ous experiences, and that will enable it to recombine its known behaviors in such a way as to solve related, but novel, task problems with apparent creativity. The approach is to combine sensory-motor data association and dimensionality reduction to learn navigation and manipulation tasks as sequences of basic behaviors that can be implemented with a small set of closed-loop controllers. Over time, the aggregate of behaviors and their transition probabilities form a stochastic network. Then given a task, the robot finds a path in the network that leads from its current state to the goal.

The SES provides a short-term memory for the cognitive functions of the robot, association of sensory and motor data via spatio-temporal coincidence, direction of the attention of the robot, navigation through spatial localization with respect to known or discovered landmarks, and structured data sharing between the robot and human team members, the individuals in multi-robot teams, or with a C3 center.

*This work was done by Katherine Achim Fleming and Richard Alan Peters II of Vanderbilt University for Johnson Space Center. Further information is contained in a TSP (see page 1).*

*In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:*

*Vanderbilt University, School of Engineering*
*Department of Electrical Engineering and Computer Science*
*VU Station B 351824,*
*2301 Vanderbilt Place*
*Nashville, TN 37235*

*Refer to MSC-24363-1, volume and number of this* NASA Tech Briefs *issue, and the page number.*

# HyDE Framework for Stochastic and Hybrid Model-Based Diagnosis

**It uses hybrid models built by the users and sensor data from the system to deduce the state of the system over time.**

*Ames Research Center, Moffett Field, California*

Hybrid Diagnosis Engine (HyDE) is a general framework for stochastic and hybrid model-bused diagnosis that offers flexibility to the diagnosis application designer. The HyDE architecture supports the use of multiple modeling paradigms at the component and system level. Several alternative algorithms are available for the various steps in diagnostic reasoning. This approach is extensible, with support for the addition of new modeling paradigms as well as diagnostic reasoning algorithms for existing or new modeling paradigms.

HyDE is a general framework for stochastic hybrid model-based diagnosis of discrete faults; that is, spontaneous changes in operating modes of components. HyDE combines ideas from consistency-based and stochastic approaches to model- based diagnosis using discrete and continuous models to create a flexible and extensible architecture for stochastic and hybrid diagnosis. HyDE supports the use of multiple paradigms and is extensible to support new paradigms.

HyDE generates candidate diagnoses and checks them for consistency with the observations. It uses hybrid models built by the users and sensor data from the system to deduce the state of the system over time, including changes in state indicative of faults.

At each time step when observations are available, HyDE checks each existing candidate for continued consistency with the new observations. If the candidate is consistent, it continues to remain in the candidate set. If it is not consistent, then the information about the inconsistency is used to generate successor candidates while discarding the candidate that was inconsistent.

The models used by HyDE are similar to simulation models. They describe the expected behavior of the system under nominal and fault conditions. The model can be constructed in modular and hierarchical fashion by building component/subsystem models (which may themselves contain component/subsystem models) and linking them through shared variables/parameters. The component model is expressed as operating modes of the component and conditions for transitions between these various modes. Faults are modeled as transitions whose conditions for transitions are unknown (and have to be inferred through the reasoning process).

Finally, the behavior of the components is expressed as a set of variables/parameters and relations governing the interaction between the variables. The hybrid nature of the systems being modeled is captured by a combination of the above transitional model and behavioral model. Stochasticity is captured as probabilities associated with transitions (indicating the likelihood of that transition being taken), as well as noise on the sensed variables.

*This work was done by Sriram Narasimhan and Lee Brownston of Ames Research Center. Further information is contained in a TSP (see page 1). ARC-15570-1*

# IMAGESEER — IMAGEs for Education and Research

**Web portal shares image data with research institutions.**

*Goddard Space Flight Center, Greenbelt, Maryland*

IMAGESEER is a new Web portal that brings easy access to NASA image data for non-NASA researchers, educators, and students. The IMAGESEER Web site and database are specifically designed to be utilized by the university community, to enable teaching image processing (IP) techniques on NASA data, as well as to provide reference benchmark data to