



Integrated System for Health Management and Autonomous Control (ISHM-AC): Development and Application

Jaime A. Toro NASA Kennedy Space Center AIAA Propulsion and Energy 2016 Salt City Lake, UT



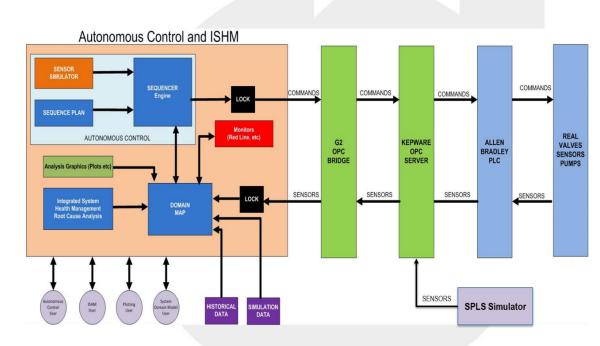
Introduction

- Project Overview
- Software Design Description
- Autonomous Operations
 - Nominal
 - Off-nominal
- Health Monitoring Operations
- Application
- Test Results



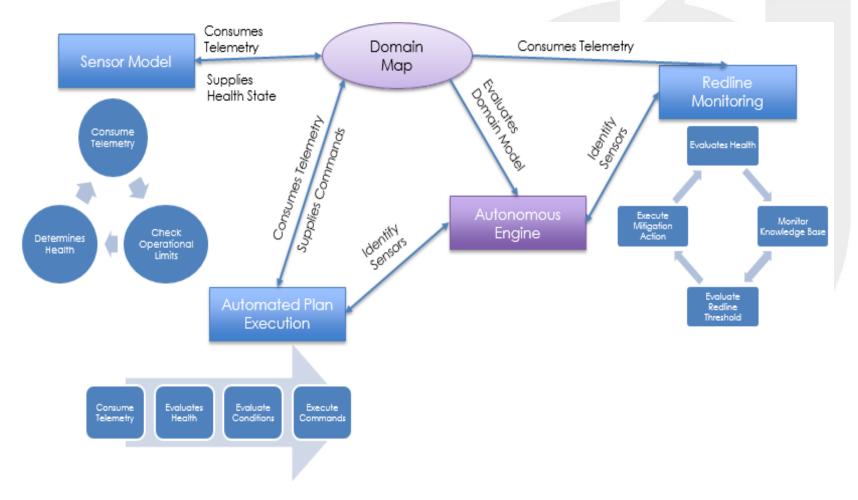
Project Overview

- Knowledge Base
- Modeling
- Automated Control
- Monitoring
- User Interface
- External I/O
- Autonomous Control



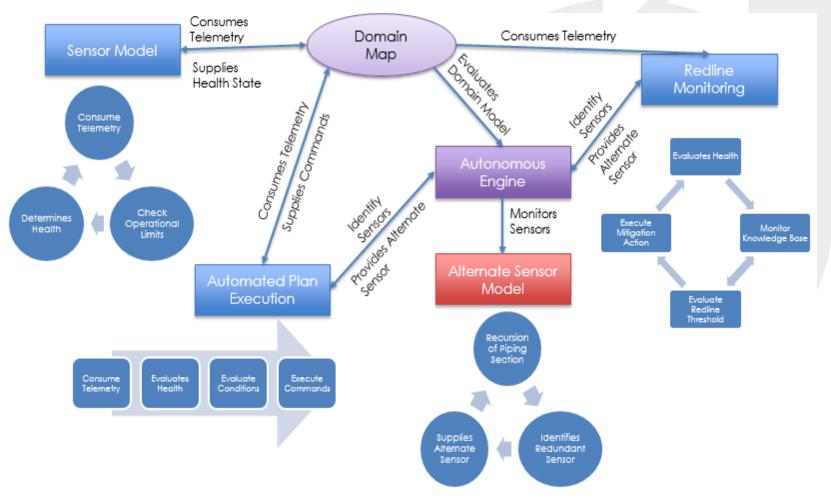


Autonomous Operations - Nominal





Autonomous - Off-Nominal





Health Monitoring

- Nominal
 - Phase Detection
 - Flow Subsystem
- Off-Nominal
 - Leak Detection
 - Valve Consistency



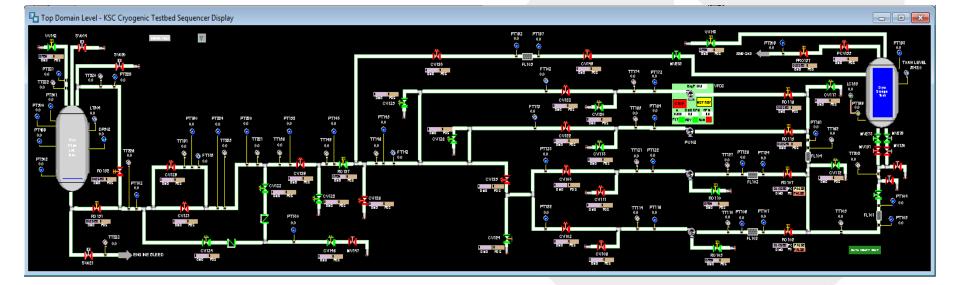
Application – Simulated Propellant Loading System (SPLS)

- Propellant Transfer Lines
- Storage Tank
- Simulated Vehicle
- Instrumentation
- Data Acquisition
- Command and Control System





