



JPL Multimission Instrument Processing Laboratory (MIPL)

Open Source Software from JPL/MIPL

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Introduction

JPL Multimission Instrument Processing Laboratory (MIPL)

- **MIPL: Multimission Instrument (Image) Processing Lab at JPL**
 - Responsible for the ground-based instrument data processing for a wide variety of missions
- **Most MIPL software is based on VICAR**
 - Video Image Communication And Retrieval
 - Continuously evolved since the late 1960's
 - Still actively maintained today
 - C, C++, Fortran, Java, various scripting languages
 - File format in addition to software package
 - Label + raster image, similar to PDS3
- **Several software subsystems have been open-sourced**
 - Described later in this presentation



Open Source Software Definition

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- **Source code is available to users**
- **Permissive licensing terms**
 - Modification of source code is allowed
 - Redistribution is often allowed
 - Often with conditions, such as retaining copyright notices, or using a similar license for derived works
 - Commercial use may be restricted
 - GPL (GNU General Public License) and BSD (Berkeley Software Distribution) among the most popular licenses
- **Collaborative development is common**
 - But not required
- **Open Source is distinct from Public Domain**
 - PD = no license, free to use for any purpose whatsoever
 - Authors retain some control and rights with Open Source



Open Source Benefits

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- **Benefits to End Users/Community**
 - Don't have to write the software themselves
 - Tremendous cost savings potential
 - Software can be customized for users' specific needs
 - Especially for planetary software, which is often special-purpose
 - Adapt a package to a different mission or planet, or generalize it
 - Packages tend to become community standards
 - De facto if not de jure
 - Collaboration is facilitated
 - Multiple users can contribute changes back to the mainline
 - Price is right
 - Universities and research labs often have little or no budget



Open Source Benefits

JPL Multimission Instrument Processing Laboratory (MIPL)

- **Benefits to Author/Author's Organization**
 - AO can take advantage of community contributions
 - Additional functionality or bug fixes at little or no cost
 - Organization may require vetting of contributions before use
 - Especially for mission-critical code
 - Allows a project to live on past its funding
 - Community can support package after funding runs out
 - Little reason to remain proprietary if there's no maintenance budget
 - Fosters collaboration
 - Sometimes easier to Open Source something than to execute a specific collaborative license
 - Author/AO becomes recognized authority on the topic
 - They wrote the software, they must know the topic
 - Build a name within the community
 - Little commercialization potential for planetary software
 - User pool (customer base) very small
 - Science organizations have little money to spend on commercial s/w



Open Source Concerns

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- **Security**
 - Accepting community changes can be a security concern
 - Potential for malware being inserted in mission-critical code
 - Organization may need to vet changes before accepting
 - Of most concern for medium-sized projects
 - Very large projects (e.g. GNU, Apache) have too many eyeballs looking at it for malware to creep in
 - Very small projects have known authors and are easy to vet
- **ITAR**
 - Code must be ITAR-clean and exportable
- **Intellectual Property**
 - Certain algorithms/code areas “competitive advantage” to the organization
 - May make the difference in winning or losing proposals
 - Commercialization potential (rarely)
- **Additional costs**
 - Managing open source repository and vetting changes are not free
 - Hopefully less than the benefit derived
 - Release may require more documentation/code cleaning than internal use



Open Source and Planetary Software

JPL Multimission Instrument Processing Laboratory (MIPL)

- **These are the authors opinions!**
- **Planetary software would benefit greatly from more open source**
 - Budgets are tight, nobody can do it all
 - Packages generally written by experts in a particular area
 - e.g. VICAR I/O written by MIPL, the maintainers of VICAR
 - Small community means you probably know and can trust the source
 - Commonality of core algorithms and packages means greater interoperability between packages
 - Packages are likely better debugged than if you roll your own, simply due to more users
 - And you can fix any bugs you find
 - Easier to collaborate on software
- **Caveats**
 - NIH (Not Invented Here)
 - A problem in all industries, this is no exception
 - Impedance mismatches in code or system design
 - e.g. Java vs. C, Swing vs. SWT, incompatible design approaches
 - Issues with losing competitive advantage



JPL and Open Source

JPL Multimission Instrument Processing Laboratory (MIPL)

- **JPL has a process in place to release packages Open Source**
 - Requires signoffs from author, line and program management, IT security, commercialization, export, chief technologist, tech transfer
 - Since about 2008
- **License is slight modification of BSD**
- **Release channels**
 - Originally required to go through Open Channel Foundation
 - www.openchannelfoundation.org
 - Distribution only, does not support collaborative development
 - Users can modify of course, but must send changes back to the authors for inclusion in the mainline distribution
 - Very recently, use of SourceForge has been approved
 - www.sourceforge.net
 - Supports collaborative development
 - None of the MIPL software is in SourceForge (yet)



MIPL Open Source Packages

JPL Multimission Instrument Processing Laboratory (MIPL)

- **JadeDisplay**
 - Java image display component
- **JADIS**
 - Java stereo display component
- **VICAR, PDS, ISIS Image I/O**
 - Java plugins for I/O of planetary image data formats
- **Pomegranate**
 - Python app that exposes science data files on the Web (Webification)
- **X-windows Image Widget**
 - X-windows/Motif widget (in C) for image display
- **Magellan Stereo Workstation**
 - View in stereo and manipulate match points (not Magellan-specific)



