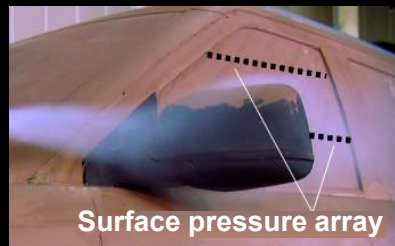
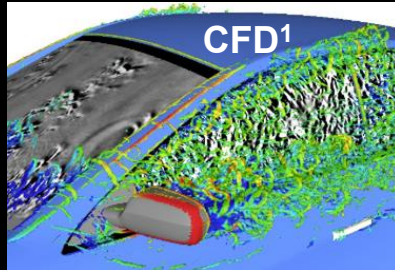
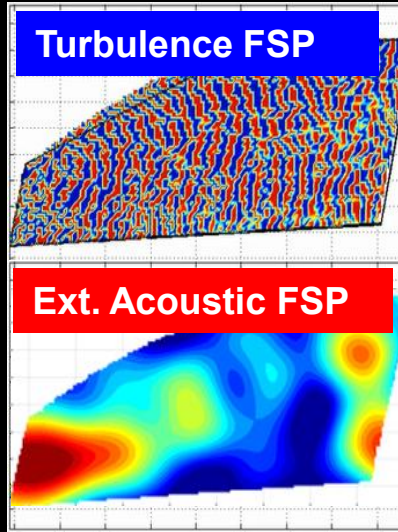


AeroVibroAcoustic challenges for Automotive Wind Noise Design

How to predict
interior Wind noise
from CFD ...
or from Clay model
in wind tunnel ?



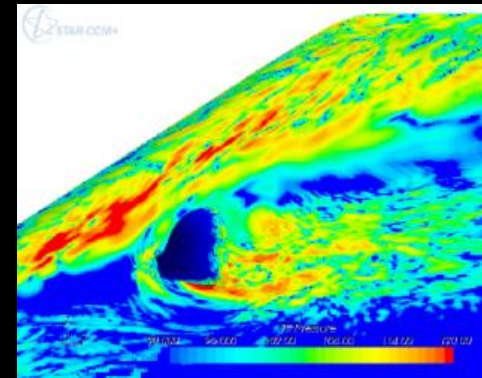
Interior
Wind
noise ?



Interior
Wind
noise ?

Wind source is BOTH
aerodynamic turbulence
AND external acoustics
transmitted via
multiple paths

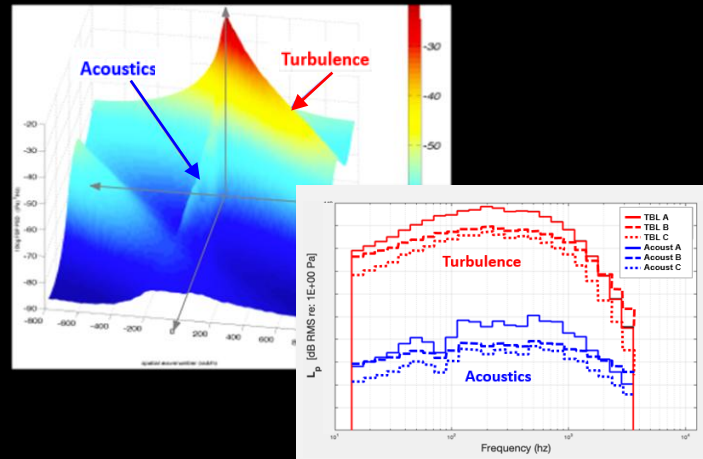
Customer perception
of Wind noise
≠ dBA SPL
= Loudness + Buffet
Sound Quality metrics



