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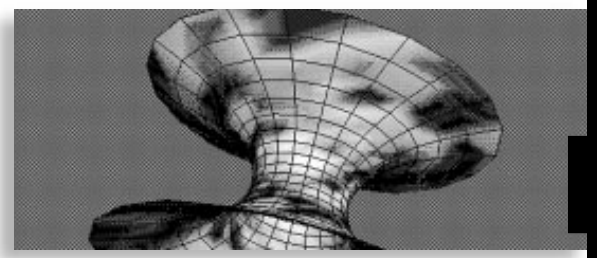
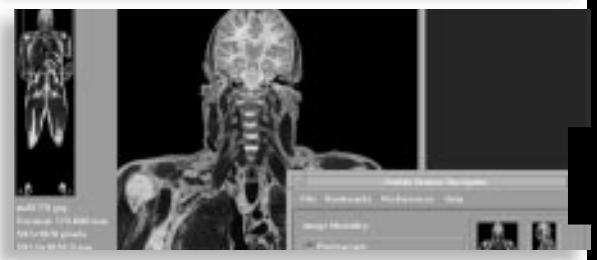
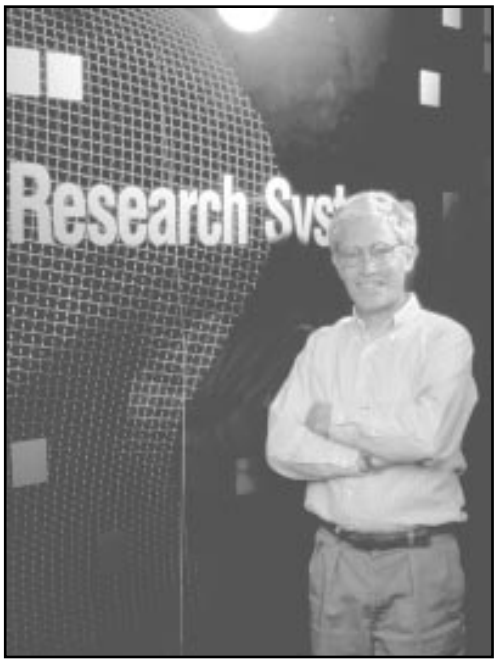






David Stern, President

IDL 5.0 is Worth the Wait

Last summer, I said that Research Systems was in the middle of our most ambitiou development effort to date – IDL 5.0. We are still in that process, but can see the light at the end of the tunnel. The development of IDL 5.0 has taken much more time and effort than we planned, but will be well worth the wait. We'd much rathe have a slight delay and deliver an excellent product than provide software that fails meet our quality standards. By the time you read this, IDL 5.0 should be well into the beta testing stage. Only after it has been thoroughly tested and polished will w release it.

There are three key components of IDL 5.0: object-oriented enhancements to the IL language; a new graphics architecture; and IDL Insight™, an IDL application in IDL 5.0 that provides a graphical user interface to its visualization and analysis functions.

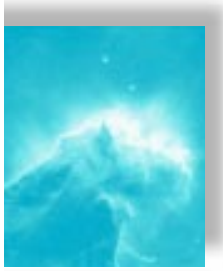
The object-oriented additions naturally extend the IDL language, making it a true object-oriented language, without changing existing IDL programs. Many of the concepts that have made IDL so popular extend without modification to the object-oriented domain. Data, and the procedures that operate on the data, are encapsulated in IDL 5.0 objects by associating class methods (IDL procedures and functions) with data structures. IDL objects support multiple inheritance, polymor phism and can be saved and restored, making them persistent.

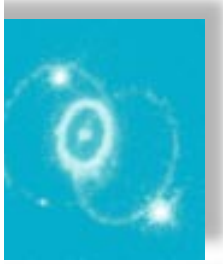
The current IDL graphics architecture has been in use for 15 years and is unmatchec in terms of efficiency and drawing speed. However, it still is a 2 1/2D system. Many customers have been asking for enhanced, true 3D capabilities, 3D hardware acceler tion, direct manipulation, and direct printing without requiring re-execution of the program that produced the graphics. We will deliver on all fronts. IDL 5.0's new graphics
architecture is designed to take full advantage of today's graphics standards and hardware capabilities. It presents a unified 2D and 3D model, is device independent, object-oriented with persistent objects and offers WYSIWYG direct printing.

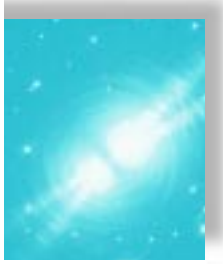
The new object graphics architecture will be supplied *in addition* to the current IL direct graphics system. It does not replace the current graphics system. IDL 5.0 wi offer two complete, independent graphics architectures and users may select either both systems within an IDL session.

IDL Insight will benefit experienced IDL users and non-programmers alike. Its cap bilities provide an easy to use graphical interface that enables quick visualization of data and direct printing. You can also easily import, export and modify files with IDL Insight's data manager and switch to command-line input if you desire. Extensive discussion of IDL Insight's features is included in the feature story begin ning on page 3.

I'm convinced that these important new features in IDL 5.0 will maintain IDL's







curious
about these images?

found all images in *Developments* can be on our web site: www.rsinc.com

IDL 5.0 - Accelerated 3D Graphics, Objects, Database Connectivity & IDL Insight

Largest evolution in IDL language in a decade

IDL's language, graphics engine and application development environment have been profoundly enhanced to boost productivity, in all areas, for anyone using IDL. A new application, called IDL Insight, has been incorporated to provide non-programmers with a graphical interface for IDL's data analysis and visualization tools. Support for OpenGL®, which facilitates rapid, interactive 3D image rendering and manipulation, has been implemented. Plus, the new IDL DataMiner™ option enables reading and writing to and from any ODBC-compliant database – directly from IDL.

