NASA STTR 2018 Phase I Solicitation

T15.01 Aircraft Design, Optimization, and Scaled Model Test

Lead Center: AFRC

Participating Center(s): ARC, LaRC

Technology Area: TA15 Aeronautics

This subtopic addresses an advanced aeroelastic design concept for dynamic elastic flight systems. Methods include prototype design and optimization and scaled model design, optimization, manufacturing, and ground and flight (or wind tunnel) tests. Both a baseline configuration (using traditional approach) and a new (or state-of-art) design concept aircraft should be studied to demonstrate the innovation. The followings are recommended as candidate flight systems to be designed, optimized, and tested:Â

- Demonstration of new design concept:
  - Test articles designed using advanced design concept.
- Or application of state-of-art design concept:
  - NASA X-plane: such as hybrid wing body aircraft, low-boom supersonic commercial transport aircraft, etc.: https://www.nasa.gov/aero/nasa-moves-to-begin-historic-new-era-of-x-plane-research.
  - Unmanned aerial vehicles: https://www.nasa.gov/subject/9566/unmanned-aircraft/ & https://en.wikipedia.org/wiki/Unmanned_aerial_vehicle.
  - Mars plane, & etc.: https://www.nasa.gov/centers/armstrong/features/mars_airplane.html.Â

This subtopic also addresses capabilities enabling design solutions for performance and environmental challenges of future air vehicles. Research in revolutionary aerospace configurations include lighter and more flexible materials, improved sonic boom performance on the ground, and improved propulsion systems. This subtopic targets efficiency and environmental compatibilities requiring performance challenges and novel structural optimization for aeroelastic considerations which are gaining prevalence in advanced flight vehicles.Â

Technical elements for the Phase I proposals may also include:Â

- Introduction of new innovative or state-of art design concept for higher performance flight systems.
- Initial conceptual design (mainly for application of state-of-art design concept):
  - Define own design requirement.
  - Outer-mold-line shape.
  - Target flight envelope for prototype.
  - Range.
  - Number of passenger (if needed).
  - Aircraft configuration, etc.Â

Proposals should assist in revolutionizing improvements in performance to empower a new generation of air vehicles to meet the challenges of subsonic and supersonic flight concerns with novel concepts and technology developments in systems analysis, integration and evaluation. Higher performance measures include energy efficiency to reduce fuel burn and operability technologies that enable information network decompositions that have different characteristics in efficiency, robustness, and asymmetry of information and control with tradeoff between computation and communication.Â

Technical elements for the Phase I results and deliverables should be as follows:Â

- Structural finite element models of the prototype should be delivered (at least preliminary design quality):
    - Baseline shape (use classical approach).
    - New (or state-of-art) design shape (use innovative approach).

- Show performance improvement between the baseline configuration and the new (or state-of-art) design concept configuration with structural optimization:
    - Stress/strain distribution under the critical design load condition with margin of safety information.
    - Primary buckling characteristics and buckling shape.
    - Natural frequencies and mode shapes of prototype models.
    - Flutter boundary information with proposed flight envelope.
    - Sonic boom noise level information on the ground (if used); & etc.
- Computer programs developed during Phase I:
    - Source codes.
    - Executable codes.
    - Quick user guide; & etc.Â

Technical elements for the Phase I listed above can be performed by small business and research institution as follows:Â

A sample recommendation

Small business:Â Â

- Develop tools or modeling methodology that can be used in initial design of baseline shape and new design shape.
- Develop tools (if needed) that incorporate stress/strain and modal analyses of initial design.
- Design and build test articles.Â

Research institution:Â

- Design tools (if needed) that allow optimization of baseline shape and new design shape.
- Perform optimization of baseline shape and new design shape.
- Design tools or a way to model buckling, flutter, and sonic boom (if needed) analyses of initial design to support small business.
- Perform ground based testing.

Technical elements for the Phase II proposals should include followings:Â

- Scaled model development plan:
    - Detailed description about scaling technique.
    - Finite element model development plan.
    - Manufacturing plan about scaled model hardware.
- Ground test plan:
    - Static test.
    - Ground vibration test.
- Flight (or wind-tunnel) test plan:

    - Detailed description about flight (or wind-tunnel) test plan.
    - Flight (or wind-tunnel) test will be performed if awarded for Phase III.Â

Technical elements for the Phase II results and deliverables should be as follows:Â

- Test articles (scaled models) developed under Phase II (baseline configuration and new (or state-of-art) design concept configuration).
- Ground test data should be delivered.
- CAD model of the test articles should be delivered.
- Validated (with respect to ground test data) structural finite element model of the test articles should be delivered.
- Stress/strain distribution under the critical design load condition with margin of safety information; Primary buckling characteristics and buckling shape.
- Natural frequencies and mode shapes of the scaled model.
- Flutter boundary information with proposed flight envelope.
- Sonic boom noise level information on the ground (if used).
- Comparisons and discussions of results between prototype vs. scaled model are needed.
- Computer programs developed during Phase II: source codes; executable codes; quick user guide; & etc.Â

Links to program/project websites:Â

- ARMD's Advanced Air Vehicles Program (AAVP): https://www.nasa.gov/aeroresearch/programs/aavp.
- ARMD's Flight Demonstrations and Capabilities (FDC) project under the Integrated Aviation Systems Program (IASP): https://www.nasa.gov/aeroresearch/programs/iasp/fdc.