EPSC Abstracts
Vol. 6, EPSC-DPS2011-1686, 2011
EPSC-DPS Joint Meeting 2011

Image Search Visualization in a Planetary VO

M. Rose (1), **J. Trimble** (2), C. Schauer (3), D. Russell (2)
(1) Dell Perot Systems / NASA Ames (mark.e.rose@nasa.gov), (2) NASA Ames Research Center (jay.p.trimble@nasa.gov), (3) UC Santa Cruz / NASA Ames (corinne.l.schauer@nasa.gov), (4) Google, Inc. (drussell@google.com)

Abstract

A multi-mission image search tool has been created through a collaboration between Google and NASA Ames Research Center, using Google Earth as a virtual observatory (VO) for accessing search results. Follow-on work will expand the utilization of the VO and refine the features based on user research.

1. Introduction

NASA and Google share the challenge of how to making vast quantities of information available to, and usable for, diverse populations of users. In 2007, Google and NASA Ames Research Center collaborated on a one-year project with the goal of making planetary image data more accessible to both scientists and the general public. The Ames Image Search tool, a web application, provides unified search among the images from several data sets from NASA's Planetary Data System (PDS). Google Earth, a GIS application freely available for several popular computer platforms, serves as a portal into the search results, providing VO capabilities for planetary science data on rocky bodies.

2. VOs for Planetary Data

VOs have been developed within the last decade to provide uniform search among a distributed set of data collections. VOs have the following characteristics[3]: 1) user *portals* which allow search among multiple distributed collections, 2) the use of standardized search interfaces, and 3) aggregated result display. Although most existing VOs focus on astronomical data, those characteristics can be met by planetary data systems as well.

2.1 Google Earth as a VO

Google Earth is a freely available desktop application and browser plugin for Windows, Macintosh, and Linux systems[2]. Since 2009 it has also included visualization layers for Mars and the Moon. Google Earth serves as a VO portal, allowing search among multiple, dynamic layers from distributed collection providers using a standard HTTP interface. It also utilizes a standard language for representing the search results and other data, KML[5].

3. Cross-Mission Image Search

The Ames Image Search tool incorporates data from eight different missions: the Viking orbiters, Clementine, Mars Global Surveyor, 2001 Mars Odyssey, Mars Reconnaissance Orbiter, and Cassini. Except for Cassini, all of these data sets are for Mars or the Moon.

3.1 Uniform Cordinates

Not all NASA data sets use the same coordinate system for the same body. For example, Viking used a different coordinate system for Mars than does Mars Reconnaissance Orbiter. The Ames Image Search tool integrates the Unified Planetary Coordinates database[1] from the USGS and JPL, which supplies uniform coordinates for the above missions, allowing simultaneous visualization of the result footprints within the VO.

3.2 Feature Search

Most search tools for planetary data allow search using longitude and latitude, but do not understand feature names. The Ames Image Search also integrates the USGS Gazetteer of Planetary Nomenclature[4] to allow searching based on standard feature names.

3.3 Result Ordering and Refinement

Two additional problems occur when searching across multiple planetary image data sets: 1) although a feature may occur in an image, it may be small, relative to the image size, or it may not entirely fit within the image; and, 2) the resolution of images

tends to get better with newer missions, making them more suitable for high accuracy.

The Ames Image Search tool addresses these problems by ordering the results according to heuristics, including preferring higher-resolution images, when possible, and preferring image sizes that match the size of the desired feature. The system also allows refinement based on the additional metadata in the images, including the mission or instrument, geometric parameters, and image band.

4. Search Result Visualization

The search tool allows visualization of the results in two ways. First, it integrates with Google Earth as a VO for planetary science, letting the user see the footprints of each image displayed on top of the Mars or Moon base map. Each footprint is a clickable object, providing further information about the image, a thumbnail, and links to the original image. Second, it can display the distribution of image search results versus time and geometry parameters, giving the scientist a visual way to determine whether any of the results match their scientific needs.

5. Future Work

Future work will include enhancements to both the VO tool and the user experience.

5.1 End-to-End Searching in the VO

As of now the Ames Image Search tool utilizes the VO for visualization of the search results and access to those results. However, the VO is not used to begin a search; instead, the web interface provided by the image search tool is the starting location. In the future, the system will be enhanced to allow searches to begin entirely within the Google Earth system.

5.2 Mental Models for Search

Mental models are analytic tools used in user-centered design to understand the context, attitudes, and behaviors a user brings with them to a given situation. Through research on planetary scientists using PDS data, we have developed mental models describing how users want to search for data. We have found that PDS data users are task-driven, focused on their search characteristics rather than missions or instruments. We expect similar findings from VO users when searching for data, and we plan on building new mental models based on the PDS models to help us guide future development.

5.3 Feedback Guiding Development

Utilizing a user-centered approach, we plan to gather user feedback on the integration of our search tool to Google Earth. The study will use qualitative evaluation techniques, and focus on usability as well as what features users want in future versions.

6. Summary and Conclusions

Google Earth, a freely available GIS visualization system, has been used as a Virtual Observatory front-end to visualize search results from a cross-mission collection of images from NASA's Planetary Data System. The search system incorporates several unique features such as feature-based search, search result ordering, and visualization of result distribution across multiple metadata axes. Future work will incorporate new features of Google Earth to enable end-to-end searching without leaving the GIS visualization. As well, a regime of user research and testing will guide refinement and new feature development.

Acknowledgements

Others who have contributed code and ideas to the project include Frank Kuehnel, Joshua Ganderson, and Laura Baalman.

References

[1] Becker, K. L. et. al.: The Unified Planetary Coordinates Database, Lunar and Planetary Science XXXVIII, 2007.

[2] Google, Inc.: Google Earth API Developers Guide, Google, Inc., 2011.

[3] Graham, M., Fitzpatrick, M., and McGlynn, T.: The National Virtual Observatory: Tools and Techniques for Astronomical Research, Astronomical Society of the Pacific Conference Series, 2007.

[4] USGS Planetary Geomatics Group: Gazetteer of Planetary Nomenclature, USGS Astrogeology Science Center, http://planetarynames.wr.usgs.gov/.

[5] Wilson, T., ed.: OGC™ KML Version 2.2.0, Open Geospatial Consortium, Inc., 2008.