JadeDisplay

JPL Multimission Instrument Processing Laboratory (MIPL)

- **High-performance Java image display component**
- **Standards-based**
 - Uses Java Advanced Imaging (JAI)
 - Uses Java2D and Swing
 - Displays any Java2D RenderedImage
- **Asynchronous loading/computation/display of tiles**
 - Keeps GUI thread responsive during long image loads
- **Works with very large images (> 2 GB)**
- **Graphics overlay support**
 - Plot tiepoints, cursor, annotation, etc.
- **Background painter**
- **Used as the imaging core of MIPL's *Marsviewer* application**
- **<http://www.openchannelfoundation.org/projects/JadeDisplay>**



JADIS

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- **Stereo display infrastructure for stereo**
 - (JADIS = Java Advanced Display Infrastructure for Stereo)
- **Provides common interface for display Swing GUI components in stereo**
 - Choose to render component on Left, Right, or Both
- **Works both with and without specialized hardware**
 - Hardware support: LCD shutter glasses, polarized glasses, etc.
 - Anything supported by platform's OpenGL system
 - Anaglyph: Red/blue glasses
 - Application works the same either way
- **Standards-based**
 - Displays any Swing component that uses standard Graphics/Graphics2D rendering mechanism
 - Including JadeDisplay
 - Uses OpenGL (via JOGL) to perform all rendering and control hardware stereo
- **Supports stereo cursor rendering, horizontal & vertical disparity adjustment**
- <http://www.openchannelfoundation.org/projects/Jadis>



VICAR, PDS, ISIS Image I/O

JPL Multimission Instrument Processing Laboratory (MIPL)

- **Java Image I/O package for VICAR, PDS, and ISIS**
- **Three access levels**
 - Image I/O (IIO) Plugin
 - Java core standard mechanism
 - Format-neutral software infrastructure with plugins for various file formats
 - JAI Codec
 - Older mechanism, predates and inspired IIO facility
 - Low-level I/O package
 - Used by both of the above
 - API specific to this package (not format neutral)
- **Supports metadata I/O and conversion**
- **VICAR: Full format support**
 - Read and write, all access levels
- **PDS: Common uncompressed PDS3 image format only**
 - Read and write, all access levels
- **ISIS: Common image files**
 - Read only, IIO level only
- <http://www.openchannelfoundation.org/projects/VicarPdsIO>



Pomegranate

JPL Multimission Instrument Processing Laboratory (MIPL)

- **Python application that exposes science data files on the web**
 - An implementation of the Webification (W10N) specification
 - <http://webification.org>
 - This specification defines a common way to expose data stores (composite files, databases, etc.) on the web
- **The core idea of Webification is to make the inner components of a data store directly addressable via well-defined and meaningful URLs**
 - Data format independence
 - Provide supported format to applications vs. expect each application to support a given format
 - Installed on web servers as either WSGI or CGI applications
 - Supported formats include netcdf, hdf4, hdf5, grib and fits. Planetary image formats VICAR, PDS, ISIS coming soon
- **Benefits**
 - Simplifies the retrieval of meta and data information from files
 - Enables search, query, and operations to be quickly built
- <http://www.openchannelfoundation.org/projects/Pomegranate>



X-windows Image Widget

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- **High-performance X-windows (Motif-compliant) image display widget**
- **Used as the core of MIPL's *xvd* image display program**
- **Primary features**
 - Zoom, pan, stretch (via lookup table)
 - Displays single-band or color data (dithers if needed)
 - Supports non-byte data
 - Pseudocolor display
 - Graphics overlay
 - Mouse-based panning
 - Cursor handling, shaping, and planting (disconnecting from mouse)
 - Background loading and display of images (doesn't freeze the GUI)
 - Tiling of images
- **I/O is responsibility of app (so works with any image file format)**
- **Open Source release approved, but package not posted yet**
 - Perceived lack of demand since X/Motif is an old technology
 - Contact the author if you are interested



Magellan Stereo Workstation

JPL Multimission Instrument Processing Laboratory (MIPL)

- **Java-based stereo workstation**
 - Built around JADIS and JadeDisplay
- **Core workstation built by European collaborators**
 - Mullard Space Science Laboratory (MSSL)
 - Part of P_RoV_isG consortium
 - Planetary Robotics Vision Ground Processing, www.provisg.eu
 - Open Sourced by them
 - Primarily for Mars images
- **Extended for use with Magellan (Venus) radar imagery**
 - PMDAP (Planetary Mission Data Analysis Program) project, part of NASA ROSES
 - Retains earlier functionality, so it is multimission in nature
- **View and manipulate images and match points in stereo**
- **Under development - not yet available**
 - Task plan specifies Open Source release for workstation
 - Intended to foster community collaboration
 - Preliminary version hopefully this fall
 - Contact author if interested in the meantime



Conclusion

JPL Multimission Instrument Processing Laboratory (MIPL)

- **Open source software – done properly and appropriately – benefits everyone**
 - Users, authors, community
- **Central registry of Planetary-related open source software would be helpful**
 - Hopefully one outcome of this conference
- **Open Sourcing of MIPL software is done based on demand/need**
 - If someone needs it, we will consider it
 - It takes time and resources so we can't do everything
 - Generally done based on a collaborative need
 - If we have other software you think should be open sourced, contact us