Flow and Acoustic Characteristics of a Circulation Control Airfoil

Louis N. Cattafesta
Department of Mechanical Engineering, Florida State University

Thursday, March 16, 2017
Time: 9:30 – 10:20 AM
Location: 260 Willard
Coffee and donuts will be provided

Abstract:
Underwater vehicle maneuverability is currently limited by conventional control surface (e.g. sails) technology. The use of circulation control on the sails and planes of an underwater vehicle can greatly enhance its maneuverability. A circulation control airfoil uses tangential blowing over a rounded trailing edge, the Coanda effect, to generate lift unlike conventional control surfaces that are pitched or rotated. However, circulation control can only be applied to underwater vehicles if it improves maneuverability without substantially increasing the ship’s noise signature.

The purpose of this investigation is to experimentally identify and characterize the flow field and corresponding noise sources of a circulation control airfoil. Flow and acoustic data are obtained for a dual-slotted, elliptic circulation control airfoil in an anechoic wind tunnel. The effect of single-slot blowing on the aerodynamic characteristics of the airfoil and the flow field is evaluated using pressure measurements and PIV. Noise sources are identified for a variety of test conditions using phased microphone arrays and beamforming methods, and the acoustic data are compared with Howe’s analytical model of circulation control acoustics. An accurate acoustic model combined with specific information about each noise source mechanism will provide future researchers with the tools necessary to intuitively design and test quiet circulation control appendages for use on underwater vehicles.

Bio:
Louis N. Cattafesta III is currently an endowed University Eminent Scholar and Professor in the Department of Mechanical Engineering at the Florida State University. He received a BS degree in Mechanical Engineering in 1986 from Penn State University, a MS degree in Aeronautics from MIT in 1988 via an AFRAPT Fellowship, and a Ph.D. degree in Mechanical Engineering in 1992 from Penn State University via a PSU College of Engineering Dean’s Fellowship and a NASA GSRP Fellowship. In 1992, he joined High Technology Corporation as a Research Scientist at NASA Langley Research Center. His research at NASA Langley focused on...
supersonic laminar flow control and pressure- and temperature-sensitive paint measurement techniques, and in 1996 he was awarded the 1996 NASA Team Excellence Award for his contributions. At that time, he became involved in active control of flow-induced cavity oscillations, which provoked his current research interests in active flow control and aeroacoustics. He joined the University of Florida as an Assistant Professor in 1999 and was promoted to an Associate and Full Professor in 2003 and 2008, respectively, before joining Florida State University in 2012. Funding for his research has been provided by grants from NASA, AFOSR, ONR, NSF, Boeing, Lockheed-Martin, General Electric, Gulfstream, among others. Dr. Cattafesta has co-authored 4 AIAA best conference paper awards in 2001, 2002, and two in 2004. He is the author or co-author of 7 US Patents, 7 book chapters, and approximately 80 archival journal publications. Dr. Cattafesta is an Associate Fellow of AIAA and a Fellow of ASME. He is also a member of ASA and APS.