site. Once near the site, AutoGNC achieves a prescribed guidance condition for TAG sampling (position/orientation, velocity), and a prescribed force profile on the sampling end-effector. A dedicated 6DOF TAG control then implements the ascent burn while recovering from sampling disturbances and induced attitude rates. The control also minimizes structural interactions with flexible solar panels and disallows any part of the spacecraft from making contact with the ground (other than the intended end-effector).

This work was done by John M. Carson, Nickolaos Mastrodemos, David M. Myers, Behcet Acikmese, James C. Blackmore, Dhemetrio Boussalis, Joseph E. Riedel, Simon Nolet, Johnny T. Chang, Milan Mandic, Laureano (Al) Cangahuala, Stephen B. Broschart, David S. Bayard, Andrew T. Vaughan, Tseng-Chan M. Wang, and Robert A. Werner of Caltech; Christopher A. Grasso of Blue Sun Enterprises; and Gaskell W. Robert of the Planetary Science Institute 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 Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-47250.

Efficient Web Services Policy Combination

This algorithm serves as the basis for reliable, fast, and automatic network communications.

NASA's Jet Propulsion Laboratory, Pasadena, California

Large-scale Web security systems usually involve cooperation between domains with non-identical policies. The network management and Web communication software used by the different organizations presents a stumbling block. Many of the tools used by the various divisions do not have the ability to communicate network management data with each other. At best, this means that manual human intervention into the communication protocols used at various network routers and endpoints is required. Developing practical, sound, and automated ways to compose policies to bridge these differences is a long-standing problem. One of the key subtleties is the need to deal with inconsistencies and defaults where one organization proposes a rule on a particular feature, and another has a different rule or expresses no rule. A general approach is to assign priorities to rules and observe the rules with the highest priorities when there are conflicts.

The present methods have inherent inefficiency, which heavily restrict their practical applications. A new, efficient algorithm combines policies utilized for Web services. The method is based on an algorithm that allows an automatic and scalable composition of security policies between multiple organizations. It is based on defeasible policy composition, a promising approach for finding conflicts and resolving priorities between rules.

In the general case, policy negotiation is an intractable problem. A promising method, suggested in the literature, is when policies are represented in defeasible logic, and composition is based on rules for non-monotonic inference. In this system, policy writers construct metapolicies describing both the policy that they wish to enforce and annotations describing their composition preferences. These annotations can indicate whether certain policy assertions are required by the policy writer or, if not, under what circumstances the policy writer is willing to compromise and allow other assertions to take precedence. Meta-policies are specified in defeasible logic, a computationally efficient non-monotonic logic developed to model human reasoning.

One drawback of this method is that at one point the algorithm starts an exhaustive search of all subsets of the set of conclusions of a defeasible theory. Although the propositional defeasible logic has linear complexity, the set of conclusions here may be large, especially in real-life practical cases. This phenomenon leads to an inefficient exponential explosion of complexity.

The current process of getting a Web security policy from combination of two meta-policies consists of two steps. The first is generating a new meta-policy that is a composition of the input meta-policies, and the second is mapping the meta-policy onto a security policy. The new algorithm avoids the exhaustive search in the current algorithm, and provides a security policy that matches all requirements of the involved meta-policies.

This work was done by Farrokh Vatan and Joseph G. Harman 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 Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-47279.

Using CTX Image Features to Predict HiRISE-Equivalent Rock Density

NASA's Jet Propulsion Laboratory, Pasadena, California

Methods have been developed to quantitatively assess rock hazards at candidate landing sites with the aid of images from the HiRISE camera onboard NASA's Mars Reconnaissance Orbiter. HiRISE is able to resolve rocks as small as 1-m in diameter. Some sites of interest do not have adequate coverage with the highest resolution sensors and there is a need to infer relevant information (like site safety or underlying geomorphology). The proposed approach would make it possible to obtain rock density estimates at a level close to or equal to those obtained from high-resolution sensors where individual rocks are discernable.

The low-resolution data considered here are CTX images, which have a lower resolution than HiRISE images but have a broader span. An important characteristic of CTX and HiRISE images is that they are captured concurrently. Thus, there is a natural pairing between the two data sets.

Bayesian Networks (BNs) are used to graphically model the statistical relationship between rock density estimated from HiRISE images and features extracted from CTX images. Gray Level Co-occurrence Matrix (GLCM) features are used to model the texture in CTX images. The statistical relationship among CTX image features, geomorphology, and rock density is learned by incorporating rock counts from HiRISE images and geomorphic information provided by scientists corresponding to the landing site. The trained BN is then used to infer rock density directly from CTX image features even in the absence of higher resolution images like HiRISE.

This work was done by Navid Serrano and Andres Huertas of Caltech and Patrick McGuire, David Mayer, and Raymond Arvidson of Washington University in Saint Louis for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov.

The software used in this innovation is available for commercial licensing. Please contact Daniel Broderick of the California Institute of Technology at danielb@caltech.edu. Refer to NPO-46989.