AIAA Hampton Roads Section
P.O. Box 7392
Hampton, VA 23666

AIAA Hampton Roads Section & NASA LaRC
2022-2023 Pizza Lecture Series

Toward Analytical and Fully Parabolic Prediction of the High-Speed Aerodynamic Near-Field and Sonic Boom with Global Perspective

with

Dr. Steven A. E. Miller

DATE & TIME: February 16th, 2023
Pizza at 11:00 am
Talk from 11:30 am to 12:30 pm

LOCATION: **NACA Room, B2102**
(in person encouraged)
Virtual via AIAA Zoom

Registration: Google Form Registration - Miller

Contact Matt Galles at aiaa.hrs.vicechair@gmail.com with any questions.

Abstract

Hypersonic research has advanced to a point where powerful nations have deployed preliminary or first generation operational hypersonic wave rider weapons. Also, there is great interest in commercial supersonic aviation driven by the NASA X-59 flight-vehicle. These flight-vehicles create sonic booms. The prediction of sonic boom signatures is important for defense analysis, reduced annoyance, and possible acceptance of overland flight. These ground pressure signatures can be predicted through analytical theory or numerics. Design must be balanced with aerodynamic drag reduction, near-field waveform analysis, and sonic boom minimization. Current analytical theory cannot predict the near-field of hypersonic flight-vehicles. To overcome this limitation, we show a model to predict the near-field analytically from hypersonic flight-vehicles. For validation, we use NASA Langley's FUN3D CFD solver with adjoint based grid adaptation and fully parabolic methods. Select and simplified analytical and numerical predictions in the near-field are presented from various simplified slender aerodynamic bodies. The near-field signature is propagated to the ground for analysis to predict sonic boom. This is accomplished using a modified form of the waveform parameter method and PCBoom. Sonic boom is also altered by atmospheric turbulence, and these effects are quantified via parabolic predictions.

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Biography

Steven A. E. Miller, Ph.D. is an Associate Professor of Mechanical and Aerospace Engineering at University of Florida and leads the Theoretical Fluid Dynamics and Turbulence Group. He conducts research in theoretical fluid dynamics, theoretical aeroacoustics, and related disciplines in conjunction with his students. His students have obtained positions in government agencies, industry, and academics. He joined the University of Florida in August of 2016. Prior to joining the University of Florida, for seven years he was a Research Aerospace Engineer at the National Aeronautics and Space Administration, Langley Research Center, Aeroacoustics Branch. He received his Ph.D. and M.S. in Aerospace Engineering from the Pennsylvania State University under A.D./Welliver Boeing Professor Philip J. Morris, B.S. in Mechanical Engineering from Michigan State University, and studied statistics briefly at Taganrog State University, Russia. He received numerous awards including: the Defense Advanced Research Projects Agency Faculty Award for analytical prediction of the hypersonic near-field, the NASA Early Career Achievement Medal for theoretical jet aeroacoustics, the United States Air Force Faculty Fellowship for combustion instability and thermo-acoustics, and others. He enjoys opera, art history, and scientific history.