An Efficient Approach to Collect Inlet Characterization Data

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ABSTRACT

This report considers a novel process to acquire performance data for supersonic mixed compression inlets that is faster, and therefore less costly, than the previous one. In the previous process, measurements were recorded in discrete increments. The backpressuring actuator was advanced, there was a pause to allow for airflow fluctuations to diminish, and then the measurements were recorded. While this process was methodical, reliable and accurate, it consumed significant wind-on time. In general, high-speed wind tunnels are expensive to operate considering maintenance, energy and human resource requirements. Furthermore, many facilities, such as blowdown wind tunnels, are limited in the duration that they can maintain the desired test condition. Consequently, a quick method to collect the measurements is desired. A favored approach has the actuator moving in a continuous fashion with measurements recorded as the actuator continuously progresses through the increment points. This approach, identified as the dynamic inlet characteristic data acquisition procedure, uses in situ dynamic high-speed pressure sensors to measure pressure signals. While faster, continuous movement adds dynamic effects to the data. To better understand these dynamic effects and other potential influences, a study was undertaken to compare wind tunnel measurements taken at discrete actuator position points with data gathered during continuous actuator movement. Specially, plots of inlet pressure recovery versus mass capture ratio, or total pressure characteristic curves, were examined. The data were measured during experiments in the NASA Glenn Research Center Abe Silverstein 10- by 10-Foot Supersonic Wind Tunnel (SWT) with an inlet propulsion test article. In this report, the wind tunnel experiment and the study objectives are described. The processes to reduce the data and for analysis are explained. A discussion of the results along with features noted in the data is given. Finally, conclusions from this study that may be used to guide future wind tunnel experiment planning are presented.