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Gradient Flows for the Möbius Energy

Abstract:

Aiming at optimizing the shape of closed embedded curves within prescribed isotopy classes, we use a gradient-based approach to approximate stationary points of the Möbius energy. The gradients are computed with respect to certain fractional-order Sobolev scalar products that are adapted to the Möbius energy. In contrast to L^2-gradient flows, the resulting flows are ordinary differential equations on an infinite-dimensional manifold of embedded curves. In the fully discrete setting, this allows us to completely decouple the time step size from the spatial discretization, resulting in a very robust optimization algorithm that is orders of magnitude faster than following the discrete L^2-gradient flow.