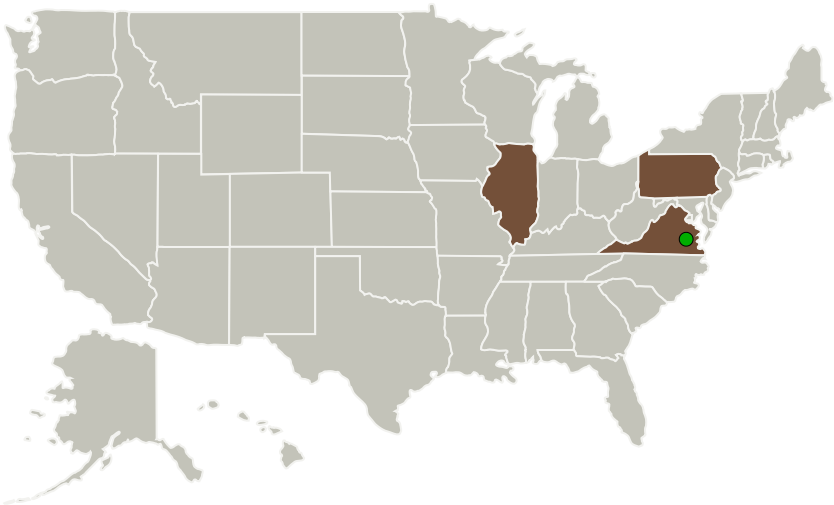
An Automated High Aspect Ratio Mesher for Computational Fluid Dynamics, Phase II

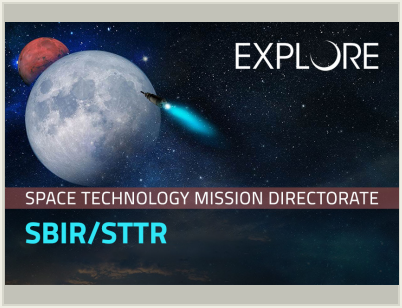
Completed Technology Project (2011 - 2014)

Project Introduction

The work will focus on the 3D implementation of the Phase 1 CHARM mesher, with solution-adaptive iteration for CFD and non-CFD applications. The proposed 3D method will incorporate and extend a previously developed method of generating field-guided hexahedral elements from a metric tensor field. While the fundamental technical approach ⬭ a combination of metric tensor conditioning, metric-tracing mesher, and cell-packing mesher ⬭ remains the same, there are many technical challenges specific to the 3D domain, including the following: - Investigation into conditioning of volume metric tensor fields - Investigation into the topology (structure) of volume metric tensor fields - Developing algorithms for the generation, repair, and adjustment of streamsurface arrangements - Developing algorithms to convert streamsurface arrangements to hex-dominant meshes - Developing algorithms to combine streamsurface- and packing-based meshes - Investigation into designing these algorithms for mesh adaptation rather than adaptive remeshing - Investigation of time and storage efficiency of these algorithms in a large-scale parallelism context In addition to the above, the goal is to generalize the solution in order to support its packaging and commercialization for a number of problem sets and target applications. This includes generalization of the solver-adaptive framework, creation of APIs to programatically expose core functions, and provide UI access to appropriately control and configure the application.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
Ciespace Corporation	Lead Organization	Industry	Oak Brook, Illinois
Carnegie Mellon University	Supporting Organization	Academia	Pittsburgh, Pennsylvania
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Illinois	Pennsylvania
Virginia	

Project Transitions

August 2011: Project Start

February 2014: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138698)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Ciespace Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

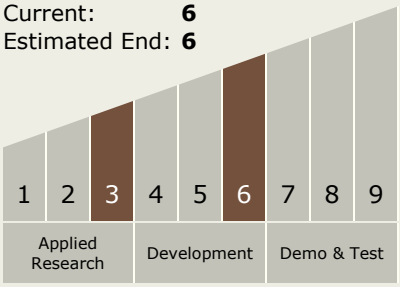
Carlos Torrez

Principal Investigator:

Kenji Shimada

Technology Maturity (TRL)

Start: **3**
Current: **6**
Estimated End: **6**



Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  └ TX15.1 Aerosciences
    └ TX15.1.7 Computational Fluid Dynamics (CFD) Technologies

Target Destinations

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