Influences Of Gas Thermodynamic Properties On Jets In Hypersonic Cross Flow

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Abstract

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This study investigates the scaling and sensitivity of the large-scale flow features of jets in hypersonic cross flow for a range of gasses, Mach numbers, and stagnation temperatures. A gas heating system was devised to vary jet stagnation temperature and deliver quasi-steady jet conditions throughout the test duration to explore thermodynamic sensitivities of the flowfield. Heater performance was verified through benchtop and in-situ experiments, demonstrating that it could provide a wide range of mass flows and sustained stagnation temperatures. Each of the supersonic perfect-gas jets were injected into the hypersonic boundary layer over a flat plate as a simplified analog for the fuselage of a flight vehicle and the large-scale flow features were examined using high-speed schlieren photography. Both mean fields and their variability were examined to identify if these features are altered by changes to the gas properties. By comparing the flowfields between jet test cases at a constant jet momentum, the relative sensitivities of each

jet injection feature were explored. This investigation serves as an effort to better extrapolate wind tunnel data to conditions more representative of the control of high-speed vehicles.