NASA SBIR/STTR Technologies

Free-Surface Modeling of Cryogenic Fluids Using a Higher-Order, Unstructured Grid Volume-of-Fluid (VOF) Method

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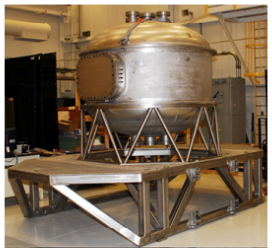
X2.01--9105

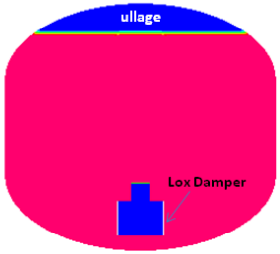
Identification and Significance of Innovation

- Cryogenic Fluid Management (CFM) technology is an integral part of NASA's Exploration Vision.
- VOF capability in several commercial codes (e.g., CFD-ACE+, FLOW3D) is being used by NASA to simulate free-surface flows in CFM applications.
- NASA engineers would benefit from a number of modeling advancements to the existing VOF capability.
- Best opportunity to increase the value is to implement VOF in Loci/STREAM:
  - Most widespread dissemination within NASA/MSFC
  - Best way to realize potential of parallel processing

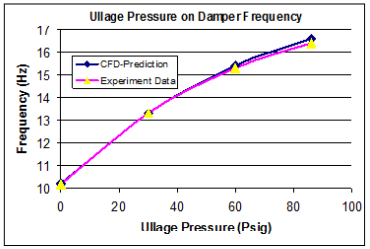
Expected TRL Range at the end of Contract (1-9): 6



CTB tank with stand at MSFC



CFD model of CTB tank with LOX damper



Comparison of LOX damper frequency with test data.

Technical Objectives and Work Plan

- Formally verify the second-order spatial accuracy of the VOF interface tracking module previously developed by CFDRC.
- Couple the stand alone Loci-based VOF module to Loci-STREAM.
- Show the feasibility of the proposed approach by validating the coupled 2-D Loci-STREAM-VOF code.

NASA and Non-NASA Applications

- NASA
  - Cryogenic fluid slosh in launch vehicle tanks.
  - Assessment of thrust oscillation mitigation designs
  - Liquid rocket engine fuel injectors
  - Cryogenic Fluid Management

- Non-NASA (selected from numerous uses):
  - OEM contractors for liquid rocket engines
  - Gas turbine engine and Diesel engine manufacturers
  - Casting and other mold-filling
  - Naval design
  - Liquid break-up applications (e.g., spray atomization)
  - Micro-fluidic devices

NON-PROPRIETARY DATA