Development of a SMA Hybrid Composite Jet Engine Chevron Concept

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HA 141 (Harrelson Hall)

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Abstract: Reduction of jet engine noise in the vicinity of airports continues to be of paramount importance. Exhaust nozzle *chevrons* have been shown to reduce jet noise at takeoff conditions. Chevrons produce a "scalloped" trailing edge to the exhaust nozzle(s) and protrude into the flow increasingly from root to tip. Although chevrons are a proven noise reduction technology, parametric effects are not well understood so it is likely that performance can be significantly improved. Additionally, all noise reduction studies to date have been performed using static chevrons, where the geometry and flow immersion is predetermined and invariant. Such static chevron systems have the negative attribute of reducing thrust at cruise conditions. The concept of deployable or *active* chevrons has been proposed to enable parametric studies and to minimize the thrust penalty. The active chevron application is ideal for shape memory alloy (SMA) actuation technology because SMA actuators can be thermally activated, they produce large force and stroke, and the time response requirement of the application can be easily achieved.

NASA Langley has conducted a multi-year effort to develop a model scale active chevron system for use in the jet engine simulator of the Low Speed Aeroacoustic Wind Tunnel. The ultimate goal of the project is to enable optimal control of far-field noise under realistic operating conditions by independent control of an array of active chevrons, i.e., optimal immersion amplitude and distribution with airframe integration effects and variable operating conditions. The active chevron concept employed in this project consists of a laminated composite structure with embedded SMA actuators, termed a SMA hybrid composite (SMAHC). SMA actuators are embedded on one side of the bending axis of the structure such that thermal excitation generates a moment and deflects the structure. This presentation will give an overview of the project with particular emphasis on critical design challenges to meet the objectives of the wind tunnel testing. Details of the fabrication processes, experimental setup, computational models, and correlation of measured and predicted results will be discussed.

Biography: Travis L. Turner is a Research Scientist in the Structural Acoustics Branch at NASA Langley Research Center. He received a BS in Mechanical Engineering and a MS in Engineering Mechanics from Old Dominion University and a PhD in Engineering Mechanics from Virginia Polytechnic Institute and State University. He has over 18 years of experience conducting a balance of theoretical and experimental research in the areas of smart structures, thermoelasticity, random vibration, nonlinear vibration, and sonic fatigue. His research over the last 10 years has been focused in the area of active/adaptive structures for thermoelastic, vibration, noise transmission, and structural shape control with particular emphasis on shape memory alloy actuation technology.