Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Development of a Magnetic Resonance Imaging-Based Method for Particle Concentration Measurement DANIEL D. BORUP, CHRISTOPHER J. ELKINS, JOHN K. EATON, Stanford Univ — Magnetic Resonance Imaging (MRI) is well suited for the study of fluid mechanics in complex flows where optical access is not possible. Current MRI-based techniques allow for the measurement of 3D, 3-component velocity and scalar concentration fields. The current work aims to develop and validate a technique for measuring the concentration of a dispersed phase of solid microspheres in a turbulent water flow. Such a diagnostic would allow for the study of the transport of small particles in arbitrarily complicated biological, engineering, or natural flows. In the presence of paramagnetic particles, MRI signal decays more rapidly than it does for pure water due to small disturbances in the magnetic field. We predicted the spatial extent and magnitude of this disturbance using a standard theoretical framework for MRI and obtained reasonable agreement with experimental results. Using the linear relationship between particle volume fraction and signal decay rate, we also obtained 3D concentration data for a particle streak injected into a ribbed serpentine channel flow. These data were used to validate the new method, and the transport of solid particles was compared to the transport of a passive scalar in the same flow. Daniel Borup is supported by NSF Grant No. DGE-114747.

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Date submitted: 25 Jul 2016 Electronic form version 1.4