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Lagrangian Strain Rate Tensor Evaluation based on Multi-pulse Particle Tracking Velocimetry and Radial Basis Functions LUCAS PILOZO-HIBBIT, University of Waterloo, Waterloo, ON, Canada, PRABU SELLAPPAN, Florida State University, Tallahassee, FL, US, PETER SCHMID, Imperial College London, London, UK, LOUIS CATTAFESTA, Florida State University, Tallahassee, FL, US, ZHAO PAN, University of Waterloo, Waterloo, ON, Canada — Physical conservation laws are inherently Lagrangian. However, analysis in fluid mechanics using the Lagrangian framework are often forgone in favor of those using the Eulerian framework. This is perhaps due to a lack of experimental techniques with high temporal and spatial resolution that track the movement of every fluid parcel in a flow domain. Development of time-resolved Particle Tracking Velocimetry/Accelerometry (TR-PTV/A) that measures flows with high seeding density has made the use of the Lagrangian framework more accessible. A challenge facing PTV/A is the need for robust mesh-free numerical schemes that handle random particle locations. Such a scheme can be created with high-order accuracy using Radial Basis Functions (RBFs). RBFs allow direct evaluation of derivatives of vector and scalar fields at random locations with infinite-high order of smoothness. The current work uses RBF-based differential schemes to develop a post-processing tool for PTV/A data, which can accurately evaluate spatial derivatives directly from Lagrangian particle tracks. This RBF-based strain rate tensor evaluation tool is validated with two and three-dimensional flows from analytical solutions and is then tested with experimental data measured by a multi-pulse PTA system.

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