

Abstract Submitted
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Vortex Axis-line Extraction with the VATIP Algorithm: Application in Newtonian and Viscoelastic Channel Flow¹ LU ZHU, LI XI, McMaster University — Vortex is a central concept in the understanding of turbulent dynamics. Objective algorithms for the detection and extraction of vortex structures can facilitate the physical understanding of turbulence regeneration dynamics by enabling automated and quantitative analysis of these structures. Despite the wide availability of vortex identification criteria, they only label spatial regions belonging to vortices, without any information on the identity, topology, and shape of individual vortices. This latter information is stored in the axis-lines lining the contours of vortex tubes. We propose a new tracking algorithm which propagates along the vortex axis-lines and iteratively search for new directions for growth. Vortex axis-lines in near-wall turbulence are automatically identified and extracted. Vortices are classified into different shapes, including quasi-streamwise vortices, hairpins, hooks, and branches, according to the axis-line topology. The VATIP (vortex axis tracking by iterative propagation) algorithm is applied to both Newtonian and viscoelastic turbulence to reveal vortex organization patterns and self-sustaining dynamics.

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