



## Sample Analysis at Mars Instrument Simulator

**A novel tool will optimize and validate science operation plans of the instrument on the surface of Mars with a turnaround time of a few hours instead of multiple days.**

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The Sample Analysis at Mars Instrument Simulator (SAMSIM) is a numerical model dedicated to plan and validate operations of the Sample Analysis at Mars (SAM) instrument on the surface of Mars. The SAM instrument suite, currently operating on the Mars Science Laboratory (MSL), is an analytical laboratory designed to investigate the chemical and isotopic composition of the atmosphere and volatiles extracted from solid samples. SAMSIM was developed using Matlab and Simulink libraries of MathWorks Inc. to provide MSL mission planners with accurate predictions of the instrument electrical, thermal, mechanical, and fluid responses to scripted commands. This tool is a first example of a multi-purpose, full-scale numerical modeling of a flight instrument with the purpose of supplementing or even eliminating entirely the need for a hardware engineer model during instrument development and operation.

SAMSIM simulates the complex interactions that occur between the instrument Command and Data Handling unit (C&DH) and all subsystems during the execution of experiment sequences. A typical SAM experiment takes many hours to complete and involves hundreds of components. During the simulation, the electrical, mechanical, thermal, and gas dynamics states of each hardware component are accurately

modeled and propagated within the simulation environment at faster than real time. This allows the simulation, in just a few minutes, of experiment sequences that takes many hours to execute on the real instrument.

The SAMSIM model is divided into five distinct but interacting modules: software, mechanical, thermal, gas flow, and electrical modules. The software module simulates the instrument C&DH by executing a customized version of the instrument flight software in a Matlab environment. The inputs and outputs to this synthetic C&DH are mapped to virtual sensors and command lines that mimic in their structure and connectivity the layout of the instrument harnesses. This module executes, and thus validates, complex command scripts prior to their up-linking to the SAM instrument. As an output, this module generates synthetic data and message logs at a rate that is similar to the actual instrument.

The mechanical module simulates the actions of a number of mechanical components of the SAM instrument. This module contains the valves, the pumps, and the Sample Manipulation System (SMS). The response of each of these elements is modeled to produce outputs of state variables (velocity, position, force, etc.) that duplicate the behavior of the real elements.

The thermal module simulates the action of  $\approx 60$  heaters and their local thermal impact on the instrument. It also predicts the individual temperatures sensed by  $\approx 70$  thermistors and transmitted to the C&DH.

The gas flow module simulates the gas dynamics (time-dependent pressures and gas flows) in the Gas-Processing System (GPS) of SAM. The conductance of each gas transfer element (pipe, manifold, leak, pump, etc.) is dynamically computed as a function of the component dimension, gas composition, pressure, and temperature.

The electric module captures the electrical behavior of motors, control boards, Bayard-Alpert gauges, detectors, valves, heaters, and all components that contribute to the instrument power profile.

The behavior of each element of the SAMSIM model is reconstructed by accounting for all the relevant modules to that element. Complex components like pumps integrate contributions from modules to simulate the evolution of their command logic, rotor speeds, currents, temperatures, and throughputs.

*This development was conducted by Mehdi Benna of the Center for Research and Exploration in Space Science & Technology (CRESTT) at Goddard Space Flight Center and Tom Nolan of Nolan Engineering, LLC. Further information is contained in a TSP (see page 1). GSC-16566-1*

## Access Control of Web- and Java-Based Applications

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Cybersecurity has become a great concern as threats of service interruption, unauthorized access, stealing and altering of information, and spreading of viruses have become more prevalent and serious.

Application layer access control of applications is a critical component in the overall security solution that also includes encryption, firewalls, virtual pri-

vate networks, antivirus, and intrusion detection. An access control solution, based on an open-source access manager augmented with custom software components, was developed to provide protection to both Web-based and Java-based client and server applications.

The DISA Security Service (DISA-SS) provides common access control capabilities for AMMOS software applica-

tions through a set of application programming interfaces (APIs) and network-accessible security services for authentication, single sign-on, authorization checking, and authorization policy management.

The OpenAM access management technology designed for Web applications can be extended to meet the needs of Java thick clients and stand-