"IDL 5.0 represents the largest evolution in the IDL language since 1987," says David Stern, founder and president of Research Systems. IDL Product Manager Dave Uhlir adds, "We are aware that while implementing these sweeping changes, IDL 5.0 must be backward-compatible with earlier IDL programs. We are taking extra steps during development to ensure compatibility with IDL 4.0.1 applications."

Objects and Pointers Speed Development

While helping to make this the best, most robust version of IDL ever, the IDL 5.0 object system works transparently in the background – unless you want to take advantage of the power and flexibility it offers. Using IDL objects, developers can more rapidly build reliable, full-featured applications. Exchanging and reusing code objects simplifies the extension and maintenance of programs and makes creating robust applications easy. IDL pointers, also new with this release, give access to arbitrary data structures via a natural language notation and can be freely copied with minimal memory overhead. Objects are fully supported by IDL's `SAVE` and `RESTORE` procedures and therefore can be saved or restored with a single command.

Language Limitations Lifted

You will be able to develop large applications easier than ever with the removal of language limits. The compiled program size of an application is now constrained only by the virtual memory of the system. IDL 5.0 uses a default program buffer size of 16K while eliminating the upper limit. An unlimited quantity of variables is now accepted and users can freely add new variable names with the `EXECUTE` command. Also, the external language-integration tools, `Callable IDL`, `LINKIMAGE` and `CALL_EXTERNAL`, have been extended to the Linux version of IDL, enhancing compatibility with this popular version of Unix for PC hardware.

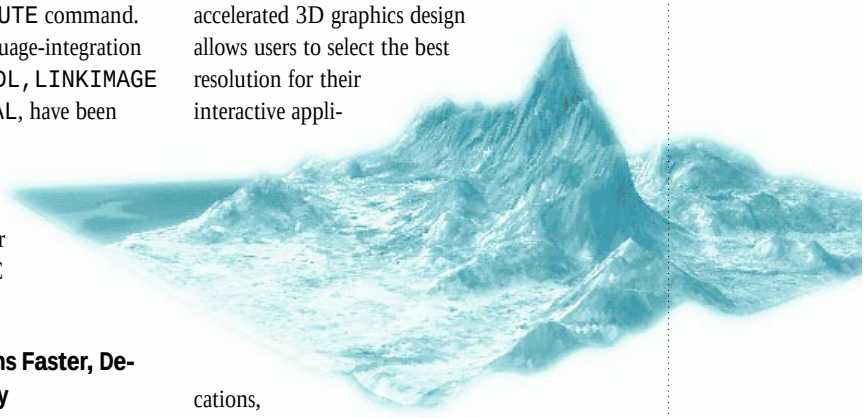
Optimized Code Runs Faster, Demands Less Memory

Application programmers and interactive users will both benefit from 5.0's optimized code. New memory allocation and deallocation algorithms minimize the accumulated memory of IDL programs, reducing the space requirements and speeding overall performance.

Superior Graphics for Better Analysis & Output

Get superior analysis and insight using IDL 5.0's truly interactive, easy to implement 3D graphics. You can now "fly through" and transform visualizations, shade and illuminate 2D and 3D graphical objects with multiple, colored lights and render imagery as wire frames, point surfaces, filled volumes or Gouraud and flat-shaded surfaces. Cross-platform color consistency is ensured through IDL's new unified color model, which supports RGB and CMYK Indexed color systems.

Fast, interactive rendering of 3D graphics is facilitated by IDL 5.0's support for OpenGL. The IDL OpenGL implementation is fully scaleable – taking advantage of graphics accelerator hardware, if present on the system, or operating purely via software on systems without OpenGL graphics boards. For IDL users with operating systems that do not yet support the OpenGL standard (see Table 1 on page 12) IDL 5.0 provides the Mesa-3D graphics library for 3D visualization. The IDL accelerated 3D graphics design allows users to select the best resolution for their interactive applications, within the constraints of their computer resources. This allows users with modest systems to rapidly rotate, scale and manipulate 3D visualizations at lower resolutions, or to choose higher-resolution visualizations for static displays.



IDL's 2D and 3D graphics have been integrated into a unified system in version 5.0. For example, the unified graphics system allows the overlay of a texture map on a 3D surface. Furthermore, publication-quality annotations and presentations are easily produced using the built-in TrueType®

fonts and WYSIWYG printing, controlled by native system print dialogs.

IDE – The IDL Development Environment

Easier, faster cross-platform application development has been the conceptual foundation for IDL since its beginning. "IDL 5.0 raises the bar again with the introduction of the IDL Development Environment (IDE). Completely integrated into IDL, the IDE is the ideal place to write, edit, debug, compile and run IDL code and execute IDL commands," says Uhlir. IDL application developers will appreciate the robust editing and enhanced debugging support – all designed to make writing IDL code faster and more rewarding. It's now easier than ever for end-users to run applications written by others. And the IDE's user interface is the same on all platforms, minimizing training time on new systems.

The addition of a table widget to IDL's GUI toolkit simplifies creating IDL applications with effective user interfaces. With the table widget, you can quickly create an interface with a grid for displaying, selecting and sorting data in a cellular, spreadsheet-like format.

