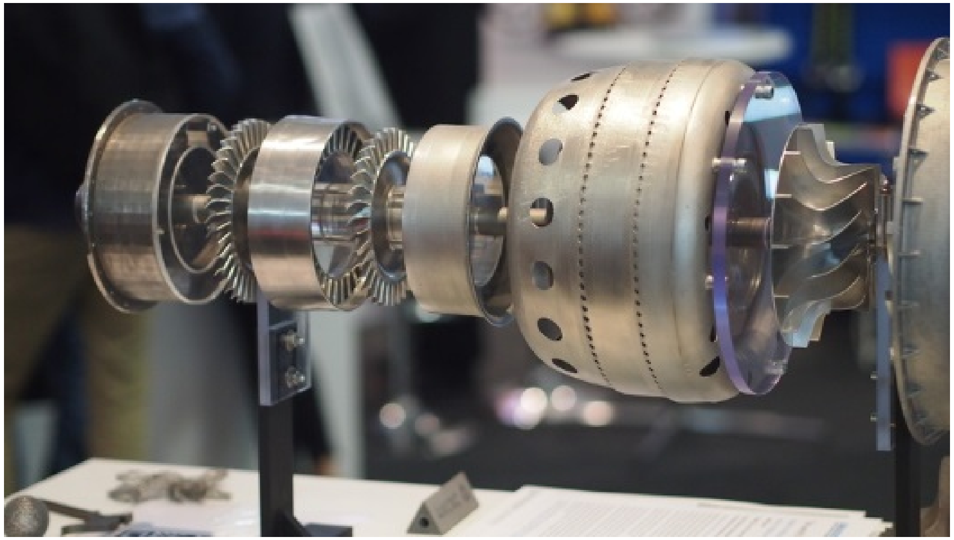
Additive Component Manufacturing

Current technology relies heavily on centuries-old techniques like casting, forging, and machining to create fluid control valves, significantly limiting what can be manufactured. State of the art technologies, such as additive manufacturing, have not yet been thoroughly applied to fluid control valves. Many valve manufacturing issues, such as flow passage machining, deep hole boring, and bi-metallic joining, could successfully be addressed using additive manufacturing technologies. The goal of this project is to apply additive manufacturing techniques specifically to the problems fluid control valves present.

Project Manager: Jonathan Dickey



Rocket engine 3D printed at Marshall Space Flight Center

Autonomy Strategies: Ontology and Implementation

John C. Stennis Space Center

Autonomy strategies enable systems to overcome unplanned events that affect the nominal execution of a mission. This project will address a crucial gap in the development and implementation of autonomy strategies to enable "Thinking Autonomy." Experts from SSC and JPL will collaborate to develop a substantive list of autonomy strategies founded on experience. With this data, a taxonomy, architecture, and language for autonomy strategies will be developed and properly documented. The first phase of the project will focus on efforts to conceptualize and formulate an ontology for autonomy strategies at high levels of abstraction and generate some initial language modules for a space habitat (e.g. power, ECLSS) and the SSC nitrogen storage and distribution system. In parallel, we will begin implementation of the capability in SSC's NASA Platform for Autonomous Systems (NPAS) and carry out verifications.

Project Manager: Fernando Figueroa

Logo for the NASA Platform for Autonomous Systems

Hydrocarbon Cold-Flow Simulation of LOX/LH2 Rocket Aerodynamics

Current analytical and empirical rocket diffuser design methodologies are inhibited by the limited envelope of available experimental data collected via low-pressure nitrogen and steam testing in the 1960s. The goal of this project is to develop and demonstrate a lab-scale hydrocarbon cold-flow simulation of coupled rocket/diffuser system aerodynamics. The objectives for year one include design and fabrication of a hydrocarbon cold-flow rocket/diffuser testbed and a test article representative of a hot-fire system that has already been experimentally characterized. Year two includes tasks to activate the test bed, perform a series of cold-flow tests on one or more rocket/diffuser configurations, and characterize the performance of the ethane simulation compared to hot-fire.

