

Vortex dynamics by geometric and structural complexity analysis

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ABSTRACT

In quantum fluids vorticity tend to be highly localized in bundles of filaments and tangles. Energy localization and transfer is therefore strongly correlated with the spatial properties of vorticity. In this situation geometric methods and structural complexity analysis provide useful information to understand and interpret dynamical and energetic properties in terms of the morphological aspects of the system. Moreover they provide tools that can be easily implemented into advanced diagnostics to study complex phenomena by direct numerical simulations of turbulent flows. In this talk we review progress made in this direction by an overview of some key results in this area, starting from the original work of Da Rios (1906) on LIA (Localized Induction Approximation) and the intrinsic kinematics of vortex filaments [1]. A geometric interpretation of the conserved quantities associated with integrable vortex dynamics (under LIA or higher order LIAs) provide further information useful in structural complexity analysis [2]. Applications of algebraic and topological methods to vortex entanglement can then provide interesting relationships between energy and structural complexity [3, 4]. We conclude this survey with some examples of recent work and latest results [5].

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