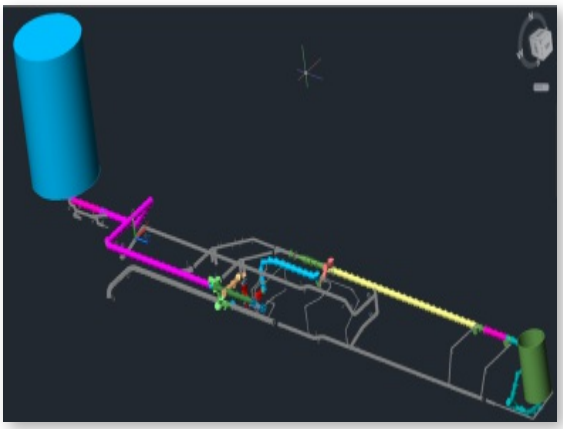
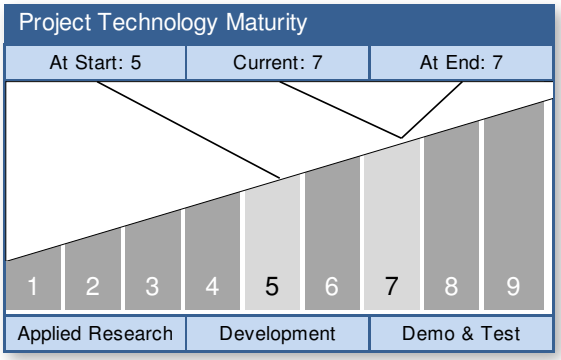
Advanced Ground Systems Maintenance Physics Models For Diagnostics Project

Human Exploration And Operations Mission Directorate (HEOMD)

National Aeronautics and Space Administration



Physics model of Simulated Propellant Loading System produces a high-fidelity simulation that is used for design and operations analysis and real-time diagnostics of cryogenic system operations



ABSTRACT

The project will use high-fidelity physics models and simulations to simulate real-time operations of cryogenic and systems and calculate the status/health of the systems. The project enables the delivery of system health advisories to ground system operators. The capability will also be used to conduct planning and analysis of cryogenic system operations.

Technology Area: Ground & Launch Systems Processing TA13 (Primary)
Robotics, Tele-Robotics & Autonomous Systems TA04 (Secondary)

ANTICIPATED BENEFITS

To NASA funded missions:

Reduces trouble-shooting time during system operation and can also be used as an enginering analysis tool during the design phase. Provides the capability to conduct subsystem assessment of known, undetectable system failure modes. Provides capability to assess the system design and identify the

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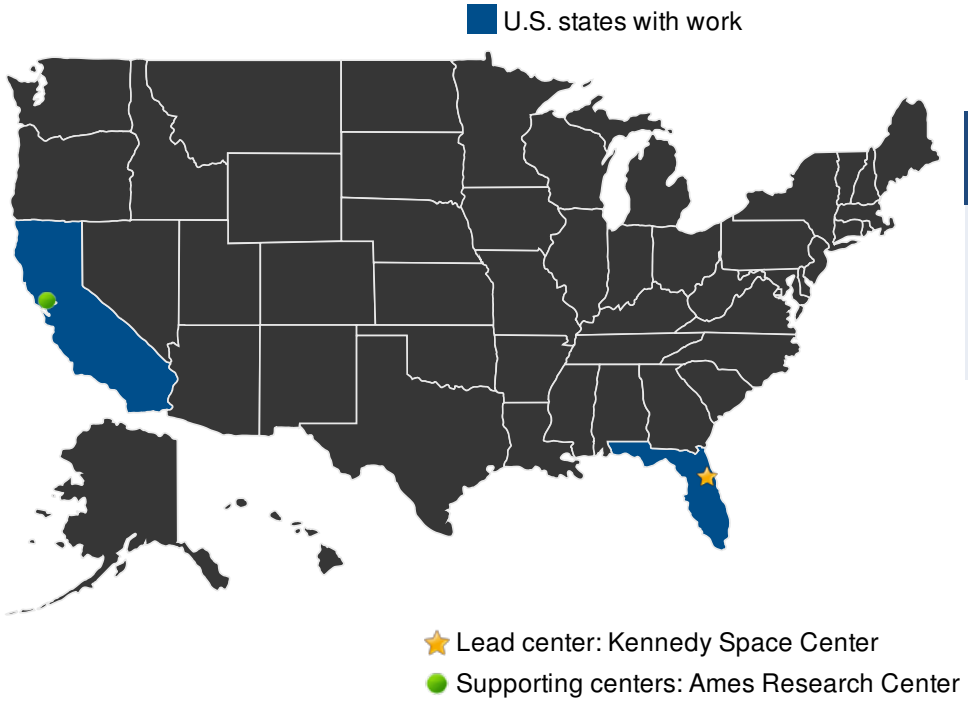
Read more on the last page.



