

Rotary Wing Aeromechanics Research Statement of Work

Introduction

The opportunity to dramatically increase the usage and efficiency of the national airspace system with large civilian rotorcraft vehicles will drive an increased emphasis on rotary wing aeromechanic technologies, both experimental and analytical. This task captures a breadth of technology needs and skills required by the Government to meet the technical challenges established for the Subsonic Rotary Project in aeromechanics-related disciplines.

Scope

The object of the work described here is to advance rotary wing aeromechanics technologies, both experimental and analytical, that will advance the technology readiness of advanced vertical lift civilian transport aircraft. The work includes experimental research using unique rotorcraft test facilities at NASA Ames Research Center and integrates aeromechanics modeling and assessments for a multi-disciplinary focus on solving critical rotary wing aeromechanics problems.

Tasks

Task 1. Full-Scale Rotor Aeromechanics Experimental Research

The contractor shall develop plans, conduct, and report research directed at documenting and interpreting rotor aeromechanic behavior in full-scale rotor experiments, both ground based and in flight.

1. Large field of view particle image velocimetry wake measurements of a full-scale isolated tilt rotor shall be acquired in the National Full Aerodynamics Complex 40- by 80-Foot Wind Tunnel. Technical challenges will include large fields of field for the horizontally-operated Tiltrotor Test Rig using the wind tunnel turntable for edgewise and forward flight operating conditions.
2. Rotor blade displacement measurements of rigid body and elastic rotor blade displacements using fixed system photogrammetry techniques of a full-scale isolated tilt rotor shall be acquired in the National Full Aerodynamics Complex 40- by 80-Foot Wind Tunnel. Technical challenges will be visual access for the horizontally-operated rotor on the Tiltrotor Test Rig using the wind tunnel turntable for edgewise and forward flight operating conditions.
3. Rotor blade displacement measurements of rigid body and elastic rotor blade displacements in flight will be analyzed using helicopter-mounted photogrammetry techniques. Data will be provided by the Government that will be subsequently analyzed and reported. The data provided the contractor shall include steady state and maneuver measurements and are intended to complement the UH-60A Airloads Program database.

Task 2. Rotor Aeromechanics Analytical Research

The contractor shall develop plans, conduct, and report research directed at providing detailed assessments and developments of state of the art aeromechanics technology for helicopters, tilt rotor aircraft, and other advance vertical lift aircraft configurations.

1. Document current state of the art capability for the rotary wing aeromechanics predictions methodologies, with a focus on advanced vertical lift aircraft configurations. The comprehensive assessment shall identify where technology is sufficient to allow for acceptable risk levels to pursue aircraft design and demonstration from an industry perspective. Recommendations for near term and future technology investments shall be developed and provided to the Government.
2. Analyses shall be performed on advanced rotorcraft configurations using computational fluid dynamics methodologies for assessment of component and overall vehicle performance.
3. Detailed computational analyses shall be performed to correlate with full-scale and small-scale wind tunnel test data. These analyses may be characterizations of analyses and test performed to date as well as validation of new analysis tools and methodologies, including applications to correct wind tunnel test results to predict free flight behavior.
4. New methodologies for efficient use in preliminary design for new configurations and physics based simulation and modeling, including real time environments, shall be developed and validated.

Task 3. Aeromechanics Graphics, Publications, and Presentations Preparation

The contractor shall develop sketches, schematics, figures, and reports in government publication, exhibits, conference proceedings or journal publication format, as appropriate, for on-going and completed research activities.

Presentation materials to support delivery of oral presentations at scientific meetings shall also be prepared as necessary. The efforts of the contractor shall include composing, visualizing, writing, editing and development of illustrations for the reports and presentations.

Task 4. Meeting and Review Participation

The contractor shall participate in aeromechanics research meetings and rotary wing project reviews at NASA Ames Research Center, Moffett Field, California. The contractor also shall attend, present findings, and support other meetings as required, including briefings for the Department of Defense and other Rotary Wing Project stakeholders.

Deliverables

All deliverables from Subtasks 1 and 2 shall document the entire effort performed under each respective subtask. All deliverables are to be in electronic form and approved by the Government.

Task 1

The deliverables for Subtask 1 shall include the following.

- A Draft Test Plan shall be submitted to the Government within 3 months of task initiation documenting the approach to be used in acquiring particle image velocimetry data (Task 1.1), blade displacement measurements (Task 1.2), and rotor blade measurements in flight (Task 1.3).
- The Final Test Plan shall be submitted to the Government within 4 months of task initiation incorporating all comments and revisions provided by the Government in the review of the Draft Test Plan.
- A Draft Final Report shall be submitted to the Government within 10 months of task initiation documenting the all experimental results and data analyzed in conducting Tasks 1.1, 1.2, and 1.3.
- The Final Report shall be submitted to the Government within 12 months of task initiation incorporating all comments and revisions provided by the Government in the review of the Draft Final Report.

Task 2.

The deliverables for Task 2 shall include the following.

- Task 2.1: A draft final report of the comprehensive assessment of rotorcraft prediction methodology shall be provided within 10 months of task initiation. The Government shall provide review and comments. A final report shall be submitted to the Government within 12 months of task initiation.
- Task 2.2: A draft final report documenting the analysis tools used, the modeling approach, the predictions made, and the major findings of the analyses performed shall be provided within 10 months of task initiation. The Government shall provide review and comments. A final report shall be submitted to the Government within 12 months of task initiation.
- Task 2.3: A draft report documenting the correlations performed together with datasets used and the computational methodologies employed shall be provided within 10 months of task initiation. The Government shall provide review and comments. A final report shall be submitted to the Government within 12 months of task initiation.
- Task 2.4: A draft report documenting the new simulation and modeling capability, including validation against existing datasets, shall be provided within 10 months of task initiation. The Government shall provide review and comments. A final report shall be submitted to the Government within 12 months of task initiation.

Task 3.

- The contractor shall provide draft graphics for use in education and technical outreach activities as specified by the Government in quarterly submittals (every three months) for review and approval. Final submittal on a quarterly basis shall be 15 days following draft

submittal. The documentation (both draft and final) shall be in electronic format for reproduction by the Government on appropriate presentation media.

Task 4.

The contractor shall provide a summary written report providing subject matter expert assessment and evaluation of the meeting attended within 7 days of the completion of that meeting. These reports shall clearly review the objectives, scope, and findings of the meetings from the subject matter expert's perspective. As appropriate, recommendations for future actions shall be included.

Travel

Four trips of three- days duration for one person are anticipated to other NASA Centers for coordination and present research findings to other Government personnel under Subtask 4.

Period of Performance

All work is to be completed within 12 months of task initiation.

Place of Performance

The work will be performed at the contractor's facilities and on-site at NASA Ames Research Center.