Title: Development of an Intelligent Coupling Approach for Modeling and Prediction of Cryogenic Propellant Behavior in Microgravity during Long-term Storage

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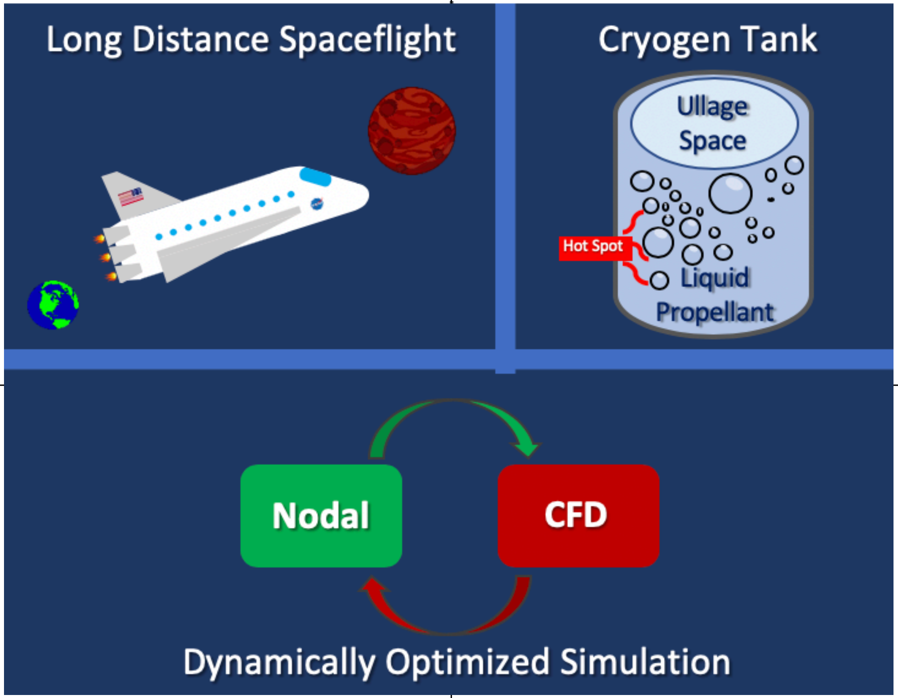
Research Objectives

- Enhance accuracy of nodal models for fast simulation of complex two-phase cryogen systems by implementing physics-informed correlations and reduced thermal models based on high-fidelity reference simulations.
- Facilitate efficient use of the CFD and nodal tools for prediction of long-term cryogenic propellant storage.
- Deliver a fully validated analysis tool accounting for accuracy and efficiency while satisfying NASA's need for mission operations.
- Start with TRL 2 and end with TRL 4.



Approach

- Develop new bubble length scales and thermal models for predicting two-phase cryogen behavior in microgravity.
- Develop dynamic coupling approaches for efficient integrated analysis.
- Optimize the integrated analysis tool for long-term mission planning to achieve both accuracy and efficiency.
- Test and validate the integrated computational models by comparing with NASA's test cases.

Potential Impact

- Enable integrated analysis of complex two-phase cryogenic propellant behavior in microgravity during long-term space missions as the first-of-its-kind tool.
- Enhance modeling capability to analyze complex physics by improving prediction accuracy and computation efficiency.
- Lead to dramatic improvements at the system level to storage tank designs with better performance.
- Minimize time, human resources, and capital cost for space mission planning.