Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Numerical Study of the Accuracy of the Particle Image Velocimetry Technique in High-Speed Turbulent Flows[1] SAI SANDEEP DAMMATI, Texas AM University, YORAM KOZAK, Tel Aviv University, CAL RISING, JONATHAN REYES, KAREEM AHMED, University of Central Florida, ALEXEI POLUDNENKO, University of Connecticut, Storrs — In this study, we investigate the accuracy of the Particle Image Velocimetry (PIV) technique for the characterization of high-speed turbulence, which is representative of the flows typically found in modern practical and experimental combustion systems. We carry out direct numerical simulations and subsequently perform synthetic PIV reconstruction of the resulting three-dimensional turbulent flow field at Reynolds numbers ≈ 5000 and Karlovitz numbers ≈ 200 (premixed CH_4-air under atmospheric conditions). The flow field is uniformly seeded with 0.3 μm monodispersed Al_2O_3 particles that represent typical PIV particles used in experiments, along with initially co-located massless Lagrangian tracer particles to recover the actual flow pathlines. We address the following questions: 1) How do PIV particles affect the carrier flow field? 2) How well do PIV particles sample the flow field of interest? 3) How closely do PIV particles follow the flow pathlines? 4) What is the accuracy of the PIV reconstructed flow field when compared to the true flow field? Finally, we conclude by discussing the implications of using PIV as a diagnostic tool for high-speed reacting and non-reacting flows.

[1]Department of Defense High Performance Computing Modernization Program

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Date submitted: 10 Aug 2020 Electronic form version 1.4