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LUNAR SCIENCE OPERATIONS TOOLS FOR REAL-TIME DATA INTEGRATION AND VISUALIZATION ON NASA'S VIPER MISSION

Abstract

The National Aeronautics and Space Administration (NASA) Volatiles Investigating Polar Exploration Rover (VIPER) mission presents a unique opportunity to develop new tools and confirm the usefulness of existing tools for a collaborating team of scientists to identify (recognize and annotate) and synthesize important data from disparate sources. Apollo era lunar science and exploration included humans on the Moon to make real-time data collection and sampling decisions and assimilate observations in real-time.

Lunar orbital missions have worked to operational timescales, e.g., decisional timelines and communication exchanges, that were weeks in length. Mars rover missions have worked to operational timescales that were on the order of 10-12 hours, days, and weeks. For the VIPER mission, however, operational decisions for rover driving and instrument commanding will be compressed to minute-scale timeframes. VIPER requires scientists to make the decisions that were delegated to Apollo astronauts, on the same time scales, remotely from earth. VST input will be of vital importance to the mission's ability to maximize science return and to meet broader NASA objectives for future lunar in-situ resource utilization (ISRU) and exploration activities. The VST works in the Mission Science Center (MSC) which is co-located in the same facility with the Mission Operations Center (MOC) and shares a common computing and network infrastructure. To meet these challenges, both the work practices of the science team and their tools and data management practices need to be adapted to support real-time, integrated decision-making.

The authors provide an account of the development approach for VIPER mission science support tools. Meeting VIPER's decisional requirements required a wholistic approach to tool design including careful integration with the MOC computing infrastructure and the software systems controlling the rover and processing data. This resulted in the development of a toolset that assembled data from multiple sources at multiple scales (orbital, surface, subsurface) to present an integrated view to the VST for real time scientific input to rover operations.

The VIPER science operations team was guided by several principles in developing tools used by the VST and operations teams: 1) Equal access to data and tools for all team members; 2) Fluid, interactive exploration of data in real-time and, 3) Efficient export of data in a format readable by popular tools (e.g., MATLAB, ARCGIS, JMP, Excel). We present examples of tools and capabilities such as real-time map visualization and identification and export of data from time-series plots.