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Flow Field Classification Using Critical Point Matching[1] PAUL S. KRUEGER, SHEILA WILLIAMS, MICHAEL HAHSLER, ELI V. OLINICK, SMU — Classification of flow fields according to topological similarities can help reveal features of the flow generation and evolution for bluff body flows, and characterize different swimming maneuvers in aquatic locomotion, to name a few. Rigorous classification can be challenging, however, especially when complex flows are distorted by measurement uncertainties or variable flow generating conditions. The present work uses critical points of the velocity field to characterize the global flow topology. Flow fields are compared by finding a best match of critical points in two flow fields based on topological and location characteristics of the critical points together with general point set distance measures. The similarity between the flow fields is quantified based on the matched critical points. Applying clustering algorithms to a set of flow fields with quantified similarity can then be used to group flows with similar characteristics. This approach has been applied to generic 2D flow fields constructed using potential flow results and is able to correctly identify similar flow fields even after large distortions (up to 20% of the vortex separation) have been applied to the flows.

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