IDL Insight– Graphical Interface to Powerful Environment

An application composed entirely of IDL objects, IDL Insight provides a graphical interface to IDL's powerful data analysis and visualization functions while adding convenient file management utilities. Users can process and visualize data without using the command line or writing IDL procedures. IDL Insight's interface can be customized to provide quick access to functions that are critical to your projects. IDL Insight can be extended via user-created plug-ins written in IDL. For maximum productivity, experienced IDL users can work both at the command line and within IDL Insight, switching to the most convenient environment to meet their analysis and visualization needs.

Greater Data Analysis Power

You'll get more data reduction and classification power with the addition of principle component and cluster analysis in IDL 5.0. IDL continues to keep pace with revisions in scientific data format standards. Not only can you easily work with data in HDF, CDF and netCDF formats, but IDL's open, array-based architecture accepts data in virtually any format for processing.

Ecologically & User-Friendly Documentation

Easier to reference and conveniently partitioned, IDL's documentation is available to users as on-line hypertext and in manuals logically categorized for particular functions.

For example, now there are chapters devoted to signal processing and image processing. Content previously covered in the *IDL User's Guide* is now split into two volumes. One volume, *Using IDL*, focuses on interactive use of IDL; the other, *Building IDL Applications*, is written with the needs of the application developer in mind. There's also the *Advanced Development Guide*, focusing on applications that communicate with programs written in external languages and processes and the *Objects and Object Graphics Guide*, which documents IDL's new object system. *Scientific Data Formats* documents IDL's support for CDF, HDF and netCDF formats, while the *IDL HandiGuide* remains a quick-reference tool, listing the routines of IDL in a convenient, compact format.

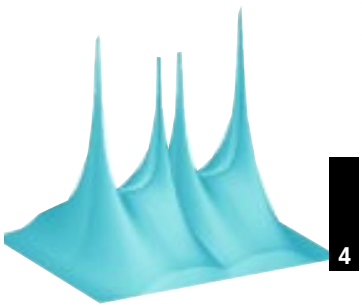
Research Systems prints all its documentation on recycled paper and ships only the essential paper documentation with licenses and maintenance updates. Additional printed documentation is available, upon request, for a nominal charge. (Please see Documentation Policy Modified page 5 for more information).

The IDL DataMiner ™ Option – Eas Connect IDL to Your Relational Database

Exposing trends and relationship collected data with IDL's DataMiner will help you make better decisions a interpretations, no matter what kind complex information you are analyzi By adding the IDL DataMiner optio users can access a central storehouse information from any computer on t network and share analysis and visual ization results. Transparent exchange data frees the developer from format compatibility issues. Using the simpl DataMiner API, users can connect to database (or multiple databases), add and delete records, retrieve and set da – all from IDL – without having to u SQL statements. Of course, the IDL DataMiner gives you the flexibility to use SQL commands for standard data base queries and operations. The IDL DataMiner comes with an ODBC dr ver set that gives you access to all the most popular relational database syste (see Table 2 on page 12 for a list of re tional databases that the IDL DataMiner currently supports).

IDL – The Cross Platform Choice

IDL has the widest platform supp of any technical visualization, data analysis and application development language. IDL runs on all popular operating systems: Windows 3.11, Windows 95, Windows NT, Macintos Power Macintosh, OpenVMS, eight versions of Unix, Solaris x86 and Linux.



PLATFORM SUPPORT UPDATE!

Announcing IDL for Solaris x86

Users of SunSoft's Solaris x86 Unix operating system for Intel-based personal computers are now able to take advantage of IDL and ENVI's power and flexibility for advanced data analysis, visualization and application development. Functionally, Solaris x86 is virtually identical to Solaris for SPARC and UltraSPARC-based Sun Workstations.

In an effort to expedite its release, Research Systems is currently offering IDL 4.0.1 for Solaris x86 only via ftp distribution, but it will be included with the IDL 5.0 CD. Users can download the software and documentation by going to ftp://ftp.rsinc.com/pub/idl/unix/solaris_x86. It is important to read the README for instructions before starting the installation. If you need further assistance, please contact our Technical Support department at (303) 413 -3920.

Solaris x86 joins the wide range of operating systems supported by IDL including: Unix (Sun, HP, SGI, Linux, Digital and IBM), Microsoft Windows, Windows 95, Windows NT (Intel and Alpha) Macintosh, Power Macintosh, and OpenVMS.

Unix OS Support

IDL 5.0 requires versions HP-UX 10.x of Hewlett Packard's operating system. HP-UX versions 9.x are not supported.

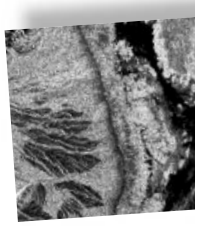
Digital Alpha customers on Unix will need to have Digital Unix v. 4.0 or higher to run IDL 5.0.

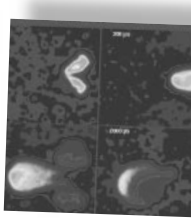
Last Version of IDL for Macintosh

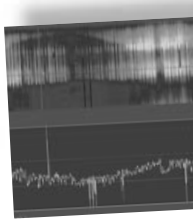
IDL 5.0 is the last version of IDL for Macintoshes with Motorola 68030 and 68040 processors. However, Power Macintosh support is still maintained and enhanced.

