# State Analysis Database Tool

NASA's Jet Propulsion Laboratory, Pasadena, California

The State Analysis Database Tool software establishes a productive environment for collaboration among software and system engineers engaged in the development of complex interacting systems. The tool embodies *State Analysis*, a model-based system engineering methodology founded on a state-based control architecture (see figure). A state represents a momentary condition of an evolving system, and a model may describe how a state evolves and is affected by other states. The State Analysis methodology is a process for capturing system and software requirements in the form of explicit models and states, and defining goal-based operational plans consistent with the models. Requirements, models, and operational concerns have traditionally been documented in a variety of system engineering artifacts that address different aspects of a mission's lifecycle. In State Analysis, requirements, models, and operations information are State Analysis artifacts that are consistent and stored in a State Analysis Database. The tool includes a back-end database, a multi-platform front-end client, and Web-based administrative functions. The tool is structured to prompt an engineer to follow the State Analysis methodology,
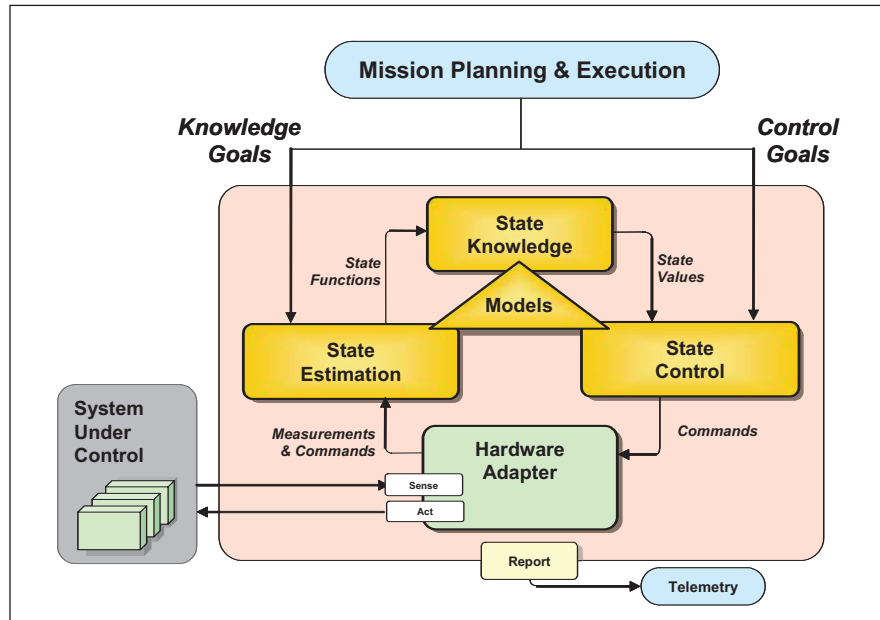
The **State-Based Control Architecture** is the foundation of the present software.

to encourage state discovery and model description, and to make software requirements and operations plans consistent with model descriptions.

This program was written by Robert Rasmussen and Matthew Bennett of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-42869.

# Generating CAHV and CAHVOR Images With Shadows in ROAMS

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Part of the Rover Analysis, Modeling and Simulation (ROAMS) software that synthesizes images of terrain has been augmented to make the images more realistic. [ROAMS was described in "Simulating Operation of a Planetary Rover" (NPO-30722), *NASA Tech Briefs*, Vol. 28, No. 9 (September 2004), page 52. ROAMS simulates the operation of a robotic vehicle (rover) exploring terrain on a remote planet.] The images are needed for modeling responses of rover cameras that provide sensory inputs for machine-vision-based algorithms for controlling the motion of the rover. The augmented image-synthesizing part of the ROAMS software supports terrain geometry and texture specifiable by the user, CAHV and CAHVOR camera models, and more-realistic shadowing (see figure). (The letters in "CAHV" represent

vectors in a standard photogrammetric model of a pinhole camera. Letters O and R in "CAHVOR" represent vectors used to model distortions.) A contemplated future version of ROAMS would support the CAHVORE model, which represents more-general cameras, including those having fish-eye or other wide-field-of-view lenses. (Letter E in "CAHVORE" represents a vector used to model apparent motion of a camera entrance pupil.)

This program was written by Richard Madison, Abhinandan Jain, and Marc Pomerantz of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

This software is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-42406.
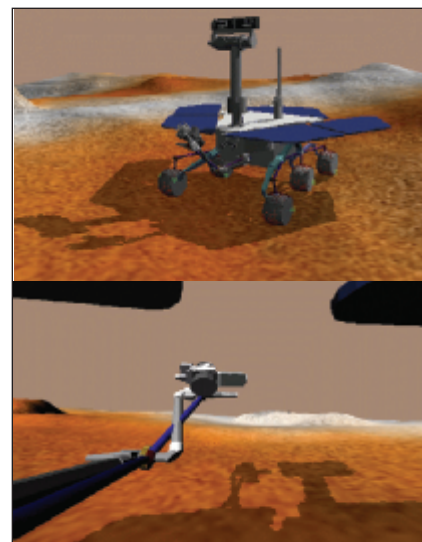
Examples of Shadowing show terrain and rover shadows. Pixels that do not have direct line-of-sight to the Sun are darkened.