Unsteady Design Optimization for Aeroelasticity Applications, Phase I

Completed Technology Project (2014 - 2014)

Project Introduction

Aeroelasticity plays an important role in the design and development of highly flexible flight vehicles and blended wing body configurations. The operating margins on these flight systems are limited by non-linear unsteady phenomena such as stall, flutter, gusts, limit cycle oscillations, vortex roll-up which exhibit strong coupling between the aero-loads and structural deformations. The use of high-fidelity time domain methods such as CFD/FEM during the design phase has been limited by the cost of computing the unsteady physics. In this proposal researchers from CRAFT Tech and Georgia Tech offer a collaborative inter-disciplinary design optimization approach to aeroelasticity problems with high fidelity aerodynamics analysis and structural dynamics. This approach is primarily feasible because of the development of a novel unsteady analysis procedure that reconstructs the unsteady dynamics with high accuracy and nominal cost. The reconstruction procedure combines CFD and FEM with a modified Proper Orthogonal Decomposition method and an Artificial Neural Network to simulate the unsteady aeroelastic features associated with different shape designs with good reliability. Furthermore, the process of reconstructing the unsteady solution permits the incorporation of control strategies and time variant system responses making it appealing for the aeroservoelasticity class of problems.

Primary U.S. Work Locations and Key Partners

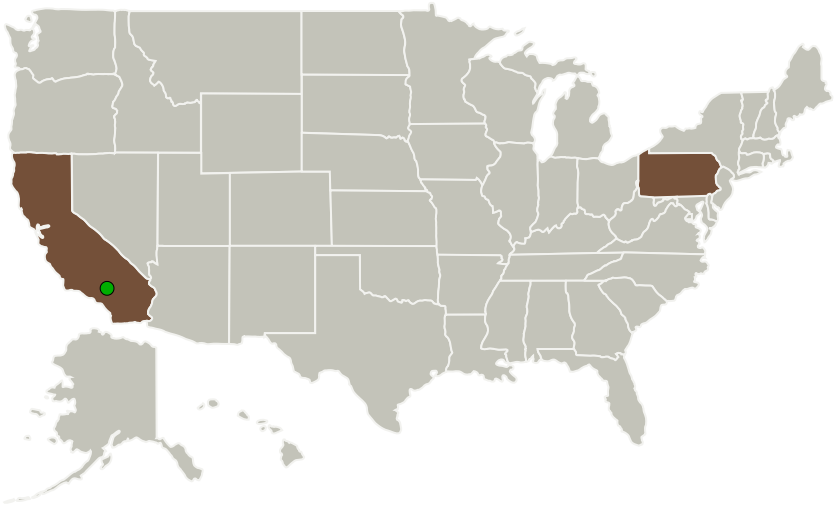

Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Organizational Responsibility	1
Project Management	1
Project Transitions	2
Images	2
Technology Maturity (TRL)	2
Technology Areas	2
Target Destinations	2

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CRAFT Tech - Combustion Research and Flow Technology

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Continued on following page.

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Organizations Performing Work	Role	Type	Location
CRAFT Tech - Combustion Research and Flow Technology	Lead Organization	Industry	Pipersville, Pennsylvania
Armstrong Flight Research Center(AFRC)	Supporting Organization	NASA Center	Edwards, California

Primary U.S. Work Locations	
California	Pennsylvania

Project Transitions

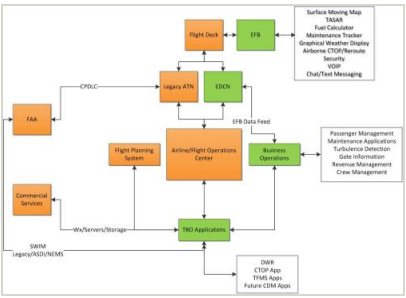
June 2014: Project Start

December 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140724)*

Images



Final Summary Chart Image
Unsteady Design Optimization for Aeroelasticity Applications, Phase I Project Image
(https://techport.nasa.gov/image/136510)

Project Image
Unsteady Design Optimization for Aeroelasticity Applications Project Image
(https://techport.nasa.gov/image/134515)

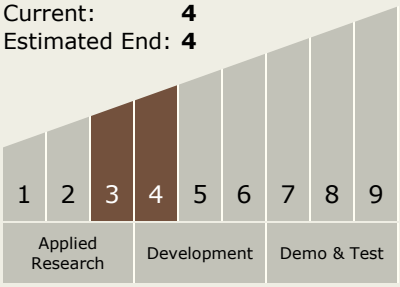
Project Management *(cont.)*

Program Manager:
Carlos Torrez

Principal Investigator:
Vineet Ahuja

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  └ TX15.1 Aerosciences
    └ TX15.1.3 Aeroelasticity

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System