Be OS Support under Consideration

Research Systems is actively investigating the BeOS, Be Inc.'s new operating system for PowerPC-based hardware (including Power Macintosh). "We are very excited by the possibility of the BeOS becoming a standard operating system on Power Computing and perhaps Apple hardware. We are in discussion with Be to evaluate the technical issues involved with a port of IDL to the BeOS,"says IDL Product Manager, Dave Uhlir.







1997 IDL License Pricing*

Windows/Macintosh/Linux	*$1,500***
Unix/VMS Single-Node Locked	*$3,495**
Unix/VMS Single-User Floating	*$3,895**
Unix/VMS Six-User Node-Locked	*$9,000**
Unix/VMS Unlimited Node-Locked	*$18,000**

**Annual Maintenance fees are equal to 10% of the License fee.*
***Annual Maintenance fee for these platforms are $200/license.*

Documentation Pricing

User's Guides	
Using IDL	*$10.00*
Building IDL Applications	*$10.00*
Objects & Object Graphics Guide	*$10.00*
Supplemental Documentation	
IDL Basics	*$5.00*
Advanced Development Guide	*$10.00*
Scientific Data Formats	*$10.00*
IDL Reference Guides	*$30.00*
Complete Set (all of the above)	*$75.00*

Documentation Policy Modified

Buyers of IDL 5.0 and customers on maintenance take note: While all of Research Systems' reference documentation is included online, the following changes have been made to reduce the printed documentation you will receive. The purpose of these changes is to minimize the use of paper, particularly for supplemental documentation that is not regularly used by every IDL customer.

Beginning with the release of IDL 5.0, maintenance customers will receive printed copies of the user's guides. The supplemental *IDL Basics, Scientific Data Formats, Advanced Development Guide*, and the two-volume (1300 page) *IDL Reference Guides* are not shipped but can be ordered at the prices listed. Customers purchasing new IDL 5.0 licenses receive *IDL Basics* and the *Advanced Development Guide* in addition to the documentation provided with maintenance shipments. "In addition to printing on recycled paper, Research Systems has always taken measures to be as environmentally conscientious as possible," says Vice President of Sales and Marketing Denise M. Fields. "We have seen that with the growing acceptance of online documentation, including the convenience of hypertext links and the ability to search on keywords, most users will be putting their hardcopy manuals aside in favor of electronic reference tools. All hardcopy documentation is printed on acid-free paper with a minimum of 20% post-consumer content, meeting EPA guidelines."

For more information, contact your sales representative at Research

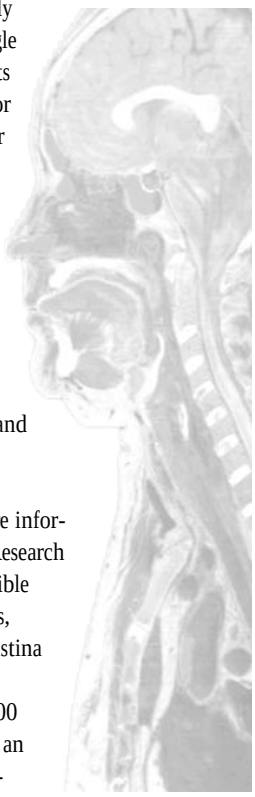
Female Visible Human CD – First Complete, Digital Reference of the Female Anatomy

ResearchSystems' Visible Human CD software now includes a complete, 10,000 image, anatomical reference of the human female in addition to the human male. This complement gives physicians and educators another simple, powerful tool for education and exploration of the human anatomy. The CD runs on Windows, Windows 95, Windows NT, Macintosh, Power Mac and Unix workstations from Sun, Hewlett Packard and Silicon Graphics. Available in February, Research Systems' *Female Visible Human CD* retail price is $495. Sets of the male and female versions are available at $795.

Using the CD's built-in graphical *Navigator*™, developed in IDL, you can easily browse inside the body from head to toe. Color photographs, registered computed tomography (CT) and magnetic resonance (MR) images (in T1, T2, and proton density forms) display detailed axial, coronal and sagittal perspectives of the anatomy. The *Visible Human's* graphical user interface provides point and click access to the modality, resolution and orientation of the images. The *Navigator* allows you to annotate slices and create bookmarks for quick reference, providing another time-saving feature for users. A series of images can be animated and played back in movie-loop fashion to give insight into the functional relationships of body structures. Images can be saved in a variety of formats and output for presentation.

The National Library of Medicine (NLM) provided the new data to Research Systems and the University of Colorado Health Sciences Center as part of the Visible Human Project, a research effort undertaken to create complete three-dimensional sets of anatomically-detailed images of a human male and female.

The data for the *Female Visible Human CD* was collected from a 59-year old woman who died from cardiac failure. She was selected from thousands of candidates by the NLM to be dissected into 0.33 millimeter slices which were then photographed and scanned. The result was more than 5,000 slices that can be viewed from each orientation, producing a library of more than 10,000 images. The huge amount of data has been compressed (using JPEG) and stored on twoCD-ROMs.



You can easily export a single image (or sets of images) for processing or output to standard graphics formats including TIFF, PICT, GIF, PostScript, EPS, JPEG and BMP.

For more information on Research Systems' Visible Human CDs, contact Christina Liebman at 303-786-9900 x. 951, send an email to visible@ rsinc.com or visit our web site at www.rsinc.com.