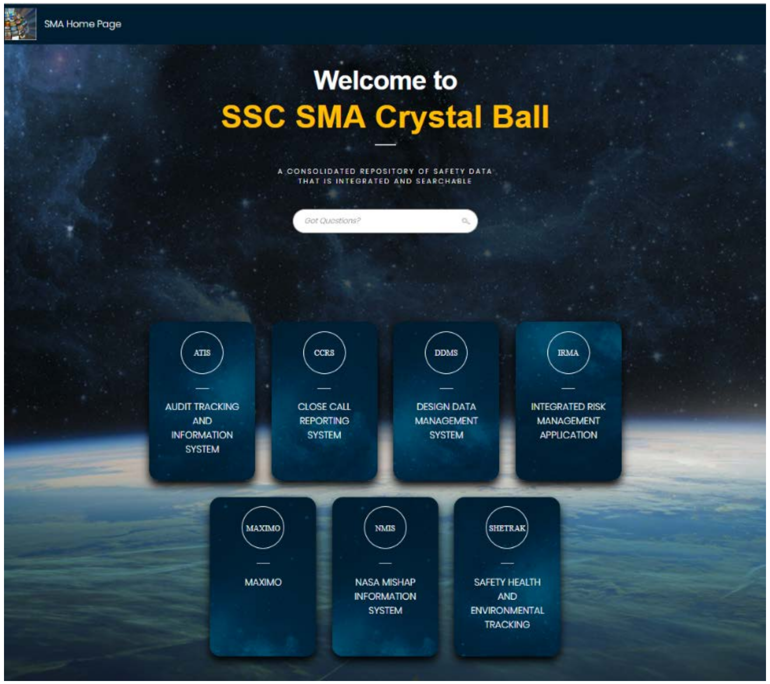
Project Manager: Daniel Jones

RS-25 being tested at NASA's John C. Stennis Space Center

Prediction of Safety Incidents

Safety incidents, including injuries, property damage and mission failures, cost NASA and contractors thousands of dollars in direct and indirect costs. Current data systems are able to collect and store information on both hazards, through inspections and employee identification programs, and incidents. However, NASA has not connected these sets of data to be able to predict safety incidents and ultimately direct limited resources to the most high risk areas. This project seeks to define, develop and test an algorithm that will use hazard identification data as input to predict when and where there is a high probability of a safety incident occurring. The ultimate goal is to take advantage of advances in the areas of machine learning, data analytics and big data to save time, money and lives.

Project Manager: Kamili Shaw

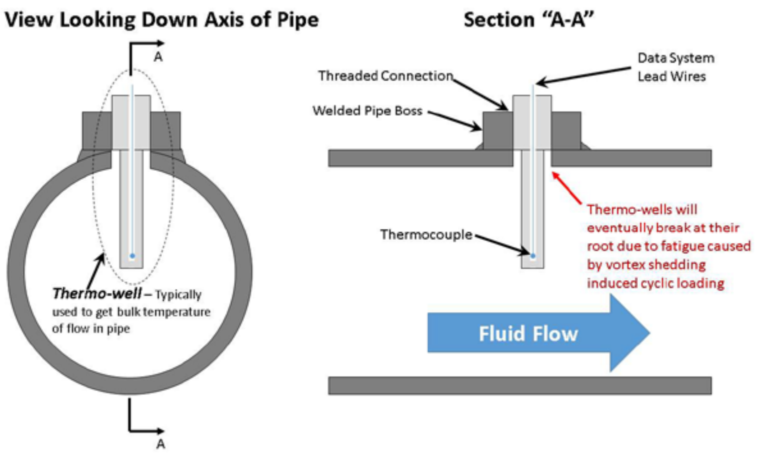


Dashboard Image of the SSC's SMA Crystal Ball

Multi-Physics Based Thermo-Well Fatigue Design Tool

Currently the thermo-well design method in use at Stennis Space Center (SSC) is an outdated method that is known to be too conservative and sometimes results in a required thermo-well size that adversely affects other design parameters. This project will focus on the development of an innovative thermo-well design tool based on a multi-physics software package currently being developed by Mississippi State University (MSU) called the CalculiX Structural Solver. The project will develop a multi-physics based thermo-well fatigue design tool, then conduct verification and experimental validation studies using it, and finally deliver a production ready tool for SSC's use.

Project Manager: Jody Woods



Cross section of a pipe highlighting the thermocouple