Application Development System – Control Map





Application Development System – Operator User Interface

- Plan Execution
- Redline Monitoring
- Console Message
- Timers

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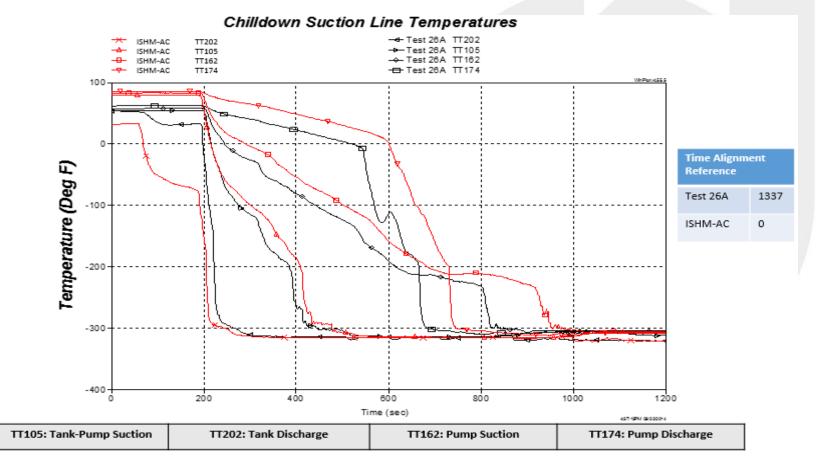


ISHM – AC vs. SPLS Baseline

TEST RESULTS

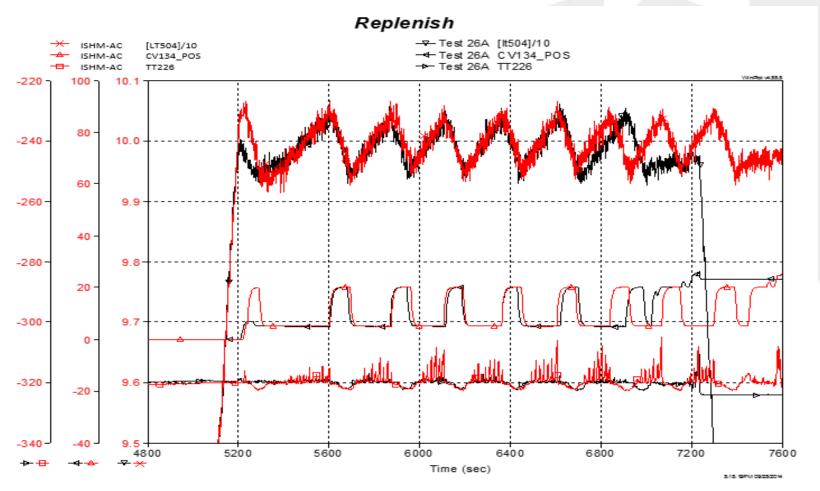


Nominal: Chilldown Phase – Simulated GSE





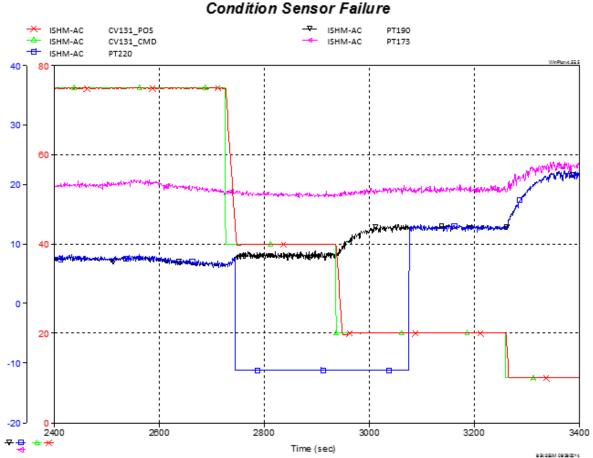
Nominal: Replenish Phase – Simulated Flight Vehicle





Off-Nominal: Autonomous Engine

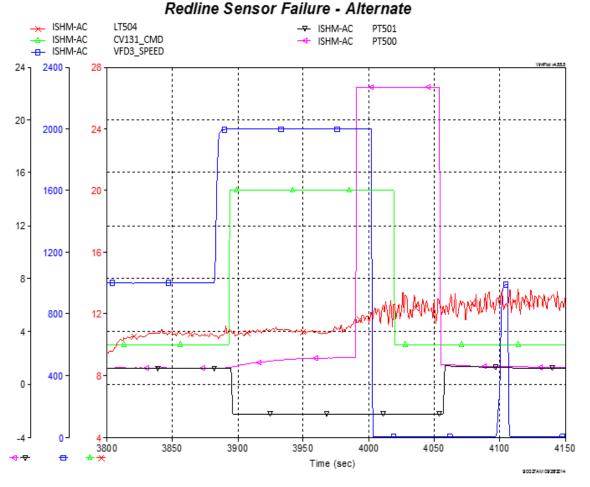
- Plan Execution
- Failure Insertion
- Alternate Sensor Model
- Mitigation Telemetry
- Plan Execution
 Continuation





Off-Nominal: Autonomous Engine

- Redline Monitoring
- Failure Insertion
- Alternate Sensor Model
- Mitigation Telemetry
- Redline Monitoring Continues





Conclusion

- ISHM-AC: Verification and Validation on Autonomous Operations
- Application supports real-time laboratory operations with cryogenic commodity
- Support mitigation procedures that allow safe continuation of operations
- NASA Technology Readiness Level (TRL) from a analytical and experimental proof-of-concept (Level 3) to validation in laboratory environments (Level 4)



Shaping the Future of Aerospace