ENVI 2.6 – ENVI is Not Just for Hyperspectral Experts Anymore

Visualization and analysis with Research Systems' ENVI®, the *Environment for Visualizing Images*, is now easier and more revealing in version 2.6, even as remote sensing data collection grows more sophisticated and the types of users more varied. ENVI's interface, advanced spectral analysis functions, data input options and interactive analysis environment each have been updated. And, you can learn to use ENVI's features more quickly because the online documentation includes new tutorials and more extensive indexing.

"ENVI has rapidly become the standard for hyperspectral image analysis on the strengths of its advanced spectral processing tools," says Denise M. Fields, Research Systems' vice president of sales and marketing. "Each new version adds more 'standard' functionality. ENVI now compares very favorably with other mainstream products designed for panchromatic, multispectral and radar data analysis. The big plus with ENVI 2.6, however, is that many of its advanced spectral processing tools can be used with traditional data types for improved analysis and all these capabilities are included in the ENVI base price."

Consistent Interfaces Speed Geolocation, Processing

ENVI 2.6 provides menu-bars for screen dialogues, facilitating quick selection of tools and making it easy to become familiar with the GUI. Each dialogue looks similar and gives users

point and click control of the available processing routines. Other interface enhancements include the ability to geolocate (in addition to georeference) imagery through the *Geo-browser*. Images can be "map-located" by the *Geo-browser* and a graphical gallery of images are available for rapid selection, display and analysis.

Faster Loading, Less Memory Demand

Faster startup time and, in many instances, decreased demand on hardware memory will result from ENVI's newly modularized code, which is loaded only as needed. Another memory saving enhancement is the ability to create "virtual mosaics." Virtual mosaics are displayed as though all of the image tiles are in one large file, but without actually creating the file. This allows the users to display and process images as a mosaic without having to first create an intermediate mosaicked image. After processing virtual mosaics, the separate images are combined for output.

Applications that require measurements within imagery to take advantage of today's precision geocoded products can use ENVI's new *Interactive Measuring Tool* for determining distances from point to point and along transects. The ability to calculate the area and lengths of the perimeters of regions of interest are also conveniently available through the graphical user interface. According to ENVI Product Manager Fred Kruse, Ph.D., "The *Interactive Measuring Tool* is a good example of the added functionality essential for new, developing technologies like precision farming."

More Than Hyperspectral Analysis

Already established as the leading hyperspectral analysis software, enhancements and additions to the spectral analysis tools increase ENVI's usefulness even more. "Many users are starting to apply ENVI's advanced spectral processing tools to data types other than hyperspectral. ENVI 2.6 continues this trend by solidifying ENVI's traditional image processing capabilities and making sure that users of all data types have access to all of the software's advanced processing techniques. ENVI is the only image processing package to provide fully integrated spectral tools such as the pixel purity index and n-Dimension Visualizer. We are now routinely applying these methods for improved analysis of Landsat TM, SPOT XS, and data from advanced SAR systems such as JPL's SIR-C," says Dr. Kruse.

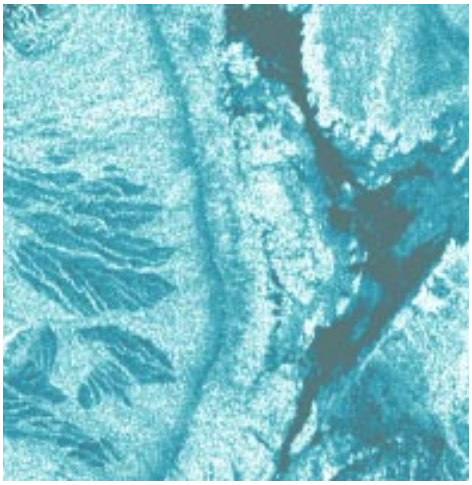
Specifically, ENVI 2.6 includes an improved Z-profile (Spectrum) paradigm that allows plotting of profiles from multiple co-registered datasets simultaneously and
plotting of an average spectrum for a box cursor N x N in size. Users will benefit by being able to compare data from a variety of sources, including "fused" data sets from different spectral regions.

Dimensionality sometimes poses a problem for determining spectral endmembers. The enhanced n-Dimensional Visualizer now can directly link the visualizer, the image display and the spectral data, simplifying this process. By collapsing selected classes into a background class, interactive reduction of data dimensionality facilitates quick, accurate identification of endmembers.

New Formats, New Mediums – No Problem!

GeoTIFF is becoming an industry standard data format. ENVI 2.6's support for GeoTIFF ensures that users can read and process data from many new data providers. And, as providers move away from tape storage, ENVI's direct disk/CD reading capabilities will prove increasingly useful.

Developed and enhanced by Better Solution Consulting, LLC., ENVI 2.6 runs on all popular operating systems: Windows 3.11, Windows 95, Windows NT, Macintosh, Power Macintosh, Unix (eight versions, including Solaris x86 and Linux). For more information, including application profiles and complete functional specifications, visit our web site at www.rsinc.com or contact Research Systems at 303-786-9900.



ENVI FreeLook – Freeware for Basic Data Viewing and Processing

Research Systems has recently made available ENVI FreeLook™ – a basic, user-friendly viewing and limited data processing software package for a wide variety of data sets. FreeLook is distributed as freeware via the Internet and may be used without fee by any individual for non-commercial use and by any United States government organization. Earthwatch, Inc. has selected FreeLook as the viewer to be included with sample data from its commercial Earlybird

satellites. Aerial Images, Inc. also has selected FreeLook as the viewer for its SPIN-2 two-meter resolution pancromatic satellite imagery of the earth's surface.

