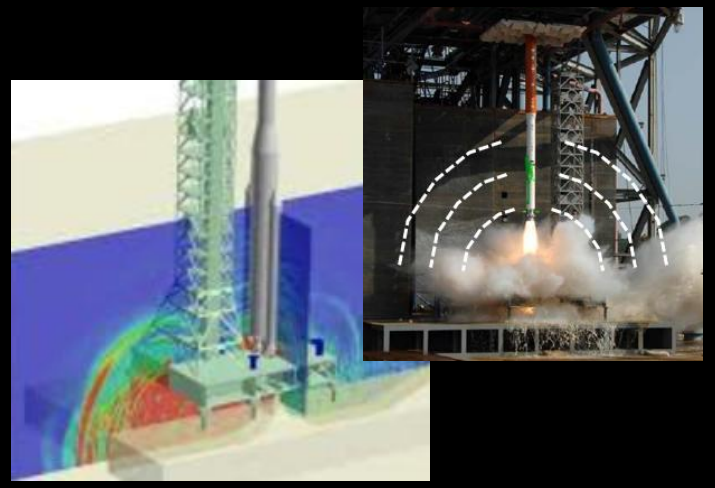
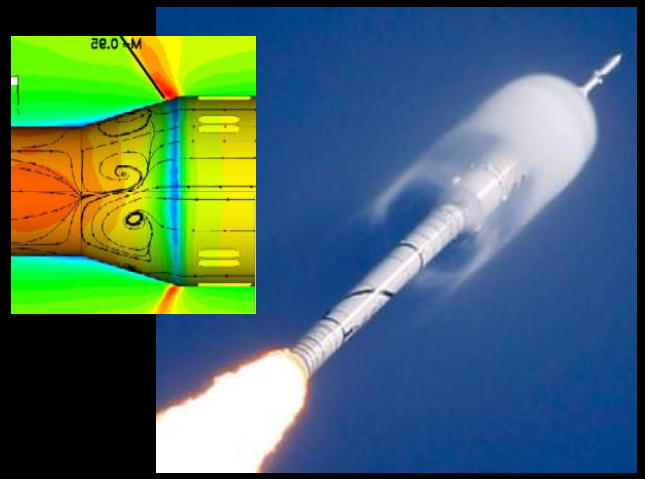
AeroVibroAcoustic challenges for Space Launch Vehicles

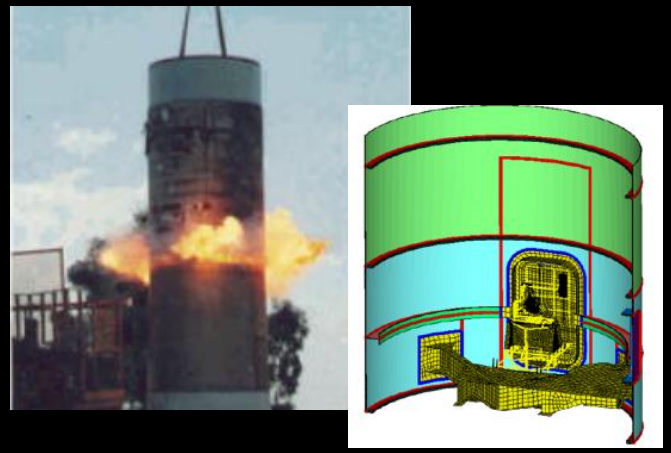
Lift-off Acoustics
Loads,
Fairing Acoustic levels
[P95/50 Statistical
Max expected]





Transonic & MaxQ
Flight loads
[P90/50 Statistical
Max expected]

