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Gas Flow Velocity Field and Turbulent Anisotropy Measurements using Magnetic Resonance Imaging (G)*

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Fluid turbulence has been called the "last unsolved problem of classical physics"and the measurement of this phenomenon presents a formidable challenge. Turbulent systems are highly sensitive to perturbations, and so a non-invasive technique is needed to probe their properties. Turbulence is also difficult to fully characterize, particularly in the case of anisotropic turbulence. Magnetic Resonance Imaging (MRI) is a useful and versatile tool in this regard, because with the application of magnetic field gradients, MRI can be sensitized to various flow characteristics. The particular version of MRI used to measure turbulent gases is the motion-encoded Single Point Ramped Imaging with T1 Enhancement (SPRITE) technique developed at the University of New Brunswick. With the application of motion-sensitizing magnetic field gradients, SPRITE can be used to measure the three-dimensional time-averaged velocity field. This information is contained within the phase of the detected signal. Results of this type of measurement will be presented with a recorder as a turbulent flow system, which is often used as an example wind-instrument in musical acoustics. SPRITE can also be used to measure the anisotropy in mean-squared displacements caused by turbulent fluctuations. This information is contained within the signal amplitude of the detected signal. Results from measurements on gas flow through a cylindrical pipe with a hemi-cylindrical obstruction will be presented. These results show that at the time scale probed by this measurement, turbulence is anisotropic.

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