MODERNIZATION OF THE INTEGRATED SOFTWARE FOR IMAGERS AND SPECTROMETERS.

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Introduction: The cartographic and scientific processing of planetary image data has a long history within the USGS Astrogeology Program. The software used has evolved numerous times to keep up with the steady advances made in computing technology. The following outlines the progression of the software over nearly thirty years:

Dates	Computer	Cartographic Software
1971-1980	PDP-11/DOS-BATCH	Unnamed
1978-1987	PDP-11/RSX-11M	Flagstaff Image Processing System (FIPS)
1985-1994	VAX/VMS	Planetary Image Cartography System (PICS)
1989-Present	UNIX	Integrated Software for Imagers and Spectrometers [1]

Background: The Integrated Software for Imagers and Spectrometers (Isis) was developed in the late-1980's, primarily to support the Galileo NIMS instrument [2]. In 1992, the cartographic capabilities of PICS were merged into Isis in order to support the Clementine mission. Since that time, software for numerous missions has been incorporated into Isis including Viking Orbiters, Voyager I/II, Galileo SSI, Pathfinder IMP, Mars Global Surveyor MOC, TES, and MOLA, Odyssey THEMIS, and Lunar Orbiter. The multi-mission capabilities in Isis make it a widely used software package among the planetary community.

This version is denoted at Isis 2.1 and because of its maturity had several key issues which needed to be addressed. These include a text-based user interface, an image size limitation of approximately 2 gigabytes, and a vast FORTRAN and C Application Program Interface (API).

The user interface is based on the Transportable Application Executive (TAE), a software package over 20 years old with limited software support. Although a gem in its time, a modern image processing package would be better suited to a graphical user interface.

In addition, Isis 2.1 was developed to support image sizes on 32-bit architectures (2GB files). Recent instruments, such as Odyssey's THEMIS have at times needed to exceed this limit, but have been unable. Future instruments such as Mars Reconnaissance Orbiter's HiRISE will routinely need to exceed this limitation.

Finally, the Isis API is composed of nearly 3000 FORTRAN and C source files, each with one or more internal functions or subroutines. This vast API is at times difficult to navigate, even for veteran Isis developers, and often leads to code duplication. Unfortunately, the intrinsic organizational capabilities and the added power of object oriented languages such as C++ and Java were not fully available in the initial design phase of Isis 2.1.

Modernization: In December 2001, the USGS began a major effort to modernize our image processing software as Isis 3.0. This new version would incorpate a Graphical User Interface (GUI) and use C++ as the primary programming language. Other major benefits include a web-based documentation set for application programs, web-based programmer documentation, test suites for software integrity checks between releases and/or ports to new operating systems, and a greatly simplified programming environment. Examples and additional information can be found on the following url, http:/Isis.astrogeology.usgs.gov.
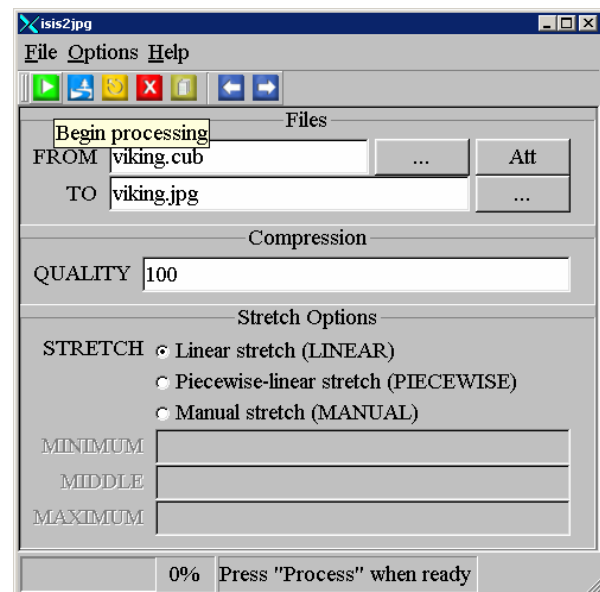
Example of GUI

The modernization effort was broken into three phases, API development, core application conversion, and mission specific conversion. The first phase involved developing a base set of C++ classes to handle

label manipulation, image I/O, map projections, camera models, and many other common capabilities found in the Isis 2.1 API.   Once completed, the second phase was to convert the core application programs, that is, common image processing algorithms including ratios, filters, contrast stretch, statistics, image import/export, and the like.   The final phase is converting mission specific applications that handle data ingestion, radiometric calibration, and a camera model.
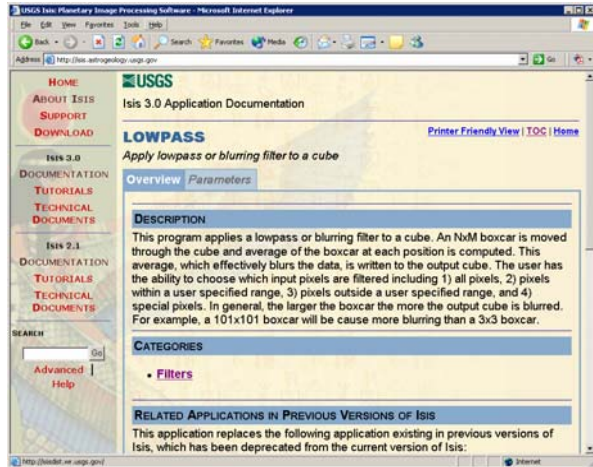
Example of User Documentation

Current Status: At the moment, we have completed the first two phases and are in the middle of the third phase, focusing heavily on Mars missions.   The following table outlines the missions:

Mission	Isis 2.1	Isis 3.0
Viking	Yes	Yes
MGS/MOC	Yes	Yes
THEMIS	Yes	Yes
HiRISE	Never	CY 2004
Mariner	Yes	Oct 2004
MGS/TES	Yes	TBD
IMP	Yes	TBD
MER	Yes	TBD
Clementine	Yes	TBD
Lunar Orbiter	Yes	TBD
Galileo SSI	Yes	TBD
Galileo NIMS	Yes	TBD
Voyager I/II	Yes	TBD
NEAR	Yes	TBD

The conversion of all missions from Isis 2.1 to Isis 3.0 will occur over several years and is not necessarily in the order presented in this table.

Availability: Isis 3.0 will be released for beta-testing in March 2004 on a PC Linux distribution.   It will only be available through download via the Internet from the Isis web-site. In the future it will be made available on Sun Solaris, MAC OS/X, and possibly other platforms.

References: [1] Torson and Becker, (1997) *LPS XXVIII,* pp. 1443-1444 [2] Gaddis, et al., (1997) *LPS XXVIII,* pp. 387-388