Unstructured Mesh Movement and Viscous Mesh Generation for CFD-Based Design Optimization, Phase I

Completed Technology Project (2005 - 2005)

Project Introduction

The innovations proposed by ResearchSouth are: 1) a robust method to automatically insert high quality anisotropic prismatic (viscous boundary layer) cells into any existing CFD mesh; and 2) a robust unstructured mesh movement method able to handle isotropic (Euler), anisotropic (viscous), and mixed element grids for CFD applications, particularly, CFD-based design optimization. ResearchSouth is proposing to develop efficient, design-oriented application software that will significantly impact the current practice of computational design and analysis of aerospace vehicles. The most overlooked?and arguably the most enabling?technical aspect associated with the rapidly maturing CFD-based design optimization is mesh movement, especially for high Reynolds number viscous flow applications. CFD analysis based on unstructured grid technology is becoming the preferred approach for flow analysis of geometrically complex configurations. However, in the area of mesh movement and viscous mesh generation, the unstructured grid arena has experienced near paralysis for several years. We are proposing research that will provide robust solutions to both of these challenges and, thus, will provide air vehicle designers access to the full potential of unstructured grid technologies for performing design optimization as well as highly efficient "what-if-and-reanalyze" geometric modifications.

Anticipated Benefits

Potential NASA Commercial Applications: No commercial software currently exists that reliably and robustly handles unstructured mesh movement. The potential market for our software is very broad?our software can be used for fluid applications in the aerodynamic, automotive, biomedical, turbomachinery, and hydroelectric fields as well as for structural and electromagnetic applications. Each of these markets can immensely benefit from design optimization, provided that unstructured mesh movement and viscous mesh generation are no longer impediments.

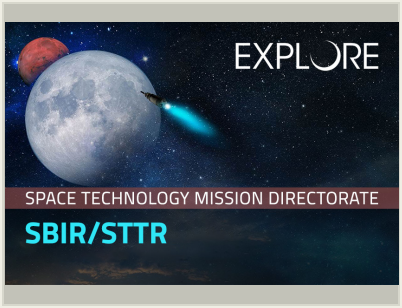

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Table of Contents

Project Introduction 1
Anticipated Benefits 1
Primary U.S. Work Locations and Key Partners 2
Organizational Responsibility 2
Project Management 2
Technology Areas 2

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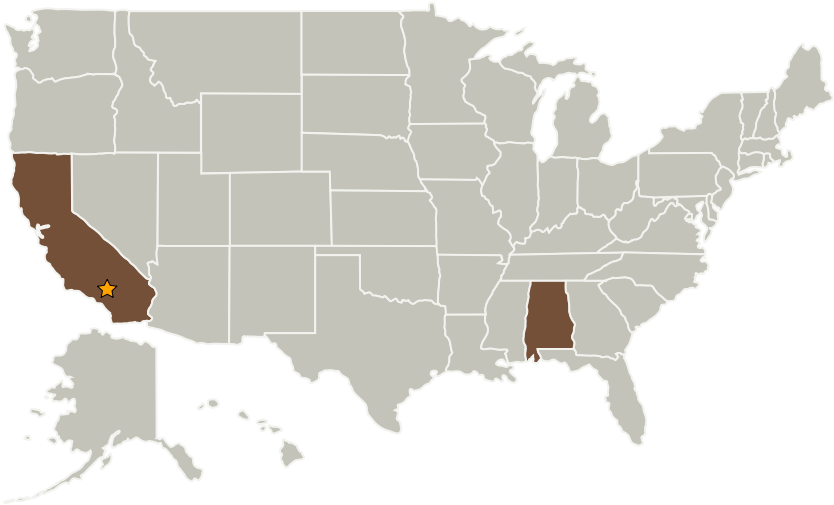
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Armstrong Flight Research Center(AFRC)	Lead Organization	NASA Center	Edwards, California
Research South, Inc.	Supporting Organization	Industry	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	California

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Armstrong Flight Research Center (AFRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Lawrence W Spradley

Technology Areas

Primary:

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