Shape Memory Alloy Actuation Technology for Adaptive Low Boom Supersonic Transports

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ABSTRACT

To enable the return to flight of civil supersonic transport (SST) aircraft, configurations must be developed that meet noise and efficiency requirements across a range of operating conditions. A team of researchers, led by Texas A&M University, is investigating real-time geometry changes, driven by compact and lightweight Shape Memory Alloy (SMA) actuators, to minimize boom signatures across all flight phases in response to changing aircraft configurations and environmental conditions [1].

For years the promise of SMA actuators as an enabling technology has seemed poised to revolutionize the design of adaptive structures and smart systems for aircraft. As far back as 2005 Boeing successfully integrated SMA actuators into the fan nozzle of a 777-300ER GE-115B engine to modify nozzle geometry in flight for community and cruise noise reduction [2]. While the Variable Geometry Chevron (VGC) flight tests clearly demonstrated that SMA technology can enable solutions for challenging aerospace applications, it also exposed critical technology gaps and needs that would be essential to advancing SMA technology.

Since 2005 Boeing and Texas A&M, along with numerous industry, academic, and government partners have made significant advances in the area of SMA technology filling many of the identified gaps. Including improved materials, design and modelling tools and approved test methods.[3]

Many of these advances in SMA technology and tools are now being applied to the development of adaptive aircraft structures as part of NASA's University Leadership Initiative (ULI) led by Texas A&M University titled Adaptive Aerostructures for Revolutionary Civil Supersonic Transportation.

In this paper the ULI program will be described, including its goals and objectives. The characterization of improved SMA materials and materials tailored for specified ULI applications will be presented. Strategies for integrated SMA design and design optimization tools, including fluid structure interaction will be discussed. Examples of hardware demonstrations of morphing structures for shock wave control in supersonic wind tunnel tests and structural shape control will be shown.[4]

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