Other Organizations Performing Work

ABACUS / ITSS
QinetiQ North America
Stinger Ghaffarian Technologies

DETAILED DESCRIPTION

This project will develop and implement high-fidelity physics-based modeling techniques to simulate the real-time operation of cryogenics and other fluids systems and, when compared to the real-time operation of the actual systems, provide assessment of their state. Physics-model calculated measurements (called “pseudo-sensors”) will be compared to the system real-time data. Comparison results will be utilized to provide systems operators with enhanced monitoring of systems' health and status, identify off-nominal trends and diagnose system/component failures. This capability can also be used to conduct planning and analysis of cryogenics and other fluid systems designs. This capability will be interfaced with the ground operations command and control system as a part of the Advanced Ground Systems Maintenance (AGSM) project to help assure system availability and mission success. The initial capability will be developed for the Liquid Oxygen (LO2) ground loading systems.

MANAGEMENT

Program Executive:
Michael Bolger

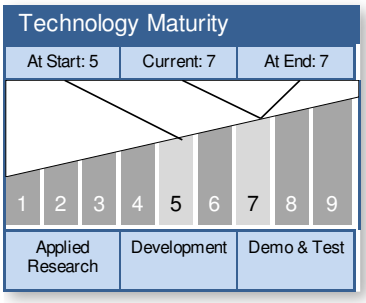
Program Manager:
Kirk Lougheed

Project Manager:
Kirk Lougheed

Principal Investigator:
Barbara Brown

TECHNOLOGY DETAILS

Advanced Ground Systems Maintenance Physics Models for Diagnostics



TECHNOLOGY DESCRIPTION

The project will use high-fidelity physics modeling techniques to simulate real-time operations of cryogenic systems and calculate the status/health of the systems. 1st order principles are used to represent thermal, mass and fluid properties and their interaction within the system to simulation system function. During system operation, simulated measures are compared to system data and used to identify off-nominal trends, diagnose failures and identify options for maintaining or restoring system function.

This technology is categorized as a software macro for engineering, design, modeling, or analysis

- Technology Area
    - TA13 Ground & Launch Systems Processing (Primary)
    - TA04 Robotics, Tele-Robotics & Autonomous Systems (Secondary)
    - TA06 Human Health, Life Support & Habitation Systems (Additional)

CAPABILITIES PROVIDED

Capabilities provided by this technology are a high-fidelity physics models that simulate real-time operations of cryogenic systems and calculate the status/health of the systems and a planning and analysis tool for cryogenic system operations.

POTENTIAL APPLICATIONS

The primary application of this capability will be to aid the system operator in quickly identifing and isolating components faults, predicting system and components trending to failure, and overcoming problems due to instrumentation failures in the systems. This capability will predict potential faults and expedite the resolution of problems that could jeopardize the intended mission. Complex failures (failures involving more that one failed component, faults that are not visible/instrumented, etc.) are identified by this capability. Presently, the project is developing and implementing an application for the liquid oxygen cryogenic loading system at the launch site. Other fluids ground systems can also benefit from this capability.

Another application for this capability is

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Read more on the last page.

PROJECT LIBRARY

Images

- Physics model of Simulated Propellant Loading System produces a high-fidelity simulation that is used for design and operations

  (https://techport.nasa.gov/fetchFile?objectId=2081)

ANTICIPATED BENEFITS

To NASA funded missions: (CONT'D)

optimal placement of sensors to optimize the ability to detect known fault modes. Can be used to enable autonomous system operations.

TECHNOLOGY DETAILS

POTENTIAL APPLICATIONS (CONT'D)

the training of ground operations personnel on their assigned systems, to increase their awareness of potential faults, how these faults propagate and what are the indications they produce.