ENVI FreeLook runs on all the platforms that ENVI supports.

Basic, Useful Processing

Written in IDL, FreeLook provides an easy means to preview data and perform limited image processing. (For image processing beyond the limitations of FreeLook, one should consider using ENVI, the most complete image processing package available). Contrast enhancement, image sharpening, edge detection and image smoothing are controlled from FreeLook's GUI. The software will also read cursor position and value for both pixel-based and georeferenced imagery to extract Z-profile (spectrum) datum from multispectral and hyperspectral data and to measure distances from points along transcects. And, FreeLook lets users stretch images using Linear 0%, Linear 2%, Equalization and Square Root with histograms information in the Image or Scroll window.

Grayscale and RGB images are displayed in three windows. The "Scroll Window" shows large images at a subsampled resolution (if image size is larger than the screen size); the "Main Image Display" shows a portion of the image at full resolution; the "Zoom Window" shows a subset of the main display with a zoom factor applied. The current subsampling factor for the Scroll Window and zoom factor for the Zoom Window are displayed in the title bar a the top of their respective display windows.

Great File & Data Support

ENVI FreeLook Version 1.0 support common image formats including GIF, TIFF, JPEG, and flat binary files. The Jet Propulsion Laboratories' AIRSAR/SIR-C complex scattering data can also be synthesized to image format for viewing. Support for specific remote sensing data types including AVIRIS, GeoTIFF, Landsat (NLAPS), SPOT, Planetary Data System (PDS) and Radarsat is planned fo release during the first quarter of 1997.

To download ENVI FreeLook, visit our web sites at www.rsinc.com, or contact us at 303-786-9900.

GLOBE Program Uses IDL Graphics to Display Weather, Biological Data from Around the World

Students, teachers and researchers from more than 3000 schools in 45 countries are collecting and relaying data to research scientists as part of a project to learn more about our planet. The international undertaking, know as GLOBE *(Global Learning and Observations to Benefit the Environment)*, involves NOAA, NASA, NSF and several other U.S. agencies. Ultimately, the goals of the program are to help students reach higher levels of achievement in science and math, raise environmental awareness and increase our scientific understanding of the earth. Scientists at NOAA, NASA and several universities use IDL's graphics capabilities to display the results from the processed data.

GLOBE students in grades K-12 take daily environmental measurements at or near their schools and report their data via the Internet. Data representing atmospheric and climate conditions, hydrologic characteristics (like water temperature and pH), and geological and biological features are collected and registered by entering the information into forms which are emailed to NOAA and other data analysis centers. Each day, new IDL images generated using GLOBE student data sets are posted on the web.

"In the next year we'll be developing an international constellation of servers," says Ted Haberman, assistant director of services for GLOBE at NOAA. "In the long run, we're trying to standardize IDL as the graphics engine." Contour plots overlaid with map projections and graphs created with IDL, accessible through the GLOBE web page, are helping students understand their part in the global environment. Each school can access the data it has submitted and check data sets from other sources.

Susan Postawko is the Principal Investigator of the GLOBE research center at the University of Oklahoma, Norman. She has been working with schools on islands around the Pacific fo nearly five years. On her web page she explains, "There aren't many weather stations on these islands and the students' data accounts for nearly 25% of all data collected on Pacific Islands. We've been combining the student data with data from the other weather services (that is, we treat the data the students collect the same way we treat the data weather services send us) and use the data to look for changes in rainfall patterns." Within th continental U.S., GLOBE students are providing data that goes in deeper deta than the weather stations by measuring small scale variations not recognizable

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Real Time Imaging System Enhances Fusion Experimentation

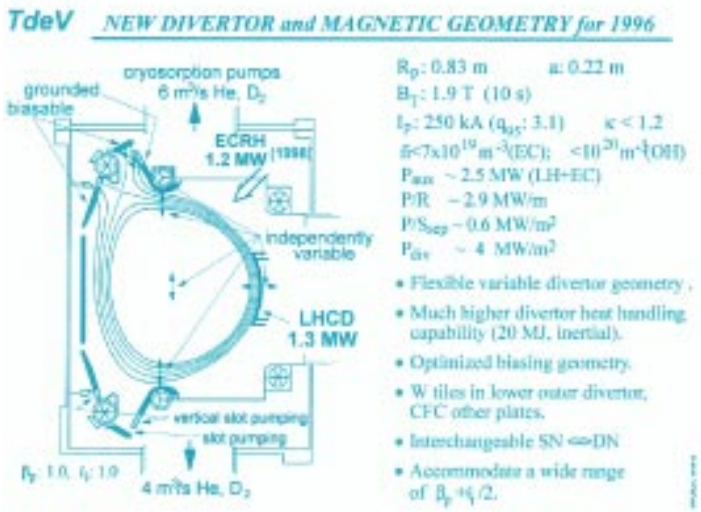
At the Centre Canadien de Fusion Magnetic (CCFM) in Varennes, Quebec, Fernando Meo, Pierre de Villers and their co-workers (G. Ratel and F. Brunet) have developed a real-time digital imaging system that is advancing our understanding of magnetically defined plasmas. Their research into thermonuclear fusion could help lead to a safer, cleaner, renewable energy source with a lower impact on the environment than either traditional power plants or fission reactors. Fusion research also drives advances in related fields, such as superconducting magnets, high-powered lasers and electronic diagnostic equipment.

