NASA SBIR/STTR Technologies

Comprehensive Aeroservoelastic Analysis Tool for Flexible and Deformable Aerostructures

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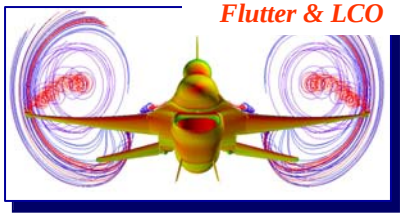
Identification and Significance of Innovation

- Modern aerospace systems are designed with very flexible structures to achieve lower cost and fast responsive vehicles.
- Nonlinear interaction between the flexible structures and aerodynamics has led to several aeroelastic instabilities such as buffet, flutter and LCO.
- Basic aeroservoelastic capabilities exist, but simulations are very inefficient and impractical. Limitations exists in understanding physics of interaction and data transfer between physical analysis modules.
- Physics of interaction are missing due to inefficient and lack of generality of data transfer between the different grid systems of fluid, structures, and smart materials.

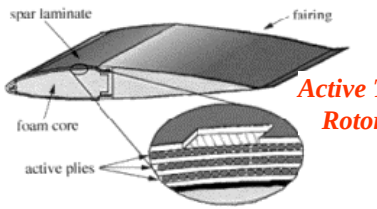
Innovation

- Accurate nonlinear electrodynamics FEM model for smart materials (SMT).
- Arbitrary mesh interface model between SMT and flexible structures.
- Novel and fast grid motion model for general grid systems deformation
- Advanced data management for efficient data transfer and manipulation

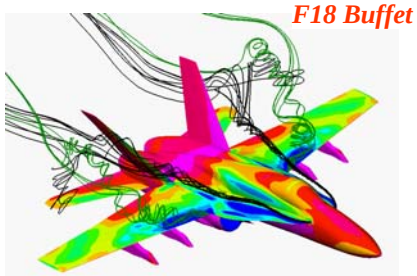
Active Aeroelastic Wing (AAW)



F16 Flutter & LCO



Active Twist Rotor



F18 Buffet

Typical Aeroservoelastic Problems of Aerospace Systems

Technical Objectives

- Development of fast and accurate physics-based multidisciplinary aeroservoelastic analysis capabilities for complex aerospace systems, involving interactions between fluid, structure, control, and flight system.
- Demonstration of the developed technologies for typical aeroservoelastic problem of aerospace vehicle.

Work Plan

- Development of a nonlinear electrodynamics FEM model for SMT.
- Development of arbitrary mesh interface model between SMT and structures
- Development and coupling of a novel modular solid-brick analogy grid motion/deformation capability and generalize it for large deformations and general grid systems.
- Identification of requirements for advanced data management, including model requirements for physical models, model interfaces, and GUI.
- Demonstration of the feasibility of the technology for proof of concept.

NASA Applications

- Prediction of aeroservoelastic problems of aerospace vehicles, such as buffet, flutter, buzz, limit cycle oscillations (LCO), and control reversal.
- Similar application in rotorcraft, controlled micro air-vehicles, UAV, nonlinear lift systems, space vehicles.
- Advanced applications, such as active aeroelastic wings and active twist rotors.

Non-NASA Applications

- General FSI problems such as vortex-blade interaction of rotorcraft, heat exchanger vibration, strumming of cables and offshore pipelines, galloping of towers and masts, and fatigue of panels.
- This framework can also be used by automotive and propulsion industries and by academic institutions as well.

Firm Contact

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NON-PROPRIETARY DATA