Plume Impingement,
Retro-propulsion
Re-entry Loads
& environments

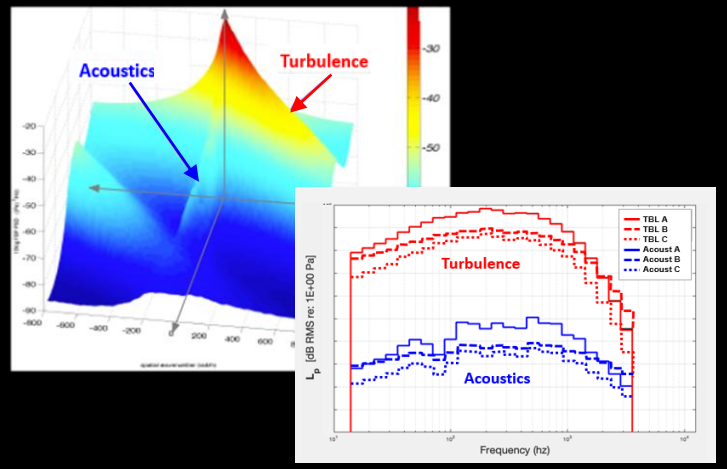


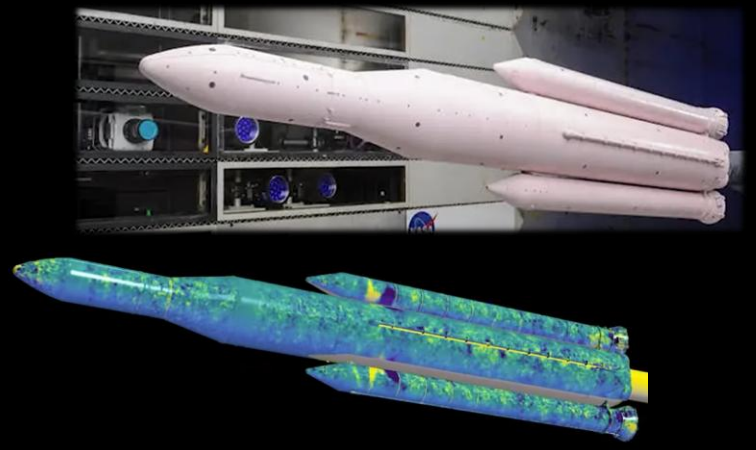
Random Vibration
& Shock levels
on Lightweight
Composite Structures
[P95/50 Statistical
Max expected]

AeroHydroPLUS

Our unique AeroVibroAcoustic engineering solutions

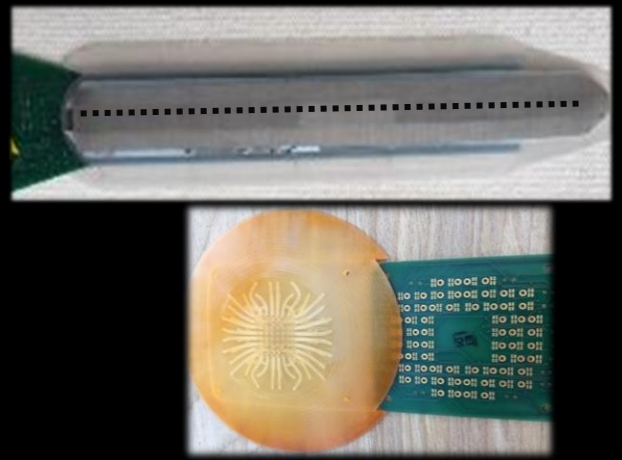
We pioneered Wavenumber filtering to extract Acoustics from Turbulence FSP

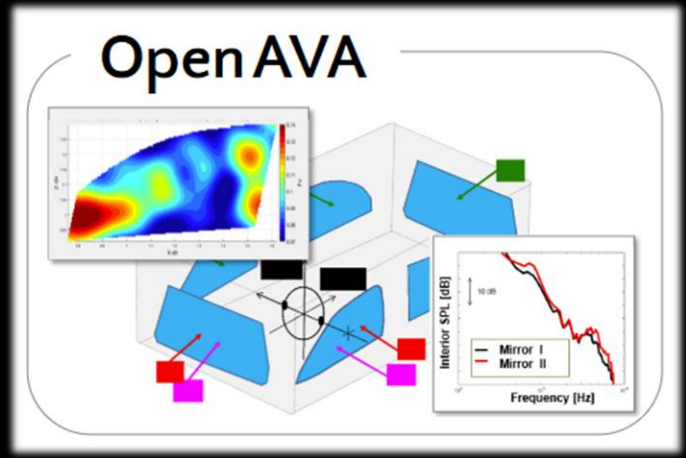




Unsteady Pressure-Sensitive Paint (uPSP) wind tunnel testing

Our Stick-on/Peel-off MEMS mic. arrays measure wind FSP at CFD-like resolution





Our OpenAVA MATLAB™ toolkit predicts Vibration, Stress & Noise from AeroAcoustic Loads

