

Aeroelastic Simulation Tool for Inflatable Ballute Aerocapture

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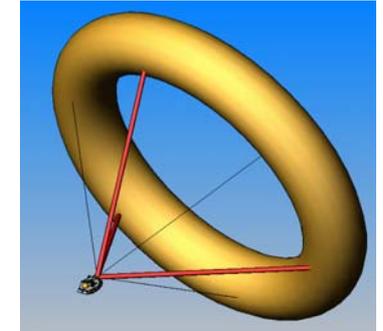


Identification and Significance of Innovation

- Ballute Aerocapture Technology Critical Risk Area:
 - 1) Impact of Aeroelastic Deformation on Aerodynamics, Structures, Aeroheating
 - 2) Flow Unsteadiness and Dynamic Stability of Large Trailing Ballute Systems
- There Is Currently No Multi-Disciplinary Analysis Tool In The NASA CFD Arsenal That Can Perform Ballute Coupled Aeroelastic And Dynamic Analyses
- Project Will Develop Multidisciplinary Simulation System for Predicting Impact of Dynamic and Aeroelastic Effects on Functionality of Inflatable Aeroassist Vehicles
- Based on Proven *Multi-Disciplinary Computing Environment* (MDICE) Software That Couples Standalone Fluid, Thermal, Structure and Dynamics Analysis Codes
- Existing Framework Contains Continuum CFD, 6-DoF Motion, Structures, and Thermal Modules; Extend to Inflatables in Continuum And Rarefied Flow
- Implement NASA Codes-of-Choice (Laura/HEFSS, DAC, ...) in Framework



Attached Ballute Concept



Trailing Ballute Concept

Technical Objectives

- Existing System Proven for Continuum CFD, 6-DoF Motion, Structures, Thermal
- Extend Multi-Disciplinary Simulation Capabilities To Inflatable Aerocapture Applications (Continuum And Rarefied Flow)
- Demonstrate For Ballute Concepts In Continuum And Rarefied Flow Regimes
- Identify Suite of NASA Codes-of-Choice (Laura/HEFSS, DAC, ...) for Integration

Work Plan

Phase I:

- Demonstrate Existing Continuum Flow Aeroelastic Capability for Ballutes
- Identify Improvements Required for Inflatable Structure Simulations
- Demonstrate Implementation of DSMC Code for Rarefied Flow Analysis

Phase II:

- Fully Integrate DSMC in Simulation System for Aeroelastic Analysis
- Implement Suite of NASA Preferred Codes (Laura/HEFSS, DAC, ...)
- Apply in Ballute Technology Development With NASA and Industry Teams
- Explore Further Improvements (DSMC Speedup, Hybrid Navier-Stokes/DSMC)

NASA Applications

- NASA Ballute Aeroassist Technology Development
- Deceleration And Precision Landing For Cargo Delivery To Mars Outposts
- Hypercone Decelerators: Return Down-Mass From Earth Orbit
- Space Based Inflated Structures (Telescopes, Mirrors), Solar Panels

Non-NASA Applications

- Space Based Inflated Structures (Telescopes, Mirrors), Solar Panels
- Military Reentry Vehicles (Inflatable Decoys)
- Store Separation With Inflatable Decelerators, Drogue Chutes
- Parachutes, Paragliders, High-Altitude Endurance Planes

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