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A Discretized Method for Deriving Vortex Impulse from Volumetric Datasets NOAM BUCKMAN, MIT, LEAH MENDELSON, Massachusetts Inst of Tech-MIT, ALEXANDRA TECHET, MIT — Many biological and mechanical systems transfer momentum through a fluid by creating vortical structures. To study this mechanism, we derive a method for extracting impulse and its time derivative from flow fields observed in experiments and simulations. We begin by discretizing a thin-cored vortex filament, and extend the model to account for finite vortex core thickness and asymmetric distributions of vorticity. By solely using velocity fields to extract vortex cores and calculate circulation, this method is applicable to 3D PIV datasets, even with low spatial resolution flow fields and measurement noise. To assess the performance of this analysis method, we simulate vortex rings and arbitrary vortex structures using OpenFOAM computational fluid dynamics software and analyze the wake momentum using this model in order to validate this method. We further examine a piston-vortex experiment, using 3D synthetic particle image velocimetry (SAPIV) to capture velocity fields. Strengths, limitations, and improvements to the framework are discussed.

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