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MRI Based Diagnostics for Temperature Measurements in Turbulent Flows LAUREN SASCHA BURTON, CHRISTOPHER J. ELKINS, JOHN K. EATON, Stanford University — Accurate modeling of the thermal diffusion in the complex turbulent flows related to cooling high temperature gas turbine blades is critical to optimize the performance and predict the lifetime of the blades. Magnetic Resonance Imaging (MRI) techniques for temperature measurement in simple but related flows are being developed in an effort to obtain full field thermal measurements to better understand diffusion processes and support the development of more accurate computational models in these flows. Magnetic Resonance Thermometry (MRT) utilizes the temperature dependence of the hydrogen proton resonant frequency (PRF) in water. MRT is now routinely used to measure tissue temperatures during medical procedures, and a few previous studies have made velocity and temperature measurements in turbulent pipe flows. In this study, MRT is applied to the flow of a heated single hole film cooling jet (Reynolds number 3000) inclined at 30 degrees injected into a cold developing turbulent channel flow (Reynolds number 25,000 based on bulk velocity and channel height.) The jet fluid temperature is 30 degrees Celsius above the temperature in the channel. The temperature measurements compare well to previously published results for measured passive scalar concentration in the same flow although the temperature measurements show higher uncertainties of 5-10% of the temperature difference. Techniques for reducing this uncertainty will be presented as well as procedures for applying MRT to quantify the turbulent heat transfer coefficient in turbulent internal flows.

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