What is VICAR?

- Video Image Communication And Retrieval (VICAR)
- Image processing system developed at JPL
  - Used primarily but not exclusively for planetary image processing
- Command-line oriented system
  - > 400 applications (almost 350 for the open source version)
  - VICAR is not Photoshop – don’t expect flashy GUI’s
- Applications are strung together to accomplish tasks
  - Great for scripting
- Simple file format
  - Designed for efficient metadata handling
  - Uncompressed, making random-access reads and writes easy
  - Supports large (>>2GB) images
  - Supports many data types (byte, short int, long int, float, double, complex)
- Extensive metadata support
  - “Labels” embedded in the image
  - Describe how/when/where the data was taken, spacecraft state, temperatures, processing history, mapping parameters, pixel units, etc.
Brief History of VICAR

- 1962/3 – Bob Nathan proposes image processing at JPL
- 1964/5 – Fred Billingsley (first publisher of “pixel”) and Roger Brandt develop Video Film Converter (digitizer); Howard Frieden develops code to process Ranger data on IBM 7094
- 1966 – First published reference to VICAR; IPL (Image Processing Lab) formed
  - Written by Stan Bressler, Frieden, Nathan, Billingsley, et al
  - First documented use with Surveyor
  - Originally developed for IBM 360 computers
- We believe, but cannot prove, that this makes VICAR the oldest continuously used image processing system in the world
- 1971 – First “Open Source” delivery of VICAR (via COSMIC)
- 1973-4 – Interactive processing on IBM/TSO introduced
- late 1970’s – IBIS developed (tabular data support)
VICAR History (cont’d)

• 1984 – VICAR converted to VAX/VMS
  – Multimission Image Processing Lab (MIPL) formed
  – VICAR core redesigned to support VMS transition
    • Much application code survived the transition
  – VICAR file format redesigned to current state
    • Sometimes called VICAR2
  – TAE (Transportable Applications Executive) adopted as command line/batch/script processor
    • Also adopted by early versions of ISIS

• Early 1990’s – VICAR ported to Unix
  – Many Unix variants supported
  – “Shell VICAR” removed reliance on TAE command line

• Mid 1990’s – Open Source releases suspended

• 1994 – “xvd” display program developed

• 2003 – Marsviewer display program developed

• 2004 – VICAR ported to Mac OS X

• 2005 – VMS support discontinued

• 2015 – VICAR core again released Open Source
Why Release Now?

- Motivated by discussions at 1st Planetary Data Workshop, 2012
- Almost all potential users want/need source code
- VICAR has long history of Open Source
- No need to keep it proprietary
  - Growing ITAR concerns motivated retreat from Open Source in the mid 1990’s
  - ITAR has become somewhat more lenient of late
  - Potential ITAR code (e.g. telemetry processors) has been removed from the release
- JPL is encouraging Open Source much more now
  - Used to be very hard to get approvals
  - Requirement that code be posted at Open Channel has been lifted
    - SourceForge, GitHub, etc. now are valid options
Current VICAR Users

• **MSL, MER, InSight, Mars 2020**
  – Large Mars processing suite built on VICAR
    • Mars suite not being released at this time (licensing concerns)
  – Extensive use of VICAR core capability

• **AFIDS (Automatic Fusion of Image Data System)**
  – State-of-the-art Earth mosaic/cartography system
    • Automated subpixel registration, orthorectification, huge (>> 2GB) mosaics
  – Extensive DoD users
  – Integrates many open source tools with VICAR core processing

• **Cassini**
  – Telemetry processing
  – Cassini-specific applications for data validation and analysis
  – Mapping, photometric analysis, navigation (pointing correction)

• **Mars Express (DLR, Berlin)**
  – HRSC camera processing
Current VICAR Users (cont’d)

• PDS Rings Node, NASA ROSES (e.g. PDART) proposals
  – Voyager reprocessing

• Earth processing
  – Classification/Segmentation, change detection, large mosaics, multi-band processing
  – Detect thermal infrared anomalies in orbital data
  – Cloud detection

• PDS Data Archive
  – Image data for many planetary missions is stored in VICAR format with attached or detached PDS labels
  – MSL, MER, Phoenix, Cassini, Galileo, Voyager, Magellan, MEX(HRSC), many older missions
  – InSight and Mars 2020 (ecam) will use this same delivery concept with PDS 4
    • VICAR images with detached PDS 4 labels
What’s Included

- Almost 350 application programs
- Command-line parsing (shell) and optional environment (TAE)
- VICAR-format image I/O library
  - Both C/C++/Fortran and Java versions
- File Format Conversion ("transcoder")
  - Convert between most common file formats
    - Including VICAR, PDS, ISIS, FITS
  - Preserves metadata
- “xvd” image display program
- IBIS (Image-Based Information System) for tabular data
  - Efficient handling of large data sets
Sample Application Program Types

- General Image Manipulation
- Contrast Enhancement and Color Processing
- Map Projection and Image Warping
- Statistics and Mathematics Functions
- Filtering
- Mosaicking
- Label Manipulation
- Registration
- Classification
- Segmentation
- Graphics and Annotation
- Feature Detection and Location
- Blemish and Noise Removal
- Photometry/Radiometry
- Multispectral Analysis
- Image Calibration (Generation and Use)
Supported Platforms

• Fully tested, supported platforms
  – Linux (32 bits)
  – Solaris 10

• Available platforms (limited testing due to resource constraints)
  – Linux (64 bits)
  – Mac OS X
  – In reality, these work fine
Available Documentation

- Overall system documentation is generally old and not well maintained
  - Accurate as far as it goes, but usually does not include recent developments
  - Getting Started guide is current
    - Start there for an overall picture, including notes on the relevance of other documents
- Individual program help is generally relevant and useful
  - “PDF” format *TEXT* files contain detailed help on each program
    - Parameter Definition Files
    - Not Adobe PDF files!!
      - We had the name long before Adobe PDF was invented
    - PDF files are also converted to HTML for ease of browsing
Where to Get It, and Release Status

• Currently obtaining final approvals
  – Hoped to be done by this conference, but still working the final approvals
  – Should be very small number of weeks
• Look for it (or status updates before release) here:

Questions?

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