Vox-L Visualizer
Interactive Volume Visualization
Vox-L Inc. A Lateiner Dataspace Company

Contents

Choose any of the topics below.

The following sections deal specifically with how to install and run the Demonstration Vox-L Visualizer.

Running the Vox-L Visualizer

Quick Tour   takes you rapidly through installation and allows you to get started using the Vox-L Visualizer Demonstration.

Demonstration Version User Manual   contains in-depth information on how to install and run the Vox-L Visualizer Demonstration.

The following general information topics are also available, which can be viewed seperately from the   Vox-L Visualizer Demonstration.   Users who are unable to install the complete demonstration will still be able to see how the Visualizer works by selecting the Quick Demonstration of Features, which contains a very limited demonstration which requires no installation to run.

About the Vox-L Visualizer

Quick Demonstration of Features

Technical Summary

Full Product Listings

Ordering Information

Press F1 for information on navigating this demonstration.

For More Information

Vox-L Inc.
Product Information Dept.
500 West Cummings Park, Suite 1700
Woburn, MA   01801-6336

Tel :   617.937.8330
Fax :   617.937.8331
Net :   info@dataspace.com
FTP: ftp.near.net in the members/dataspace directory

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About the Vox-L Visualizer

Are you getting the most out of your three-dimensional data?

Volume visualization is the science of generating images of a three dimensional model. Where slicing allows users to view a two-dimensional cross section of a model, volume visualization creates a picture of a complete three-dimensional model, allowing data to be viewed in context, providing a wealth of new information.

In the past, the visualization of three- dimensional data has been attempted through the use of polygonal rendering techniques. This forces the data to be converted into a geometric form before being viewed; usually through some form of iso-surface extraction. Ray-traced volume rendering, like those produced by the Vox-L Visualizer solves that problem by *directly rendering the data.*

Vox-L: Interactive Volume Visualization

Interactive volume visualization is viewed by scientists as an important new frontier; one will finally be able to view volume data as a true three-dimensional object, rather than relying on crude iso-surface representations, which may fail to accurately represent the underlying data, or a stack of simple two-dimensional images. Vox-L allows users to interactively rotate, cut into, take a virtual X-ray of, and create true volume renderings where interior features of a model can be viewed inside of the complete object. This allows users to more efficiently explore and comprehend complex datasets.

Because volume visualization requires significant amounts of computation, volume visualization has traditionally been performed only on dedicated graphics hardware; with each image often taking several minutes to generate. However, Vox-L's high-speed ray-tracing algorithms allow a user to generate images interactively, without dedicated hardware.

To learn more about the real Demonstration Version Vox-L Visualizer, as opposed to simply an embedded demonstration with very limited functionality, proceed to <u>Running the Vox-L Visualizer Demonstration</u>

<u>See an Embedded Demonstration of Features</u>

Demonstration of Features

The demonstration version of the program allows you to view a small MRI data set of a human head.   In order to package the demonstration within the Windows Help facility, a limited gray-scale is used.   When running independently, the Vox-L Visualizer uses the full color pallette.

The sample you will see

When using the sample, experiment: try clicking on everything.   The window titles will explain the function of each object selected.

Highlights:
        Click on the Geometry Window to simulate moving the viewing plane around the object space
        Click the Pan In button on the Map Pallette to move the viewing plane into the object space,
        Click the "Trans" object in the View Pallette to observe a virtual X-ray
        There's lots more, so experiment!

To learn more about the real Demonstration Version Vox-L Visualizer, as opposed to simply an embedded demonstration with very limited functionality, proceed to Running the Vox-L Visualizer Demonstration

Try Sample

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Full Vox-L Product and Price Listings (August 1993)

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Vox-L Workstations

Vox-L   Workstations: These turnkey, interactive volume visualization workstations provide an unmatched, integrated environment that supplies the user with a rapid and intuitive means of manipulating large amounts of volume data.   All Vox-L   Workstations run Microsoft Windows-NT, allowing you to use existing DOS / Windows applications on the same machine.   Built-in networking and TCP/IP support provides improved host connectivity.   On-line hypertext documentation and the familiar
Windows interface enables users to avoid the hassle of steep learning curves.

Vox-L Workstation 66 (NEW!)   *$ 9,900.00**

Complete, low-cost Volume Visualization Environment built on high-speed, open system technology.   Based on the Intel i486 66 mhz processor, it includes 64 megabytes of system memory,1/2 gigabyte of hard-drive storage, and a 17" monitor.

* Special introductory price of $ 9,900.00 is available for a limited time only; regular list price is $ 11,000.00

Vox-L Workstation 150   *$ 28,000.00*

Turnkey, integrated Volume Visualization Environment built on high-speed, open system technology.   based on Digital Equipment's 64-bit, 150 mhz Alpha AXP RISC processor, it includes 128 megabytes of system memory, a one-gigabyte hard-drive, and a 17" monitor.

Vox-L Stereoscopic Workstation   *$ 35,000.00*

The Stereoscopic Workstation adds to the Vox-L Workstation 150 a 21" Stereo monitor and a pair of Stereographics Crystal EyesTM   bringing high-quality 3-D stereoscopic visualization to Vox-L rendered models.

Call for Institutional pricing. Prices subject to change.

