

New Layer in JMARS. J. Zhou¹, B. Ayhan¹, J. Yin¹, C. Kwan¹, and S. Vance² ¹Signal Processing, Inc., 9700 Great Seneca Highway, Rockville, MD 20850, ²Jet Propulsion Laboratory, Caltech, MS 321-560, 4800 Oak Grove Dr., Pasadena, CA 91109.

Introduction: JMARS (Java Mission-planning and Analysis for Remote Sensing) is a geospatial information system (GIS) developed by ASU's Mars Space Flight Facility to provide mission planning and data analysis tools for NASA planetary mission data to scientists, students of all ages, and to the general public [1]. We developed a custom layer for JMARS to show the traverse map of Mars rovers including Spirit, Opportunity and Curiosity (see Fig. 1). The tool allows users to easily view spectral measurements obtained by the rovers (Fig. 2) and concentration results (Fig. 4) generated by scientists. When a particular sol (Mars day) is selected, the graphics window of the JMARS software shows the location of the rover at that day (see Fig. 3). In Fig. 1 and Fig. 3, we also load HiRISE data to show the high resolution image of Mars.

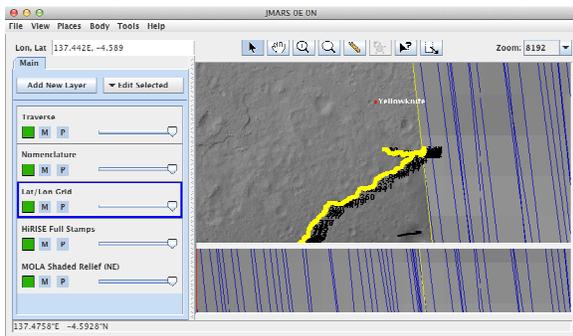


Fig. 1: Rover traverse layer developed by our team.

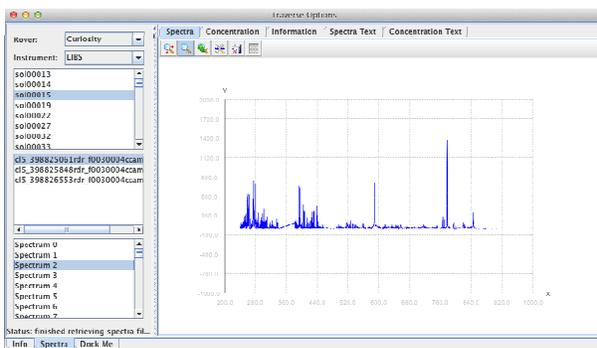


Fig. 2: Options panel for the traverse layer.

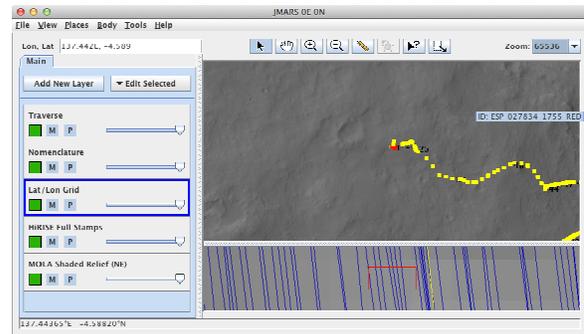


Fig. 3: Location highlights (red dots) for the selected sol day.

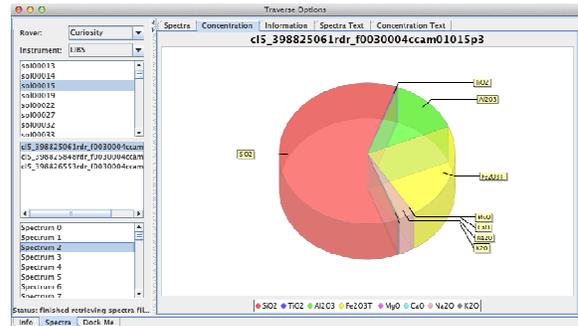


Fig. 4: Concentration for selected sol day and Chem-Cam measurements.

Data: All data were downloaded from PDS Geosciences Node [2]. We collected APXS and LIBS data from three Mars rovers: Spirit, Opportunity and Curiosity. Curiosity corresponds to MSL in the archive; Spirit corresponds to MER1 and Opportunity corresponds to MER2. To download the data, we can use the ftp server. For instance, all Curiosity data can be downloaded from <ftp://pds-geosciences.wustl.edu/msl/>.

