Researchers remotely unlock mysteries of water on Mars

July 31 2006

A mission to Mars requires an estimated six-month voyage from Earth, but researchers at the University of Houston and the Lunar and Planetary Institute (LPI) have found a way to study its landscape without having to take that long trip.

Ricardo Vilalta, a UH computer scientist, has joined forces with Tomasz Stepinski of the LPI to develop new computational tools to characterize large portions of the Martian landscape. The duo's work is being funded by a three-year, quarter million dollar grant from NASA's Applied Information Systems Department titled "Automated Identification and Characterization of Landforms on Mars." Stepinski is the principal investigator.

Founded in 1968, the LPI conducts research in lunar, planetary and terrestrial sciences on behalf of university science departments and NASA. Part of the Universities Space Research Association (USRA), the LPI is a NASA-funded research institute in Houston, dedicated to studies of the solar system, its evolution and formation. The USRA was chartered in 1969 as the LPI's parent organization, and its role is to provide a mechanism through which universities can cooperate effectively with one another, the government and other organizations to further space science and technology, as well as promote education in these areas.

This most recent project between UH and LPI seeks to identify natural landscape structures, such as the inside of craters, valley networks, the

outside and inside rims of craters, the rims of inside craters and inter-crater plains. Identifying these structures is important because rocks, minerals and geologic landforms hold clues to past water activity on Mars. Understanding the history of water on Mars is a part of NASA's long-term Mars Exploration Program.

"Currently, there's a lack of automated tools designed to assist planetary scientists with analyzing the surface of Mars, and only a small percentage of the data collected has been analyzed," said Vilalta, an assistant professor and co-director of the UH Data Mining and Machine Learning Group. "In fact, most of the latest work is based on a method known as descriptive geomorphology, essentially consisting of narrating what is in a picture. The scientific community needs automated methods to look for complex patterns across Mars' surface."

Combining techniques from data mining, machine learning and geomorphology, Vilalta and his research group are in charge of providing novel data analysis methods for the analysis of Mars' surface. His research specifically involves analyzing massive amounts of data with the goal of extracting meaningful and informative patterns. Stepinski, then, processes all data obtained from the Mars Orbiter Laser Altimeter instrument aboard NASA's Mars Global Surveyor spacecraft. This data are subsequently used to construct global topographic maps of Mars in the form of digital elevation models.

"From a data mining point of view, the project is generating novel and computationally challenging techniques," Vilalta said. "For example, we are looking for new techniques to classify the surface of Mars with minimal expert intervention. Using a technique known as semi-supervised learning, we are exploiting information from very few regions of Mars and using that to label large portions of the planet's surface."

The Data Mining and Machine Learning Group at UH aims to develop data analysis techniques with applications that challenge problems in physics, geology, astronomy, environmental sciences and medicine. The group's work includes the design and development of a statistical-learning tool (STL) for classification and characterization of topographical features on Mars. This STL automates geomorphic mapping and expedites geologic mapping, thus enabling fast and quantitative characterization of large sections of the Martian surface.

Source: University of Houston