Department of Mathematics,
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Computational Geometric Mechanics Research Seminar

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Covector Fluids

Abstract:

The animation of delicate vortical structures of gas and liquids has been of great interest in computer graphics. However, common velocity-based fluid solvers can damp the vortical flow, while vorticity-based fluid solvers suffer from performance drawbacks. We propose a new velocity-based fluid solver derived from a reformulated Euler equation using covectors. Our method generates rich vortex dynamics by an advection process that respects the Kelvin circulation theorem. The numerical algorithm requires only a small local adjustment to existing advection-projection methods and can easily leverage recent advances therein. The resulting solver emulates a vortex method without the expensive conversion between vortical variables and velocities. We demonstrate that our method preserves vorticity in both vortex filament dynamics and turbulent flows significantly better than previous methods, while also improving preservation of energy.

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