The data have different levels. The lowest level data is binary with the name “edr”. The next level name is “rdr”, which contains text data. We downloaded rdr data and put it to our own web server. The hierarchy of data is:

rover -> instrument -> sol -> file -> spectrum

Each higher level item contains multiple low level items. For instance, in each sol, there are multiple measurements saved in different files. In each file, there are multiple spectra. Based on the data hierarchy, we implemented the GUI as shown in Fig. 1.

Concentration data from Curiosity were downloaded from wustl.edu web server. However, for Spirit and

Opportunity, there are no concentration data. We generated our own concentration results for Spirit and Opportunity. Details can be found in [7].

NASA has not released rover traverse data in terms of longitude latitude. To the best of our knowledge only traverse maps are available [3]. We obtained the desired information from other sources [4, 5, 6]. We then wrote a program to convert the original traverse data to our own format in JSON and used it in our visualization software.

Software Design: JMARS is a software using client server architecture as shown in Fig. 5. The data are stored on the server. The JMARS client handles communication with server and visualizing the data. The communication is through HTTP protocol. Following this architecture, we created a data server with HTTP communication protocol. In JMARS, we developed a layer called Traverse layer which follows JMARS layer API. The traverse layer communicates with our data server and visualizes the data in JMARS software.

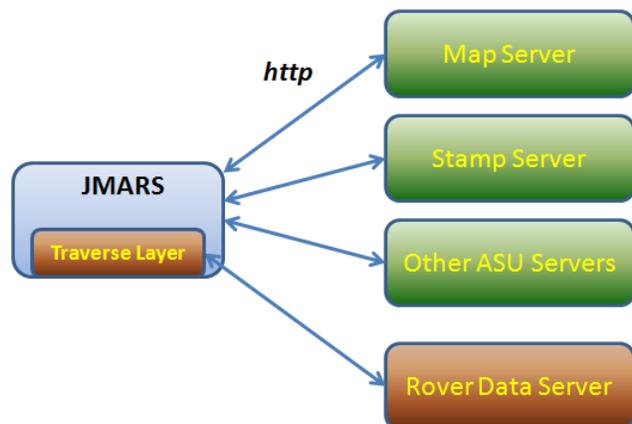


Fig. 5: Client server architecture of JMARS and the module from SPI (in chocolate color).

Design of the traverse layer is shown in Fig. 6. To ease integration and testing, we implement the spectral visualization GUI in a separate package, `net.signalpro.mars.spectra`. This package can be a standalone app for visualizing rover spectral data without installing JMARS. On the JMARS side, the traverse layer only implements the code visualizing the rover's traverse map and delegates the spectral visualization task to the spectra GUI package. Fig. 6 shows major components of each package. In essence, we separated the data model, data reader, and data visualization.

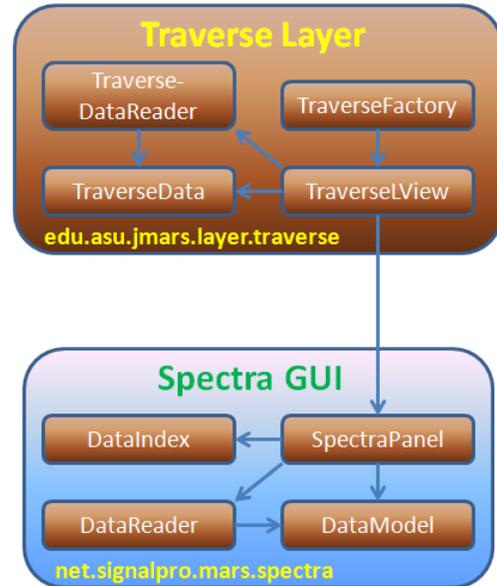


Fig. 6: Design of traverse layer and the associated spectra GUI.

Future Work: We passed our software to the JMARS team at ASU. We plan to expand the current tool to allow users to perform interactive functions such as concentration analysis and visualization. We are interested in collaborating directly with potential users, both to improve the tool and to generate new insights into processes on Mars. Interested users can contact Dr. Kwan at chiman.kwan@signalpro.net.

References:

- [1] JMARS, <http://jmars.asu.edu/>
- [2] PDS Geosciences Node, <http://pds-geosciences.wustl.edu/>
- [3] Where is rover now, <http://mars.nasa.gov/msl/mission/whereistherovernow/>
- [4] Spirit rover waypoints
- [5] Opportunity rover waypoints
- [6] Curiosity rover waypoints, <http://mars.jpl.nasa.gov/msl-raw-images/locations.xml>
- [7] W. Wang, B. Ayhan, C. Kwan, H. Qi, S. Vance, "A Novel and Effective Multivariate Method for Compositional Analysis using Laser Induced Breakdown Spectroscopy," 35th International Symposium on Remote Sensing of Environment, April 2013.

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