



Modal Propellant Gauging

Problem Statement

- Propellant mass gauging currently requires settling burns or pressurant hardware.
- Modal Mass gauging has been characterized in lab and settled, 1-g gauging resolution has been established. FOP flights will yield data on gauging resolution for unsettled fuel states in zero-g.
- MPG experiment tracks acoustic resonances in propellant tanks. Peaks shift with changing liquid volume.
- Potential users include commercial launch vehicles, life support and habitation systems.

Technology

Development Team

- Project PI: Dr. Kevin Crosby, Carthage College, kcrosby@carthage.edu.
- Partners: Dr. Brant Carlson, Carthage College; Mr. Rudy Werlink, KSC Cryogenics Lab.

Proposed Flight Experiment

Experiment Readiness:

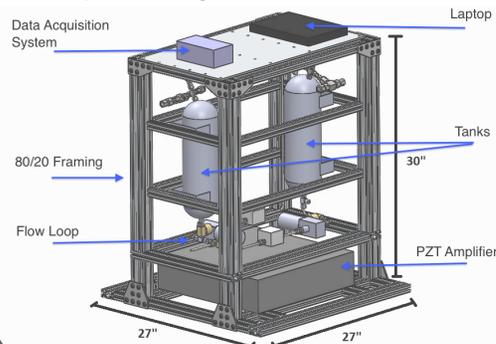
- MPG Experiment is currently configured for flight. In-tank cameras will be added and tested prior to July, 2015.

Test Environment:

- Previous tests aboard parabolic flights yielded preliminary data on gauging resolution and demonstrated proof-of-concept. A sounding rocket flight yielded data on settled fuel states in small tanks.

Test Apparatus Description:

- The test rig measures 27"x27"x30" and weighs approximately 77kg. Rig consists of two experimental tanks, a flow loop, and a data acquisition system. Operator control is via a laptop computer running a *Labview* user interface.



Technology Maturation

- Current TRL of MPG Experiment is 5. For advancement, we require demonstrated consistent 1.5-2% resolution in gauging fill levels between 30%-70% across different tank geometries and sizes.
- Advance technology maturation through low-g flights with two different tank sizes; characterize power requirements for large-scale tank propellant gauging.

Objective of Proposed Experiment

- Measure modal mode peak positions at 2% fill intervals.
- Flight experiment will provide modal gauging resolution data. This is the second tank tested on parabolic flights and so will address question of universality of technique across tank types.
- Next phase of development: flight tests with cryogenic tank.

Roadmap Technologies Addressed: TA01 Launch Propulsion Systems, TA02 In-Space Propulsion Systems