NASA Dryden Flight Research Center (DFRC)  
In Partnership with the  
AERO Institute

Senior Design Competition in  
Aerostructures Research Aligned to  
NASA’s Aeronautics Research Mission  
Directorate

2007 Announcement

24 January 2007
NASA Dryden Flight Research Center
Senior Design Competition
in
Aerostructures Research - 2007 Announcement

Fostering new generations of highly skilled scientists and engineers is critically important to the aeronautics community. The Aeronautics Research Mission Directorate (ARMD), as part of its commitment to mastering the core competencies of aeronautics in all flight regimes, is restructuring its education program, including focusing investments in undergraduate and graduate education. As part of these focused investments, NASA Dryden Flight Research Center (DFRC) is announcing an undergraduate (junior – senior level) Student Design Competition.

The NASA Dryden Flight Research Center (DFRC), in cooperation with the AERO Institute and the California Space Grant, is soliciting proposals from university/college teams that are composed of students at the junior - senior level. These student team proposals (limited to 5 pages) will focus on one or more of the following DFRC Aerostructures Research areas – more details at (http://aeroi.org/2007design):

• **Wing Shape Sensing**
  o Develop innovative technique(s) for determining the deflected shape of aircraft structures using differential GPS technology.
  o Validate the technique in a laboratory demonstration of a simulated wing or control surface tested under both quasi-static and simulated flight dynamic loading.

• **Wing Shape Control**
  o Develop innovative technique(s) for performing real-time active shape control of high-aspect ratio aerospace structures.
  o Validate the technique(s) in a laboratory demonstration.

• **Flexible Wing Ground Vibration Test Technique Development for Structural Dynamics**
  o Develop new ground vibration test technique for high aspect ratio flexible wings, i.e. wings with geometric nonlinearities.
  o Measure pitch, yaw, & roll moments of inertia.
  o Develop ground flutter test technique, i.e. simulate unsteady aerodynamic loads on the ground.

• **Fiber Bragg Grating Demodulation Algorithm Development**
  o Develop an efficient demodulation algorithm to advance the overall system speed performance of a Fiber Bragg Grating system by a factor of four over the current state-of-the-art of four updates per second. Consider algorithms that incorporate wavelet transforms, sliding or hopping fast Fourier transforms, etc.
  o Validate the algorithm through a laboratory demonstration utilizing data provided by NASA.

• **Aeroservoelastic Simulation Development**
  o Develop enhanced batch and real-time aeroservoelastic model simulations.
  o Use rapid model development techniques with a reduced set of aeroelastic modes.
  o Add structural flexibility and unsteady aerodynamics in current simulation models.
  o Create real-time simulation with sufficient aerodynamic fidelity.
  o Validate the technique(s) in a simulation laboratory demonstration.
AEROSTRUCTURES DESIGN COMPETITION OPPORTUNITY

I. Introduction
Aeronautics Research Mission Directorate (ARMD) at NASA DFRC is funding a one-year higher education project that will distribute funds to accredited U.S. university and college student teams for aerostructures-oriented design and subsequent development projects. We invite university student teams (junior – senior level) to submit proposals for a two-phase opportunity relating to DFRC Aerostructures Research.


We are asking accredited U.S. universities and colleges to electronically submit (katrina.emery@dfrc.nasa.gov) a proposal (not to exceed five pages) in one or more of the Aerostructures-oriented research areas stated above. Researchers from the NASA-DFRC Research Directorate will competitively evaluate qualifying proposals and 5-6 student team proposals will receive Phase I funding. The selected teams will receive $15,000 to develop and complete their designs and present their project designs to NASA DFRC by 7 May 2007.

Phase II:  Team Design Implementations at DFRC (10 June 2007 – 15 August 2007).

After the proposal Design Review, two teams will be selected for Phase II implementation of their project designs at DFRC during the 2007 summer period (10 June 2007 – 15 August 2007). Each selected team must nominate two team members to participate as resident DFRC research interns. In Phase II, funds will be provided to support the interns (travel, lodging, stipends) and the development of the team design. Mentors from the Aerostructures Research area will be assigned to each team to assist them. An Internet-based portal at (http://aeroi.org/2007design) will be implemented that will allow all team members (even though they are not resident at DFRC) to participate on a day-to-day basis during the summer.

II. Pertinent Dates

Date of Announcement: Wednesday, January 24, 2007
Proposal Due Date: Friday, February 23, 2007, 5 p.m. Pacific Time

III. Eligibility Requirements
Proposals will be accepted from accredited U.S. universities and colleges.

IV. Background and Purpose
Part of NASA’s mission is to inspire the next generation of engineers, scientists, and explorers. NASA Dryden Flight Research Center (DFRC) offers university/college
students an opportunity to try to solve some of the technical challenges facing real aeronautics projects. This opportunity focuses on Aerostructures Research. To solve these complex problems, real world teams from public and private sectors collaborate. In this university/college competition, challenges may be more thoroughly examined by multi-disciplinary, multi-department teams. Where possible, such teams are encouraged. Through this solicitation, opportunities will be provided to involve a diverse team of undergraduate students (junior – senior level) in substantive and hands-on engineering experiences to prepare them for future careers in aeronautics and space.

V. DFRC Aerostructures Design Competition

NASA DFRC Aerostructures Research Team Competition Grants - Provide Phase I design grants to five or six university teams to participate with DFRC in Aerostructures-oriented research. Funds can be used to provide student scholarships, buy materials for design prototypes, publication costs relating to design reviews, and to defray costs for interactions with mentors from the government and industry sectors.

The priorities are to:

- Promote competition nationally to allow students and faculty from a number of universities and colleges to participate with NASA DFRC on ongoing aeronautics research,
- Maximize the number of college or university students participating, and
- Provide experience working in interdisciplinary teams on aerostructures research projects.