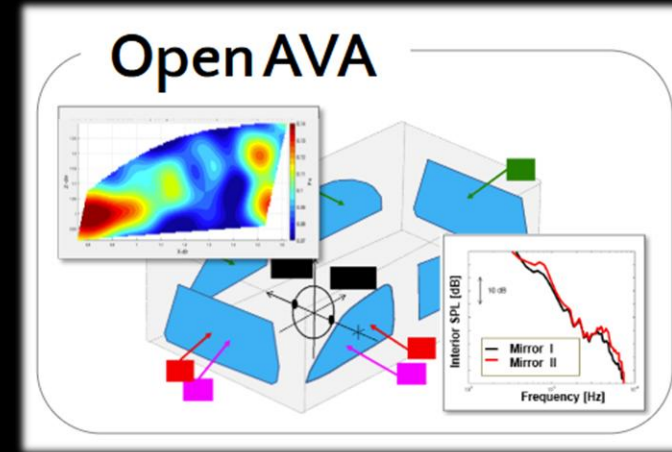
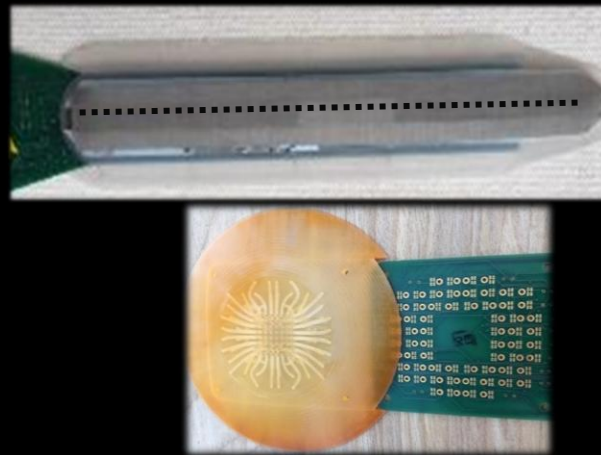
Aero-acoustic CFD
is complex & expensive
– is a lower cost
Open Source CFD
code accurate ?

Our unique AeroVibroAcoustic engineering solutions

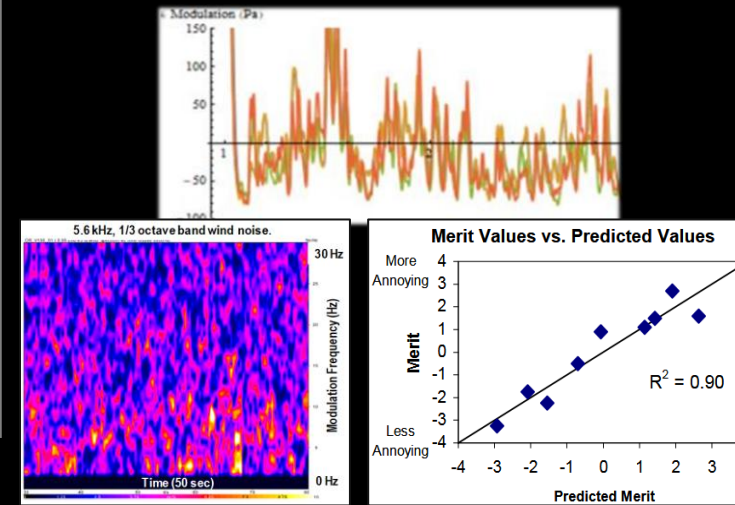
We pioneered Wavenumber filtering to extract Acoustics from Turbulence FSP



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



MEMS mic. arrays quantify low freq. modulation / buffet of audible audio wind noise over 20+ sec

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.

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.



Paul
Bremner

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.

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).



Chris
Todter

40 years of Leading-Edge Experience

- 1992 **Ford Motor Co** – World's first SEA model predicting interior noise from turbulence + acoustic wind sources.
- 2002 **IRAD** / AIAA Aeroacoustics Conf. – Original paper and inaugural session formally introducing Aero-Vibro-Acoustics
- 2011 **NASA NESC** - Prediction of vibration response of panel in near field of hot supersonic jet, based on measurement of turbulence and acoustic surface pressure loading
- 2012 **Mercedes-Benz** / CD Adapco – Wavenumber filtering of acoustic vs turbulence loading from CFD model of flow over an idealized side mirror and prediction of wind noise transmission across a glass panel
- 2014 **Chrysler** – Evaluation of MEMS FSP array in wind tunnel and wavenumber analysis of EXA POWERFLOW CFD results to identify and correct meshing problems evident in EXA ACOUSTIC solution for interior wind noise.
- 2017 **IRAD** / SAE N&V Conf. – Effect of pin hole porting and windscreens on MEMS surface pressure array measurements of both turbulence loading and acoustic loading in boundary layer of subsonic flow
- 2019 **TOYOTA** / SAE N&V Conf – Successful use of MEMS surface pressure array to measure buffeting character of airflow loading and predict modulated interior wind noise of passenger car in wake of larger vehicles.
- 2019 **BMW** [Confidential] - Wind tunnel evaluation of MEMS FSP array measurements
- 2022 **TOYOTA** / SAE World Congress – MEMS FSP array measurement of underfloor flow loading and aero-vibro-acoustic model to diagnose effectiveness of underfloor covers at reducing low frequency interior wind noise
- 2023 **HONDA** Delivered OpenAVA Matlab code for wavenumber filtering of turbulence and acoustic wind loading from HOINDA's CFD code; and prediction of localized interior wind noise at Head Measurement System

Contact Us



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