AeroHydroPLUS

Our team

Marc Shaw-Lecerf

B.S Aero/Engr Physics U. Michigan 2012, S.M. Aero MIT 2014. 10+ year career in aerospace systems and measurement technology. NASA Scientist 2019-2024 using Pressure-Sensitive Paint to measure launch vehicle environments. Developed software to reduce large (TB-scale) uPSP aero-acoustic datasets to compact pressure wavenumber-frequency spectral form. Previous work in autonomous flight leading design, integration, and test of airborne sensor packages for commercial aviation operations.

Paul Bremner

40+ year career in coupled aero-vibro-acoustics (AVA) and stochastic wave mechanics. Original architect of AVA simulation software, commercialized into VA One™ 1989-2002. Co-founder of wave6™, 2010.

Founded AeroHydroPLUS in 2006, focused on emergent CFD, instrumentation and loads data reduction solutions for challenging applications in aero-vibro-acoustics engineering.

Scott Clifton

S.M. Aero MIT 1983 (M. Drela contemporary). Founder & Chief engineer at 12 Meter Research (TMR), consulting in CFD aerodynamics of 12m yachts, aircraft, and automobiles, 1985-2010.

Senior Consultant, aero-acoustic CFD and advanced signal processing at AeroHydroPLUS 2011-present. Pioneered reduction of large (TB-scale) aero-acoustic loads datasets to compact pressure wavenumber-frequency spectral form.

Chris Todter

B.S.E. Electrical Engr U. Michigan 1972. Developer of high performance, compact, aerospace sensor systems. Consultant to America's Cup yacht racing syndicates, ultimately serving as technical director for Dennis Connor's Stars & Stripes syndicate 1990-1994.

Senior Consultant, aero and acoustics loads array sensor development at AeroHydroPLUS, 2011-present. Lead inventor of patented Stick-on/Peel-off MEMS surface pressure array instruments for direct, in-service measurement of aero-acoustic loads (including automotive wind noise).

AeroHydroPLUS

35 years of Leading-Edge Experience

1991 Vibro-Acoustic Science Inc. – Bremner is founder of company and original architect of world's first aero-vibro-acoustic SEA code VA one (formerly AutoSEA)

1992 NASA / ESA / JAXA – VA one chosen as common microgravity design tool for international space station (ISS)

1995 Kistler Aerospace - Defined lift-off acoustic environments and transonic / maxQ flight vrandom vibration environmrnts for Kistler K1, world's first re-usable commercial launch vehicle

1999 Air Force Research Labs – Probabilistic theory reseach and experiments to validate improved formulation for statistical variance in SEA models of maximum expected lift-off and ascent random vibration levels

2001 Aerospace Corp / AFRL – Design and experimental validation of an active noise control system for control of lift off acoustic environment levels inside a launch vehicle fairing

2005 LockheedMartin / NASA JSC – Engaged to define maximum expected lift-off and ascent random vibration levels for crew exploration vehicle on ARES 1-X, subsequently MPCV on SLS FT1, launch abort, ascent abort

2011 NASA NESC / JSC – Prediction of vibration response of panel in near field of hot supersonic jet, based on measurement of turbulence and acoustic surface pressure loading.

2016 NASA MSFC / Aerospace Corp – Engaged on Tiger Team helping Boeing to verify their VA one model for lift-off and transonic flight random vibration environments for SLS launch vehicle

2020 NASA LaRC – Predict ascent abort random vibration levels and conduct post-flight data analysis for AA2

2022 Blue Origin - Wind tunnel data scaling to define retro-propulsion re-entry aero-acoustic loads for New Glenn

2024 NASA ARC / MSFC - Developed calibration procedure and terabyte data reduction / visualization software for unsteady pressure sensitive paint (uPSP) measurements of aero loads in wind tunnel, for SLS launch vehicle

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