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Generalized Gradient Flows of Nonlocal Interaction Energies

In this talk, I will consider a generalized notion of gradient flow, i.e., curves of maximal slope, for nonconvex nonlocal interaction energies $E(\mu) = \iint_{\mathbb{R}^d \times \mathbb{R}^d} K(x-y)\, d\mu(x) d\mu(y)$ defined via a pairwise singular interaction potential K in the power-law form over the space of probability measures with bounded density endowed with the 2-Wasserstein metric. These energies play an important role in models of collective behaviour of multi-agent systems, biological swarming, molecular self-assembly. In particular, I will show that these curves of maximal slopes can be obtained as limits as $\epsilon \to 0$ of well-understood gradient flows of semi-convex energies E_ϵ defined by a regularization of the interaction potential K. This will also provide a first step in understanding the connection between the gradient flows of unregularized and noncovex interaction energies E and the aggregation equation

$$\mu_t - \nabla \cdot (\mu(\nabla K * \mu)) = 0$$

via a singular perturbation approach. This is joint work with Katy Craig (UCLA).