude and range of alignment force. The phase boundary that separates vortex state from marching state is obtained by constructing the histogram for their appearances. Moreover, we also analyze the statistical properties for the formation times of such steady states from an initially disordered state.

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