

1. **Research Title:** *Validation and Canonical Solutions for Implementing a Second Law Analysis in Systems–Engineering and Design Optimization*
2. **Individual Sponsor:**
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3. **Academic Area/Field and Education Level:** Systems Engineering and Mechanical or Aerospace Engineering/Thermo-economic Design Optimization (BA/BS, MS or Ph.D. level)
4. **Objectives:** To validate use of the second law of thermodynamics, using entropy generation and/or exergy destruction as an objective function, in design optimization by testing it on several canonical problems.
5. **Description:** The evolutionary nature of flight vehicle design and optimization has served technological demands well in order to reach the performance of current aircraft. At times, however, we must depart from the evolutionary process and aim for a breakthrough design. The design of advanced aerospace vehicles challenges the traditional experience and databases. To meet this challenge, it has been proposed to incorporate the second law of thermodynamics (SLT) into generalized analysis and design methods based on the concept of exergy. Of particular interest is application of entropy/exergy and the second–law principle in the analysis and design of complex physical systems. This work would focus on the validation of this idea by developing and applying this methodology to several canonical problems with theoretical/analytical or other comparable solutions. These problems can be tailored to the student's background, expertise, and time constraints. Software tools developed and funded by AFRL can be utilized to develop a series of canonical “benchmark” solutions in context of the systems engineering process.
6. **Research Classification/Restrictions:** None.
7. **Interest in Summer USAFA Cadet (Avg Cost for USAF Cadet for 33 days was \$4000):**
Yes, if qualified candidate and funds available; would require working knowledge of Matlab.
8. **Eligible Research Institutions:**
 Universities (DAGSI) AFIT (only) USAFA