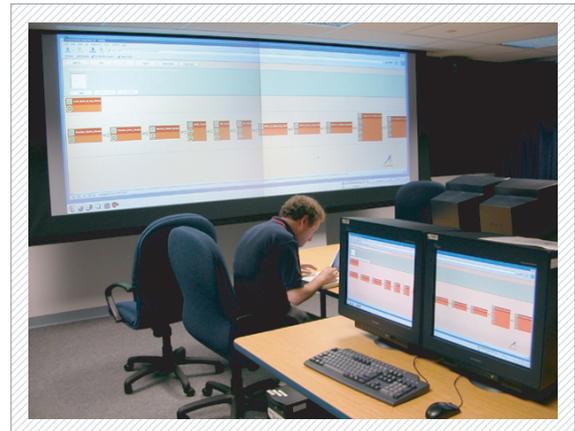# Interactive Planning Tools: Constraint Editor & Scheduling and Planning Interface

Objective

Mars surface missions must integrate the requests of hundreds of scientists into a single activity plan for execution on a daily basis. The objective of the Constraint Editor is reduce the time required for one of the most time-intensive parts of the daily planning process: the codification of science intent into machine-readable constraints.

Approach

At the request of the Mars Exploration Rovers (MER) mission PI, Steve Squyres, the Ames Human-Computer Interaction (HCI) Group in the Human Systems Integration Division led an intensive design and development effort to meet strict performance criteria: decrease the time on task for constraint editing by an order of magnitude, from over an hour to less than ten minutes. The HCI Group used a process of rapid design and iterative development to create the Constraint Editor, a graphical, browser-based interface for editing the thousands of constraints created daily during the MER mission. Throughout the Constraint Editor development process, the HCI Group used data from user behavior to assess existing assumptions about how users enter and manipulate constraints. For example, the tool was built to support an iterative approach to editing constraints instead of requiring users to specify all constraints up front.

Impact

The Constraint Editor, which successfully met the ambitious performance requirements set for it, is an integral part of the MER activity planning process. It has been used daily by mission personnel for approximately 2,000 combined days of continuous operation. It was also a critical component of the constraint-based activity planning system responsible for a 20% increase in mission science return, as estimated by mission managers.

Future Directions

The success of the Constraint Editor was instrumental in securing Ames' position as part of the baseline for future Mars surface missions: the Phoenix Mars Scout mission (2007) and Mars Science Laboratory (2009). Mission planning personnel from both missions have solicited Ames' assistance in developing activity planning tools based on the success and shared lessons learned from the MER mission, and the unique iterative, user-driven approach to design and development employed by the HCI Group. The HCI Group is working closely with developers from the ARC Intelligent Systems Division as well as the Jet Propulsion Laboratory to develop an integrated mission operations toolkit based on open standards and extensibility called Ensemble. The capabilities of the Constraint Editor have been incorporated into a set of next generation planning tools, collectively called the Scheduling and Planning Interface (SPIFe). SPIFe has generated a great deal of interest among users of activity planning systems for its unique approach to interactive plan development and refinement. An adaptation of SPIFe is also in development for the Flight Analogues Project at Johnson Space Center for use in late FY07.

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