

1. **Research Title:** Optimized Beam Systems with Geometric Non-Linearity
2. **Individual Sponsor:** Dr. Maxwell Blair, AFRL/VASD,  
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3. **Academic Area/Field and Education Level:** *For example:* Aerospace and Mechanical Engineering / Optimization of Aeroelastic Systems (MS or Ph.D. level)
4. **Objectives:** The objective is to formulate and validate design sensitivities for an optimized High-Altitude Long-Endurance (HALE) concept based on geometrically non-linear equivalent beam wing theory. The ultimate design objective is minimum induced drag.
5. **Description:** The AFRL SensorCraft program is interested to develop conceptual design models of unusual aeroelastic HALE concepts. The simplest structural wing representations are based on beam theory. However, conceptual design and optimization of large and flexible beam assemblies require a geometric non-linear formulation that incorporate the effects of stiffness coupling, follower forces and large deformations. This development begins with the extension of recently developed non-linear beam formulations to include design sensitivities suitable for design optimization. Next, design sensitivities are developed for a system of beams that represent an aeroelastic HALE concept. Design variables at the beam level include beam length and cross sectional shape. Design variables at the system level represent wing geometry as might be applicable to joined-wing configurations. Wing geometry includes aerodynamic shape and structural layout. Design constraints address mission range and payload.
6. **Research Classification/Restrictions:** All research will be based on and result in public domain data.
7. **Interest in Summer USAFA Cadet:**

The focus is on non-linear structures and optimization, generally not suitable for undergraduate research

**Eligible Research Institutions:**

- Universities (DAGSI)       AFIT (only)       USAFA