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*Aggregation diffusion to constrained interaction: minimizers and gradient flows in the slow diffusion limit*

Nonlocal interactions arise throughout the natural world, from collective dynamics in biological swarms to vortex motion in superconductors. Over the past fifteen years, there has been significant interest in aggregation diffusion equations, which consider the competing effects of nonlocal interactions and local diffusion. More recently, interest has also emerged in constrained aggregation equations, which consider the competition between nonlocal interactions and a hard height constraint on the density.

In joint work with Ihsan Topaloglu, we prove that aggregation diffusion equations converge to the constrained aggregation equation in the slow diffusion limit. As an application of this theoretical result, we adapt Carrillo, Craig, and Patacchini's blob method for diffusion to develop a numerical method for constrained aggregation equations, which we use to explore open conjectures in geometric shape optimization.