The real-time imaging system was developed and used for operations and for three diagnostic experiments on the Centre's TdeV (Tokamak de Varennes) tokamak: diverter spectroscopic imaging, infrared camera imaging and plasma rotation measurements recorded by the tokamak's intensified camera. They run the application on a Pentium PC under the Windows operating system. "One important thing to remember is that this imaging system is generic and can be used for applications other than analyzing fusion," Meo reminds.

GUI Provides Control of Digital Imagery

The system's data collection process begins with two synchronized RS-170 cameras connected to a frame grabber installed in the PC. As the grabber board digitizes, it transfers images (in real time) to the PC's memory through the 32-bit EISA bus using its direct memory access capability. After the acquisition is completed, the plasma images (now in digital form) are compressed and saved to the PC's hard drive. Using the PC, scientists control the acquisition, processing and analysis of images through a graphical user interface (GUI) that was built with IDL. The interface can easily be customized by each user to include analysis parameters relevant to their experiments and includes a "virtual VCR" for frame-by-frame or animated image analysis. After processing, the images and details of the experimental conditions can be compressed and saved on disk.

Three independent software components make up this system. At the heart is the Executive User Interface main program (IMaster) which controls the data flow, manages the images in memory and sets up the GUI that enables command over the session.



The other software components are the Grabber Control Routines, which manage the grabber board, and the Input/Output Routines, which control data compression, transfer and retrieval. "Much of the data processing and image analysis software at CCFM is written in IDL," says de Villers. "Because IDL supports such file formats as HDF, JPEG and TIFF and is portable across different computer platforms, it makes it possible to acquire, display and store images on the PC, then transfer them to the VMS server for archiving. As a result of this portability, image analysis can be done on either the VMS or PC platform."

Acquiring Images More Efficiently

When opening IMaster, the user is prompted to specify whether the operation will be in acquisition or processing mode, or both. To prepare the system, the physicist customizes his imaging session by accessing his own configuration file to implement the GUI settings. These options include directing how the frame grabber is initialized, specifying the digitizer configuration file to use, identifying which camera channels are active and the imaging compression and analysis routine names. The configuration file also establishes the appropriate input fields and pulldowns (in the GUI) for input of user-defined parameters specific to the experiment. Examples of user-defined parameters are the fstop setting of the lens, the video gain and text comments. Values are entered to describe the experiment, thus distinguishing the series of images soon to be collected during the plasma pulse. According to de Villers, "The configuration file makes controlling the software elements easy. And, IDL provides a set of high-level graphical objects (windows, buttons, sliders and pull-down menus) called widgets to construct the GUI, making it possible to rapidly develop display panels during startup."

After the acquisition is complete,

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images of interest are transferred from the DMA memory to the IDL analysis environment where they can be processed and viewed with the virtual VCR. Specific images can be displayed or a series of images can be animated to provide more insight into the tokamak plasma.

Increased Power Through More Insightful Analysis

Image analysis sessions can be active during acquisition sessions, allowing the researchers at the Centre to maximize their productivity. Using routines initiated through the GUI's pull-down menus, the images are analyzed and enhanced with any image processing routine defined in the configuration file. "The system is easily upgradeable," Meo explains. "The user can simply include other image processing and compression routines to the software." Fast Fourier Transforms, filtering, and IDL image enhancement routines have helped the researchers at the Centre learn about such things as particle flow patterns and understanding the effect of impurities (primarily carbon) in the main plasma under different operating scenarios. According to Meo, "We use the imaging systems to analyze the visible radiation of the magnetically confined plasma and thus learn valuable information on the plasma shape and positioning. The cameras have interference filters that block out all light except the light coming from carbon, hydrogen or even helium, depending on the filter."

Efficient Storage of Images and Data

Once images have been analyzed, they are compressed and stored for future study. Meo's application supports LZW and JPEG compression schemes, enabling the user to specify which method to use according to the quality of the archive that is required. LZW is used primarily for scientific data because of its "lossless" format, whereas JPEG is used mainly for qualitative applications, such as storing the images themselves, since this "lossy" method is optimized for the human eye. By offering these options, Meo's system provides maximum efficiency and accuracy while reducing demand on system memory.

Benefits of Real Time Imaging

The flexible imaging system has been used in scientific diagnostics and monitoring at CCFM since mid-1995. Being able to use the frame grabber to digitize signals in real time has elimir ed all the non-linear data gaps inhere in analog video recording, which trad tionally has been used to store and pl back images. It also drastically speeds the process of digitizing images, whic previously were digitized frame-by-fra using a still-image digitizer.

The easily configured, flexible in face has enabled users to rapidly customize the system to their require ments and therefore focus on looking for better ways to understand tokama plasmas. The ability to define user-pa meters and to specify image processir routines allows the support of many types of applications. Portability of d files and the GUI lets users run the c on the platform of their choice. Final the ability to run the application on a PC keeps the overall cost of the syste low and facilitates upgrading the syst by adding RAM, installing a larger ha disk or using a faster microprocessor.

To learn more about thermonucl research projects at the Canadien Cer de Fusion Magnetic visit their web si at http://ccfm.ireq.ca/. More details c this imaging system can be found at http://ccfm.ireq.ca/~meo/conferences OFT96/sof96_ii.htm.

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by regional weather monitoring efforts.

One facet of the GLOBE program is GLOBEmail, an email system that gives students an opportunity to communicate with one another. Through GLOBEmail, students share their data and experiences with other GLOBE students around the world. This also provides a medium for scientists to stay in touch with the teachers and students in addition to the online reports that GLOBE scientists publish on the web.

