

1. **Research Title:** High Frequency Load Measurements of Slender Bodies in Unsteady Flow Fields

2. **Individual Sponsor:** List the AFRL research topic sponsor's contact information

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3. **Academic Area/Field and Education Level:** Aerospace and/or Mechanical Engineering (MS or Ph.D. level)

4. **Objectives:** Develop high frequency non-intrusive pressure measuring methods for measuring unsteady loads on slender body stores in an unsteady cavity environment.

5. **Description:** To estimate a bound on store separation "trajectory spread" from weapons bays due to unsteady aero loads in the vicinity of the cavity, dynamic store balance measurements are required to accurately measure unsteady store loads in wind tunnels. A small cavity model scale increases forcing frequency applied to the store, while store/balance inertia limits traditional balance load response, which could result in inaccurate balance load measurements. A successful solution to this problem lies in a combination of intelligent design of the load measuring scheme, combined with an analytical approach to separate aero-dynamic loading from other non-aero loading picked up by the unsteady load sensor. High frequency non-intrusive pressure measuring methods (i.e. PSP) could be one way to estimate real-time unsteady aero loading on the store, but is typically limited by lack of a 360 deg view of the model. This could be supplemented by unsteady CFD to "fill in" missing views of the store for a complete 360 deg view, for integrated pressure loading over the whole surface. For the other aspect of the problem, unsteady CFD combined with a finite element model can be used to identify the unsteady test rig vibrations which will corrupt the load cells with non-aero forces. The ultimate result would be the development of a reduced order model, specific to a store / sting / cavity test setup, which could be used to back out aero-loads from total measured loads. The Aerospace Systems Directorate program "Rapid Assessment of Weapons Separation (RAWS) is currently attempting to measure store load as they traverse thru a weapons bay flow field using traditional store balance techniques. Proposed work under this topic could be consist of any or all relevant components of this problem – physics based computational, experimental, or low order modeling. Control techniques could be applied after the initial proof of concept, to enhance accuracy of measurement / minimize extraneous vibration. Ultimate application of the techniques is intended for larger wind tunnels (including the 2 ft by 2ft) TGF facility, but small university test rigs and sample problems are encouraged for initial proof of concept.

6. **Research Classification/Restrictions:** This research unclassified, with intent to publish in the open literature.

7. **Eligible Research Institutions:** All DAGSI Universities.

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