Physics Simulation Software for Autonomous Propellant Loading and Gas House Autonomous System Monitoring

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Abstract

Physics Simulation Software for Autonomous Propellant Loading

Kennedy Space Center (KSC) is developing a mobile launching system with autonomous propellant loading capabilities for liquid-fueled rockets. An autonomous system will be responsible for monitoring and controlling the storage, loading and transferring of cryogenic propellants. The Physics Simulation Software will reproduce the sensor data seen during the delivery of cryogenic fluids including valve positions, pressures, temperatures and flow rates. The simulator will provide insight into the functionality of the propellant systems and demonstrate the effects of potential faults. This will provide verification of the communications protocols and the autonomous system control and monitoring functions.

Gas House Autonomous System Monitoring

The High Pressure Gas Facility (HPGF) stores and distributes hydrogen, nitrogen, helium and high pressure air. The hydrogen and nitrogen are stored in cryogenic liquid state. The cryogenic fluids pose several hazards to operators and the storage and transfer equipment. Constant monitoring of pressures, temperatures and flow rates are required in order to maintain the safety of personnel and equipment during the handling and storage of these commodities. The Gas House Autonomous System Monitoring software will be responsible for constantly observing and recording sensor data, identifying and predicting faults and relaying hazard and operational information to the operators.

Introduction

High Pressure Gas Facility

This facility stores and distributes hydrogen, nitrogen, helium and high pressure air. These gases are required to be in a pressurized environment and kept at cryogenic temperatures.

Objectives

- Design and develop a G2 workspace to represent the Liquid Nitrogen system components
- Use G2’s real-time processing capabilities and rule-based expert system for fault detection
- Develop and enhance autonomous control and ISHM integration software
- Successfully Integrate with Monitoring and Control Systems

Approach

- Utilize Integrated Systems Health Management (ISHM) concepts [3]
- Utilizing ISHM toolkit developed in partnership with General Atomics
- Object-Oriented Programming

Results

- Created a Domain Model for Liquid Nitrogen Process Equipment
- G2 Workspace created for Liquid Nitrogen System
- Integrated into overall monitoring application

References