*Phase I Budget:* $15,000 to each of the Phase I design teams.

In Phase II, two teams will be selected for implementation of their project designs at DFRC during the 2007 summer period (10 June 2007 – 15 August 2007). Representatives from each of the two teams will participate as resident DFRC research interns.

*Phase II Budget:* Funding will be provided to support the interns (travel, lodging, stipends) and the development of the team design.

VI. Proposal Format and Content

Proposals should not exceed 5 pages excluding the title page and budget, and should be prepared in the following format:

1. **Title Page (not included in the page count)**
   Include the name of the University/College, the name, address, phone/fax numbers, and e-mail and original signature of the Faculty advisor, and the name, e-mail address, major department, and academic level of education of each student team member.

2. **Body of Proposal (5 pages maximum)**
   A. **In the proposal:**
   Describe your goals and objectives for the Phase I Aerostructures Design Project and briefly describe the team’s capabilities, intellectual promise, and interest in ARMD’s Aerostructures research. Explain how the proposed suite of team
activities will contribute to the Aerostructures design target. A handy tool to use in the development of your design project goals and objectives is SMART:

- **Specific** – Provide enough detail to let us know exactly how the team and project will be structured and what will be done. Student teams will be chosen for research expertise, intellectual promise, and interest in DFRC Aerostructures Research.
- **Measurable** – Your design project should be such that the team has achievable milestones that can be tracked and you can successfully reach the design review in June.
- **Acceptable** – Aligned with the NASA DFRC Aerostructures Research goals.
- **Realistic** – Set appropriate targets based on the Aerostructures goals and budget level.
- **Time Frame** – Divide the Phase I period into manageable chunks to meet the proposed goals.

3. **Schedule (not included in the page count)** - one-page overview of the proposed schedule should include, but not be limited to, achievement milestones and expected dates of tangible outcomes.

4. **Budget (not included in the page count)** - total funding requested cannot exceed $15,000 for Phase I. Budget should contain sufficient supporting information (student scholarships, prototype supplies, documentation costs, etc.) to facilitate a speedy evaluation and award.

Proposals should be single-spaced on standard 8½ x 11 paper, no smaller than 12 point font and with one inch margins throughout.

**VII. Proposal Evaluation Criteria**

The following criteria will be used in the evaluation process:

1. **Technical Content (50 percent)**
   The proposal should present in a clear and consistent manner a concept that will satisfy one of the Aerostructures design areas as outlined in this announcement. Sufficient technical detail about the assumptions, theories, and models used should be included to demonstrate understanding of the Aerostructures research areas and to provide the evaluators with a thorough understanding of the subsystems and other system design information as identified in the competition announcement. Key assumptions must be clearly outlined and justified. Technical references and source material must be properly documented.

2. **Practical Application and Feasibility (25 percent)**
   The design should provide a feasible and practical solution to the challenge posed in this Aerostructures research announcement. Potential technical hurdles and risks should be clearly identified, and realistic solutions to meet those challenges should be presented and discussed. The design should assess and demonstrate the technical feasibility of the proposed baseline research design concept as well as include cost estimates for the proposed design.

3. **Originality and Creativity (10 percent)**
   Credit will be given for innovative solution(s) to the challenge described in this announcement.

4. **Organization and Presentation (15 percent)**
   The design proposal should be thorough in addressing all of the requirements and constraints in this announcement. The proposal should be organized in a manner
consistent with standard scientific and engineering research proposals and should be easy to follow and understand. Team partnerships/linkages (interdisciplinary team structure, faculty and industry mentors, departmental support should be clearly stated. Proposals should also adhere to any additional format guidelines outlined in this announcement.

VIII. Reporting and Supplemental Program Information
Each Phase I design team will be asked to track participants in the program and supply to NASA DFRC their contact information, grade level, major, university, and project description at the end of Phase I.

At the end of the Phase I period, the design teams shall provide the NASA point of contact with a final report summarizing who participated, their final results/reports, media coverage, feedback from participants, and lessons learned. A format for this report will be provided.

The Education Programs and University Research Division at Dryden Flight Research Center will co-manage this design competition. Dr. Miriam Rodon-Naveira will be the point of contact for Education-related communications.

Dr. Miriam Rodon-Naveira – Education Director
NASA Dryden Flight Research Center
Edwards, CA 93523-0273
Phone: 661-276-3647
Email: Miriam.M.Rodon@nasa.gov

IX. Proposal Submission
Electronic copies of proposals must be received no later than: 5 p.m. Pacific Time, Friday, February 23, 2007. Late proposals will not be considered.

A. Submit a single electronic file of proposal (Microsoft Word or PDF) to:

Katrina Y. Emery, MPA
AERO Institute - _Aerospace, Education, Research, and Operations Institute_
38256 Sierra Highway Suite A
Palmdale, CA 93550
Phone: 661-276-5807
Email: katrina.emery@dfrc.nasa.gov

Applicants will be advised by electronic mail when selections are made. Announcement of awardees will be February 27, 2007.

Questions or clarification regarding the technical aspects of the DFRC Aerostructures Design Competition should be directed to:

Larry D. Hudson
NASA Dryden Flight Research Center
Edwards CA 93523-0273
Phone: 661-276-3925
Email: Larry.D.Hudson@nasa.gov
Student submissions shall be treated as being free of restrictions and limitations on their use, reproduction, and publication.

Note: All entries should arrive on or before the due date of February 23, 2007 and include:
- One electronic copy should be saved as a PDF file and emailed to katrina.emery@dfrc.nasa.gov at the AERO Institute.
- All teams should provide a mailing address and Email address for each team so that certificates of achievement and reviewer feedback on their projects can be given.