Teachers are also involved, of course. GLOBE provides educational materials and learning activities to assist with implementing the program.

Recently, the program entered its sec year. With that, scientists created a n better measurement protocol that wil help improve the quality of the data a continued the program, naming it "GLOBE II."

For more information on GLOB visit their web site at globe.fsl.noaa.g

The following tip was submitted by alert reader Roberto Racca, Ph.D. We encourage you to submit tech tips that you think might be helpful to other IDL users. User-contributed tips will now be a regular feature of *Developments*. To submit a tip, email the complete program to techtip@rsinc.com.

The CW_PDMENU compound widget simplifies the creation of complex "pulldown menus" in IDL. The heart of the pulldown menu is a named structure that names each item in the menu and describes where in the menu hierarchy it appears. (See CW_PDMENU in the *IDL Reference Guide* or online help for a complete discussion of how pulldown menus are created.)

CW_PDMENU provides several ways of identifying which item in the menu has been selected -- by item name, by index number and by widget ID. While these are adequate in most cases, there are times when it is desirable to augment the standard options. For example, it may be inconvenient to use the menu item names in an event-handling procedure if they are long or are subject to change as code evolves. Similarly, it may be inconvenient to use item indices or widget IDs if the menu structure is altered during code development.

One way to augment the standard options is to add an extra field to the named structure that describes the pulldown menu. Adding to the description structure does not alter the way CW_PDMENU functions, but provides an easy way to maintain and use an array of short user-defined tags that correspond to the menu items. By passing the array of user-defined tags to the event-handling procedure as the user value of the CW_PDMENU
compound widget and retrieving the index number of the selected item from the selection event, we can use the tags to decide what action to take.

The following short example demonstrates this technique. First, we define a procedure to create a pulldown menu. (Note that when actually creating an application, the event-handling procedure would precede the procedure that creates the widget in the .pro file.)

```
PRO pdmenu

; Create a base to hold the menu.

base = WIDGET_BASE(TITLE='Pull-down menu',
  /ROW)

; Define the menu structure. Note the extra
; field "tag", which we will use in the
; event-handling procedure.

junk = {MENU_S, flags:0, name:'', tag:''}

; The menu description is an array of
; structures.

desc =[{MENU_S,0,'Close Application','EXIT'},$
  {MENU_S, 1, 'Select Eeny/Meeny/Miney', ''}, $
  {MENU_S, 0, 'Choose Eeny', 'EENY'}, $
  {MENU_S, 0, 'Pick Meeny', 'MEENY'}, $
  {MENU_S, 2, 'Select Miney', 'MINEY'}, $
  {MENU_S, 2, 'Choose Moe', 'MOE'} ]

; Create the pulldown menu. The items in the
; "tag" field are stored as an array in the
;  user value of the menu widget.

pdmenu = CW_PDMENU(base, desc,
UVALUE=desc.tag)

; Realize the widget hierarchy:

WIDGET_CONTROL, base, /REALIZE

; Register the base widget with the XMANAGER:

XMANAGER, 'pdmenu', base

END
```

We now create an event-handling procedure. Note that we use the index value of the item selected; this is returned in the "value" field of the widget event structure by default. We could have explicitly asked for the index value by specifying the RETURN_INDEX keyword to the CW_PDMENU function.

```
PRO pdmenu_event, event

; We stored the array of "tags" in the menu
; widget's user value. Retrieve it now and
; store it in the variable "userval".

WIDGET_CONTROL, event.id, GET_UVALUE=userval

; The index of the item chosen is stored in
the ; "value" field of the event structure. We
; use the index value to select the
; corresponding tag name from the array
; stored in "userval".

CASE userval(event.value) OF

'EXIT': WIDGET_CONTROL, event.top, /DESTROY
'EENY': PRINT, 'Eeny was selected'
'MEENY': PRINT, 'Meeny was selected'
'MINEY': PRINT, 'Miney was selected'
'MOE': PRINT, 'Moe was selected'

ENDCASE

END
```

Using the extra "tag" field allowed us to match against the short values stored in the tags field -- as opposed to the longer item names -- in the event-handling procedure's CASE statement.

Table 1

IDL 5.0/OpenGL Support

Platform	Vendor	Hardware	Operating System	OpenGL
VMS	Digital	Alpha	Open VMS	
	Digital	VAX	Open VMS	
Unix	Digital	Alpha	Digital Unix	
	HP	PaRisc	HP/UX	
	IBM	RS/6000	AIX	
	Intel	Intel x86	Linux	with OS
	SGI	R4000/8000	Irix	with OS
	SUN	Sparc	Solaris1 (SunOS)	
	SUN	Sparc	Solaris 2	
	SUN	Ultra 1 / 2	Solaris 2	with OS
	SUN	Intel x86	Solaris 2	
Windows	Intel	Intel x86	Windows NT	with OS
	Intel	Intel x86	Windows 95	with OS
	Intel	Intel x86	Windows 3.11	
	Digital	Alpha	Windows NT	with OS
Macintosh	Apple	Power Mac	MacOS	
	Apple	Macintosh	MacOS	

Table 2

Full-function access to ODBC databases

Connect, execute SQL get/put data, add/delete records

Unix & Windows: Oracle, Informix, Sybase, Ingres
Windows: SQL Server, FoxPro, Excel, dBase, Access
Macintosh: Oracle, SQL Server, Excel

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