

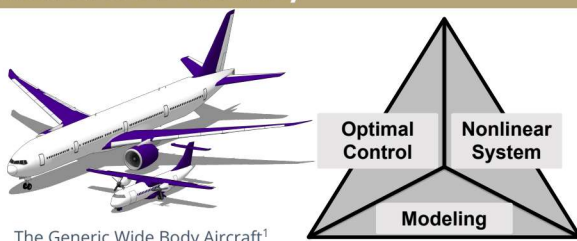


Supersonic Configuration At Low Speeds (SCALOS) & Wind Tunnel Aeroservoelasticity

STUDENT: Kuang-Ying“Eddie” Ting

Wind Tunnel Aeroservoelasticity

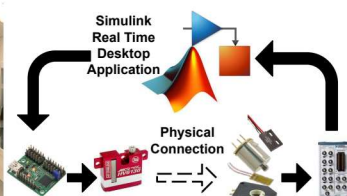
Aeroelasticity is interaction between structure and aerodynamics. The flexible airframe due to weight constraints and the flow around the vehicle leads to aeroelastic problems such as gust loads, ride comfort and flutter. Incorporating active control becomes aeroservoelasticity.



Model of Aeroelastic Response to Gust Excitation (MARGE)²



Large model of Aeroelastic Response to Gust Excitation (LARGE)³



Hardware and software integration



Gust load alleviation open-loop⁴



Gust load alleviation preview control⁴



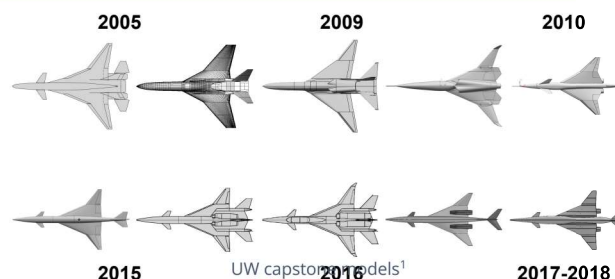
Flutter

- Preview H_2 and H_∞ control⁴
- Closed-loop robustness
- Uncertainty quantification
- μ -synthesis
- MARGE 2.0
- Flutter suppression
- Limit-cycle oscillation

References

1. Quenzer, J. D., Barzgaran, B., Mesbahi, M., and Morgansen, K., "The Generic Wide Body Aircraft Model," *2018 Guidance, Navigation, and Control Conference*, AIAA, 2018.
2. Quenzer, J. D., Zongolowicz, A., Hinson, K. A., Barzgaran, B., Livne, E., Mesbahi M., and Morgansen K., "Model for Aeroelastic Response to Gust Excitation," *Scitech 2019 Forum*, AIAA.
3. Berg, J., Ting, K.-Y., Mundt, T., Mor, M., Livne, E., and Morgansen, K., "Exploratory Wind Tunnel Gust Alleviation Tests of a Multiple-Flap Flexible Wing," *Scitech 2022 Forum*, AIAA.
4. Ting, K.-Y., Mehran, M., Livne, E., and Morgansen, K. A., "Wind Tunnel Study of Preview H_2 and H_∞ Control for Gust Load Alleviation for Flexible Aircraft," *Scitech 2022 Forum*, AIAA.

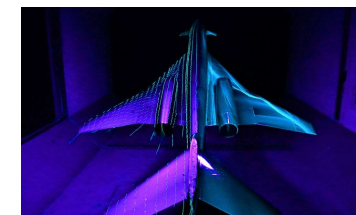
Supersonic Configuration At Low Speeds (SCALOS)



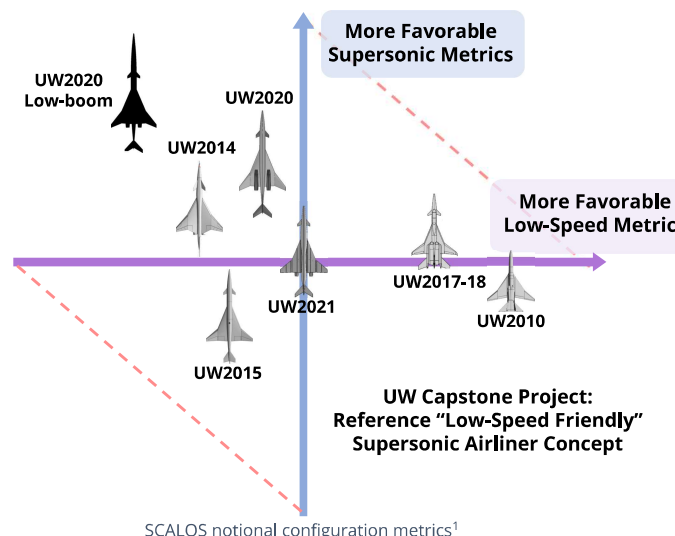
Supersonic airliners/SSBJs are optimized at cruise speed and often neglect low-speed impact at takeoff, approach, and landing. Studies on how the shapes and configurations affect handling qualities, dynamic, stability and control of the aircraft. Tests are conducted at the Kirsten Wind Tunnel.



2020 Low-boom design



Flow visualization test



- Data Reduction and correction
- Configuration effectiveness²
- Test Correlation³
- Control surface effectiveness
- Incremental Effect
- Model Regression
- Stability and Control

References

1. Nelson, C. P., Ting, K.-Y., Mavriplis, N., Soltani, R., and Livne, E., "Supersonic Configurations at Low Speeds (SCALOS): Project Background and Progress at University of Washington," *AIAA Scitech 2022 Forum*.
2. Ting, K.-Y., Mavriplis, N., Soltani, R., Nelson, C., and Livne, E., "Supersonic Configurations at Low Speeds (SCALOS): Model Geometry and Aerodynamic Results," *AIAA Scitech 2022 Forum*.
3. Mavriplis, N., Ting, K.-Y., Moustafa, A., Hill, C., Soltani, R., Nelson, C., and Livne, E., "Supersonic Configurations at Low Speeds (SCALOS): Test / Simulation Correlation Studies," *AIAA Scitech 2022 Forum*.

ADVISERS: Prof. Eli Livne and Prof. Mehran Mesbahi.

COLLABORATORS: Prof. Chester P. Nelson, Prof. Reza M. Soltani, Prof. Kristi A. Morgansen

SPONSORS: SCALOS - NASA University Lead Initiative (ULI), Award/Contract #80NSSC19K1661

Aeroservoelasticity - Joint Aerospace Center for Aerospace Technology Innovation (JACTI) and The Boeing Company

WILLIAM E. BOEING

DEPARTMENT OF AERONAUTICS & ASTRONAUTICS

