# Advanced Ground Systems Maintenance Functional Fault Models For Fault Isolation Project

Ground Systems Development And Operations Program

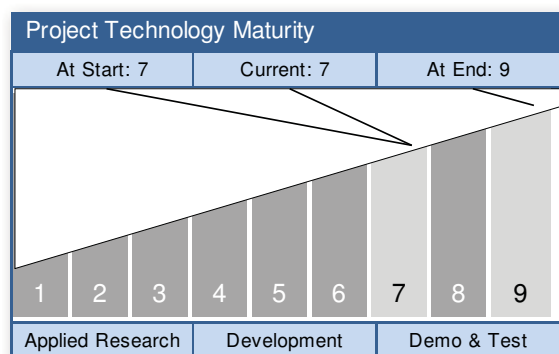Human Exploration And Operations Mission Directorate ( HEOMD )

National Aeronautics and
Space Administration



FFM

*Engineer Building FFM Model*

## ABSTRACT

This project implements functional fault models to automate the isolation of failures during ground systems operations. FFMs will also be used to recommend sensor placement to improve fault isolation capabilities. The project enables the delivery of system health advisories to ground system operators.

### Project Technology Maturity

| At Start: 7 | Current: 7 | At End: 9 |
|---|---|---|

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|

| Applied Research | Development | Demo & Test |
|---|---|---|

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

## ANTICIPATED BENEFITS

### To NASA funded missions:

Automates the identification of failed systems components during system operation and can also be used as an engineering 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 optimal placement of sensors to optimize the ability to detect known fault modes.  Optimizes troubleshooting actions.  Performs time-to-criticality analyses and supports planning of skills/time for repair of a given failure ...

Read more on the last page.
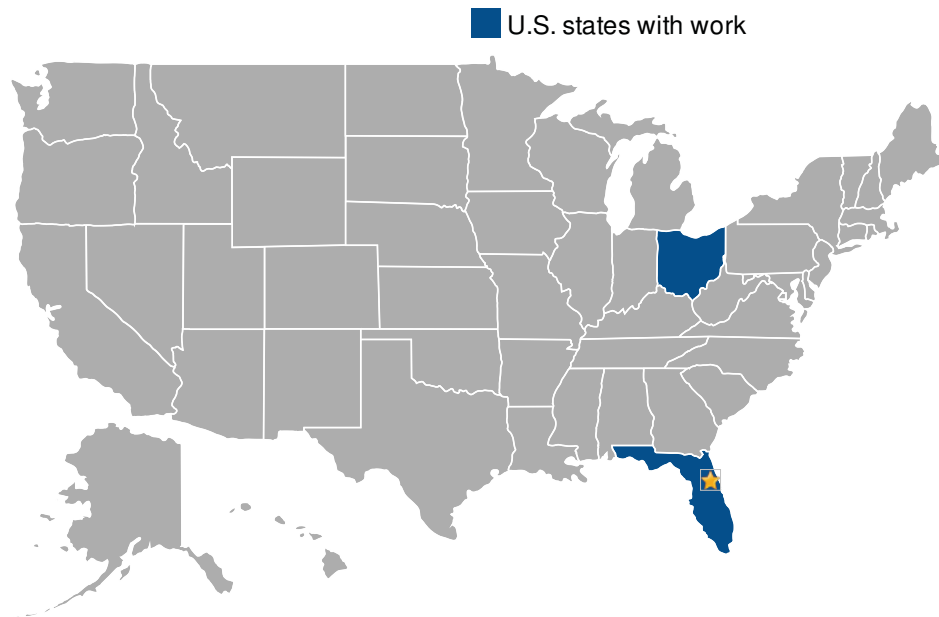
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**Other Organizations Performing Work**

Abacus / IMCS  (Baltimore, MD)
N&R Engineering  (Parma Heights, OH)
QinetiQ North America
(read more on the last page)

⭐ Lead center: Kennedy Space Center

# DETAILED DESCRIPTION

This project implements functional fault models to automate the isolation of failures during ground systems operations.  FFMs will also be used to recommend sensor placement to improve fault isolation capabilities. The project enables the delivery of system health advisories to ground system operators.
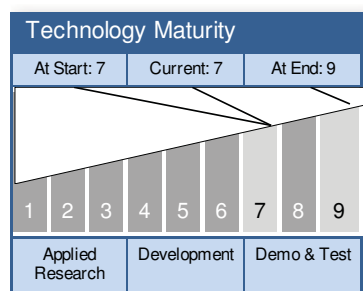
**MANAGEMENT**

**Program Executive:**
Michael Bolger
**Program Manager:**
Kirk Lougheed
**Project Manager:**
Barbara Brown
**Principal Investigator:**
Barbara Brown

# TECHNOLOGY DETAILS

Advanced Ground Systems Maintenance Functional Fault Models for Fault Isolation

### Technology Maturity

| At Start: 7 | Current: 7 | At End: 9 |
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## TECHNOLOGY DESCRIPTION

TEAMS-Designer is used to create functional fault models from FMEA reports, fault trees, schematics, instrumentation lists, operational use cases, and other technical documentation. The FFM captures a system's structure, interconnections, tests, procedures, and failure modes and the relationships between various failure modes and system instrumentation. TEAMS-RDS and TEAMS-RT are used to monitor the system's operation and perform real-time fault isolation, when needed. The TEAMS tool suite is a commercial product developed by Qualtech Systems Incorporated.

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

Automates the identification of failed systems components within the system being monitored. Provides the capability to conduct subsystem assessment of known, undetectable system failure modes. Provides capability to assess the system design and identify the optimal placement of sensors to optimize the ability to detect known fault modes. Optimizes troubleshooting actions.

Can support requirements to train personnel on system function in nominal and off-nominal operation.

## IMAGE GALLERY



Engineer Building FFM Model



Functional Fault Models for Fault Isolation

## ANTICIPATED BENEFITS

**To NASA funded missions: (CONT'D)**

mode.  Supports requirements to train personnel on system function in nominal and off-nominal operation.

**To NASA unfunded & planned missions:**

Reduces trouble-shooting time during system operation and can also be used as an engineering 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 optimal placement of sensors to optimize the ability to detect known fault modes.  Optimizes troubleshooting actions.  Performs time-to-criticality analyses and supports planning of skills/time for repair of a given failure mode.   Supports requirements to train personnel on system function in nominal and off-nominal operation.

**To the commercial space industry:**

Reduces trouble-shooting time during system operation and can also be used as an engineering 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 optimal placement of sensors to optimize the ability to detect known fault modes. Optimizes troubleshooting actions. Performs time-to-criticality analyses and supports planning of skills/time for repair of a given failure mode. Supports requirements to train personnel on system function in nominal and off-nominal operation.

## OTHER ORGANIZATIONS PERFORMING WORK (CONT'D)

- Sierra Lobo, Inc.