

Primal Dual Methods for Wasserstein Gradient Flows

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Many nonlinear evolution equations arising in porous media flow, materials science, and collective behavior can be understood as gradient flows in the space of probability measures. In this talk, we present a new numerical framework that exploits this variational structure by combining ideas from optimal transport with modern operator splitting methods. Our approach is based on the Jordan-Kinderlehrer-Otto (JKO) scheme and the Benamou-Brenier formulation of the Wasserstein distance, which together recast the solution of certain nonlinear, nonlocal PDEs as a sequence of convex optimization problems. We show how these problems can be solved efficiently using a recent primal-dual splitting algorithm with rigorous convergence guarantees. We illustrate the method with numerical examples for nonlinear PDEs and Wasserstein geodesics. We conclude by outlining extensions to more general nonlinear mobilities and transport costs, highlighting the flexibility of the approach and its potential for a wide range of applications.