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Development of Focused Laser Differential Interferometry for Hypersonic Freestream Measurements[1] JOEL LAWSON[2], MALLORY NEET[3], JOANNA AUSTIN[4], California Institute of Technology — Focused laser differential interferometry (FLDI) is a non-invasive diagnostic capable of making localized density measurements with high temporal resolution. Its distinguishing feature for ground testing is diminished response away from the focal plane, thereby mitigating signal contributions from fluid not in the facility core flow. We first present a quantitative experimental validation of a ray-tracing scheme used to model the FLDI response. This is followed by some applications of the technique to Caltech's hypersonic ground testing facilities: firstly, FLDI is applied to the Hypervelocity Expansion Tube (HET) to measure the freestream noise spectrum during test time, and relating this to the initial driver gas state as per the acoustic wave theory of Paull and Stalker [J. Fluid Mech., vol. 245, pp. 493-521, 1992]. Secondly, FLDI is used to track a laser-induced breakdown in the freestream of the T5 reflected shock tunnel, with the goal of measuring flow velocity and sound speed.

[1]Office of Naval Research award N00014-16-1-2503
[2]PhD Candidate, Graduate Aerospace Laboratories
[3]PhD Candidate, Graduate Aerospace Laboratories
[4]Professor of Aerospace, Graduate Aerospace Laboratories

Joel Lawson
California Institute of Technology

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