User System of Astrogeology Technologies

Megan Backus, Zack Ellett, Mikal Ustad, Kyle McGinn
Department of Computer Science, Northern Arizona University

Introduction

ISIS

The USAT team is working with USGS and NASA to improve their Integrated Software for Imaging Spectrometers, or ISIS, software package. ISIS is an image processing software package, which focuses on the manipulation of imagery collected by current and past NASA planetary missions sent to Mars, Jupiter, Saturn, and other solar system bodies. ISIS is capable of many of the standard image processing operations such as contrast stretch, image algebra, filters, and statistical analysis.

The real power of ISIS is its unique capabilities for processing data from NASA spacecraft missions such as Voyager, Viking, Galileo, Mars Global Surveyor, and Mars Odyssey. ISIS is able to import raw mission data and transform it into a usable geospatial image product. It has tools for digital mosaicking of adjacent images, photometric modeling and normalization, removal of systematic noise patterns, overlaying graticules, and numerous other cartographic and scientific analysis functions.

The Problem

- ISIS is very powerful, but each program must be ran individually
- Current graphical user interfaces (GUIs) do not provide multiple program processing and are out of date.
- ISIS consists of ~300 separate tools which increases the magnitude of difficulty (Figure 1)
- More tools are made every few months.
- Documentation for each tool is not easily accessible, which leads to many months of required training for any new employee to become productive with ISIS.

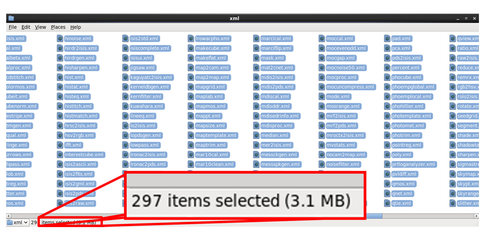

Figure 1: ISIS is currently made up of about 300 programs.

Engineering Design

The Solution

The USAT project had the task of creating a unified interface that addresses the shortcomings of the current workflow process, while maintaining compatibility with the existing ISIS system. A Graphical User Interface (GUI) increases the usability of the system by having access to all ISIS programs, along with extensive help and documentation sections.

After weeks of brainstorming, the decision was made to utilize the open source software Galaxy. Galaxy is a web based workflow creation tool. Its current focus is bioinformatics, however it has been modified to work with ISIS.

Adapting ISIS XML files to match the schemas of Galaxy XML files was one of the major steps to completing the conversion. Initially, this was going to be done with an automated converter developed by the USAT team. However, Galaxy had the capability to have more features than what ISIS currently provides, and inconsistencies exist in the mapping between the two distinct XML layouts. In the end, both the sponsors and the USAT team agreed it would be best to manually transition all of the ISIS programs into Galaxy compatible files.

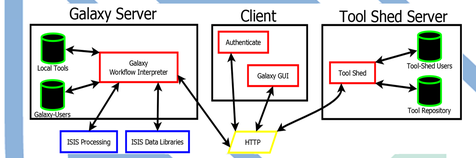

Figure 2: Overview of the system's architecture.

Obstacles Encountered

Design

The most important and difficult decision of this project was deciding what design to use. It was the main task given by the sponsors. The USAT team entertained the ideas of using Java's Swing, Nokia's QT, and a few other programming libraries before encountering Galaxy. After exploring Galaxy, it was clear that it was the best fit. It already encompassed the essence of workflow construction and just needed to be modified to work with ISIS.

Conversion to Galaxy

ISIS used XML files for its tools, and so does Galaxy. However, the XML file schemes did not match. The task of creating a conversion tool was at first an obstacle, especially because there was no direct mapping between the schemas. Manual conversion was agreed upon by both the USAT team and the sponsors. The development of the Tool Shed provided an easy way to install any tool.

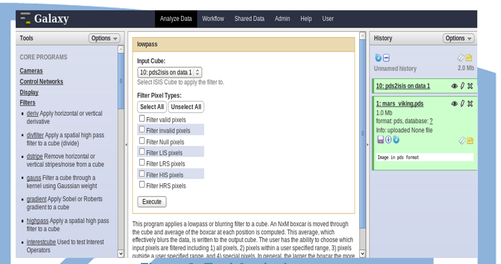

Figure 3: Tool Analysis screen.

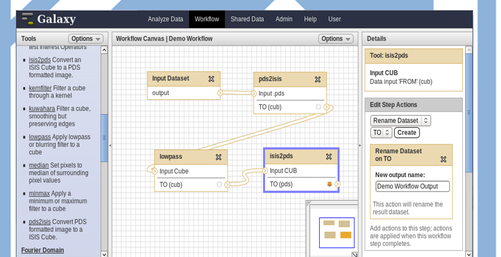

Figure 4: Workflow Creation screen.

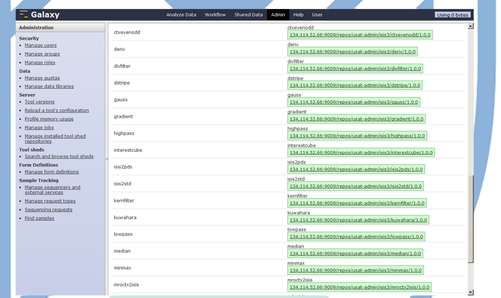

Figure 5: Galaxy also handles different versions of the tools.

Highlights

Drag-and-Drop Interface

This is the main interaction between the user and the ISIS tools when a workflow is being created (Figure 4). With the popularity of dynamic interfaces (touch screens, web technologies), such designs feel more intuitive to a user.

Web-based

With interpretation of the GUI handled by a web browser, the product can be run independent of the operating system. The servers calculating all the necessary data for ISIS processing can be run locally or remotely (Figure 2). In the future, running the server remotely can mean that a user can interact with ISIS in a mobile environment. Examples of such environments involve using a smartphone or the laptop of a researcher out on the field.

Documentation

Galaxy has the added functionality of providing documentation for each of its tools. A brief description is located in the list of each tool, and a more detailed one upon further inspection of the tool (Figure 3).

Tool Shed

The Galaxy Tool Shed is a repository for all of the tools used in Galaxy. It's an additional part of Galaxy that greatly alleviates some of the hassles that come with tool management. With the Tool Shed, administrators can easily upload tools and monitor different tool versions (Figure 5).

Workflow and History Sharing

Galaxy has the ability to publish and share workflows. Therefore, a user can reuse a specific workflow without having to create it all over again or they can help out a fellow researcher by sending them the workflow and current processing history.

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