Design of a Quiet Supersonic Aircraft Enabled by Shape Memory Alloy Actuators

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The return of commercial supersonic flight requires innovative solutions to be developed that meet noise and efficiency requirements for overland flight. To study such a possibility NASA is supporting a multi-disciplinary team of academic and industrial experts to explore the potential of structurally morphing the outer mold line of a supersonic vehicle. The team is considering recent advances in supersonic computational fluid dynamics, sonic boom propagation prediction tools and new design approaches of embedding high actuation energy density Shape Memory Alloys (SMAs) for in situ morphing, leading to optimal low boom signatures in different atmospheric environments and flight conditions. The presentation will focus on the development of the appropriate high temperature NiTiHf SMAs based on the requirement of reliable repeated actuation up to 100K thermal actuation cycles, under high levels of stress. The thermomechanical constitutive modeling of such alloys, their modeling of low cycle actuation fatigue and failure will be discussed. A unified constitutive modeling approach will be described to capture critical phenomena associated with the unique response of SMAs and the development of predictive tools for the design and reliable operation of phase transforming materials for aerospace applications.

Short CV

Dimitris C. Lagoudas is the Senior Associate Vice Chancellor for Engineering Research, Senior Associate Dean for Research, College of Engineering, and a Distinguished University Professor at Texas A&M University. He is the holder of Robert C. "Bud" Hagner Chair of Engineering.

D.C. Lagoudas' research involves the design, characterization and modeling of multifunctional materials at multiple scales, bridging the various length scales and functionalities, including mechanical, thermal and electromagnetic. He has co-authored more than 500 scientific publications in archival journals and conference proceedings and one of the widely used books on Shape Memory Alloys (SMAs). The SMA constitutive models that his research group developed have been implemented and integrated into finite element analysis software, used by many academic institutions and also by industry and government.

D.C. Lagoudas received the 2006 ASME Adaptive Structures and Material Systems Prize in recognition of his contributions to the modeling and characterization of SMAs and their use in aerospace structures and he is the 2011 recipient of the SPIE Smart Structure and Materials Lifetime Achievement Award. He is a Fellow of AIAA, ASME, IOP and SES and was named a Distinguished University Professor at Texas A&M University in 2013