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Vox-L Software

Vox-L   Visualizer :   General purpose interactive volume visualization; potential uses range from geological to medical data.   View volume data as a true three-dimensional object, rather than relying on crude iso-surface representations, which may fail to accurately represent the underlying data, or a stack of simple two-dimensional images.   Vox-L allows users to interactively rotate, cut into, take a virtual X-ray of, and create true volume renderings where interior features of a model can be viewed inside of the complete object. This allows users to more efficiently explore and comprehend complex datasets.   Vox-L's high-speed ray-tracing algorithms can generate a gradient shaded rendering of a 128^3 model -- over two megabytes of data -- in under twenty seconds on a standard 486-based PC, completely on the fly (without any pre-computation).

A flexible file read-in routine allows importing of most common data types.   High-quality, interactive ray-traced volume rendering aids in data comprehension.   On-line hypertext documentation and the familiar Windows interface enables users to avoid the hassle of steep learning curves.

Vox-L Visualizer for Windows 3.1 and NT   *$3,500.00*

Volume Visualization for the PC.   Minimum configuration, 386 with 8 megabytes of RAM (visualization of large files may not be possible).   Recommended configurations start with a 486 and at least 16 megabytes of RAM.   Windows NT versions available for DEC Alpha, MIPS,   and Intel platforms.

Vox-L Visualizer for Unix / Motif   *$ 3,500.00*

Available for most popular Unix / Motif platforms including Silicon Graphics workstations. Runs on generic workstations and does not require dedicated 3-D graphics hardware.

Call for Institutional pricing. Prices subject to change.

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Ordering Information

Mail a purchase order indicating the product name and quantity to the following address: (Refer to the Full Product Listings   for information on pricing).

Vox-L Inc.
Technical Sales
500 West Cummings Park, Suite 1700
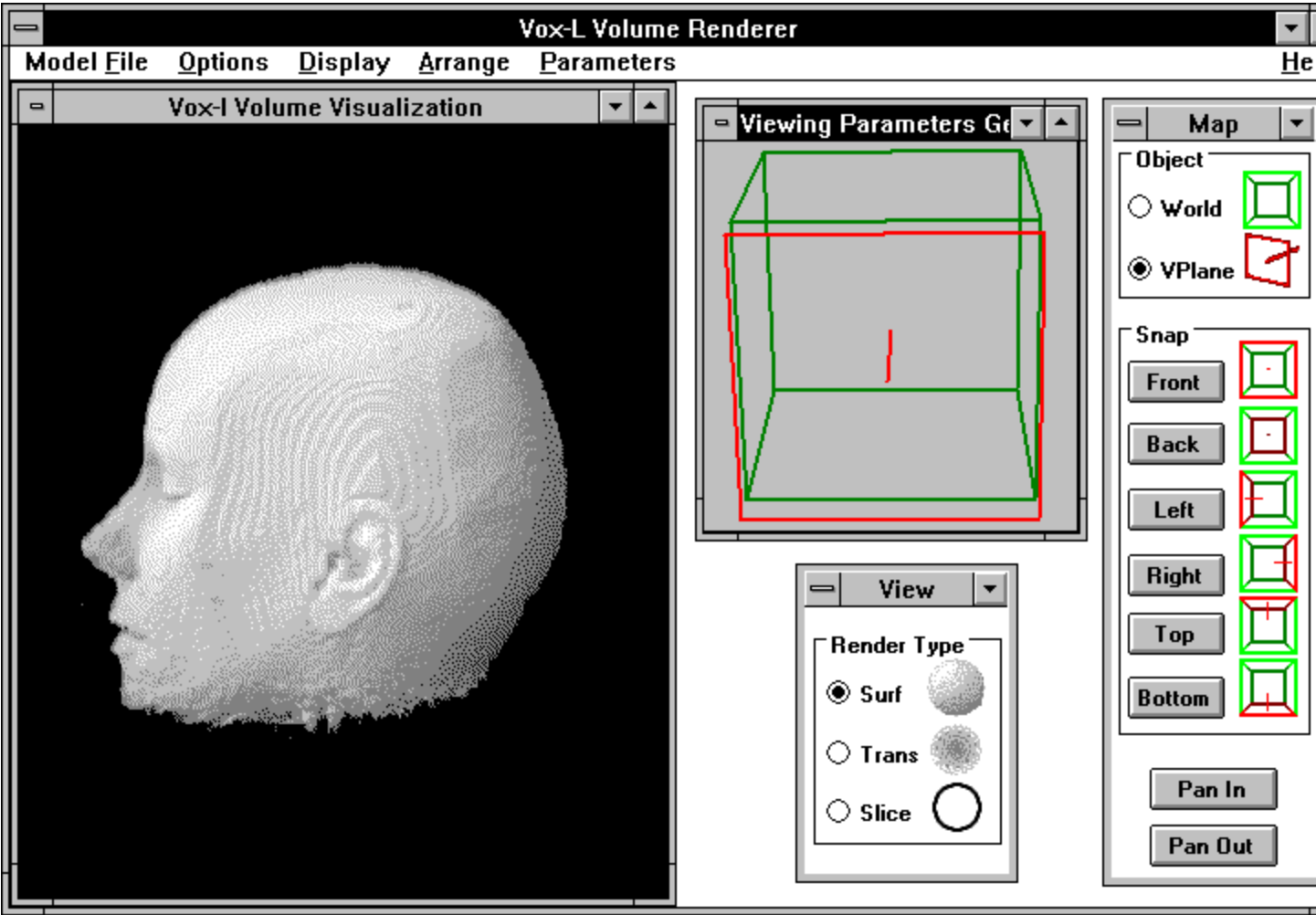Woburn, MA   01801-6336

Corporate and personal checks accepted.   Ship time is 4-6 weeks on software deliveries, and 6-8 on hardware orders.   International orders subject to approval.   Call for special institutional pricing.
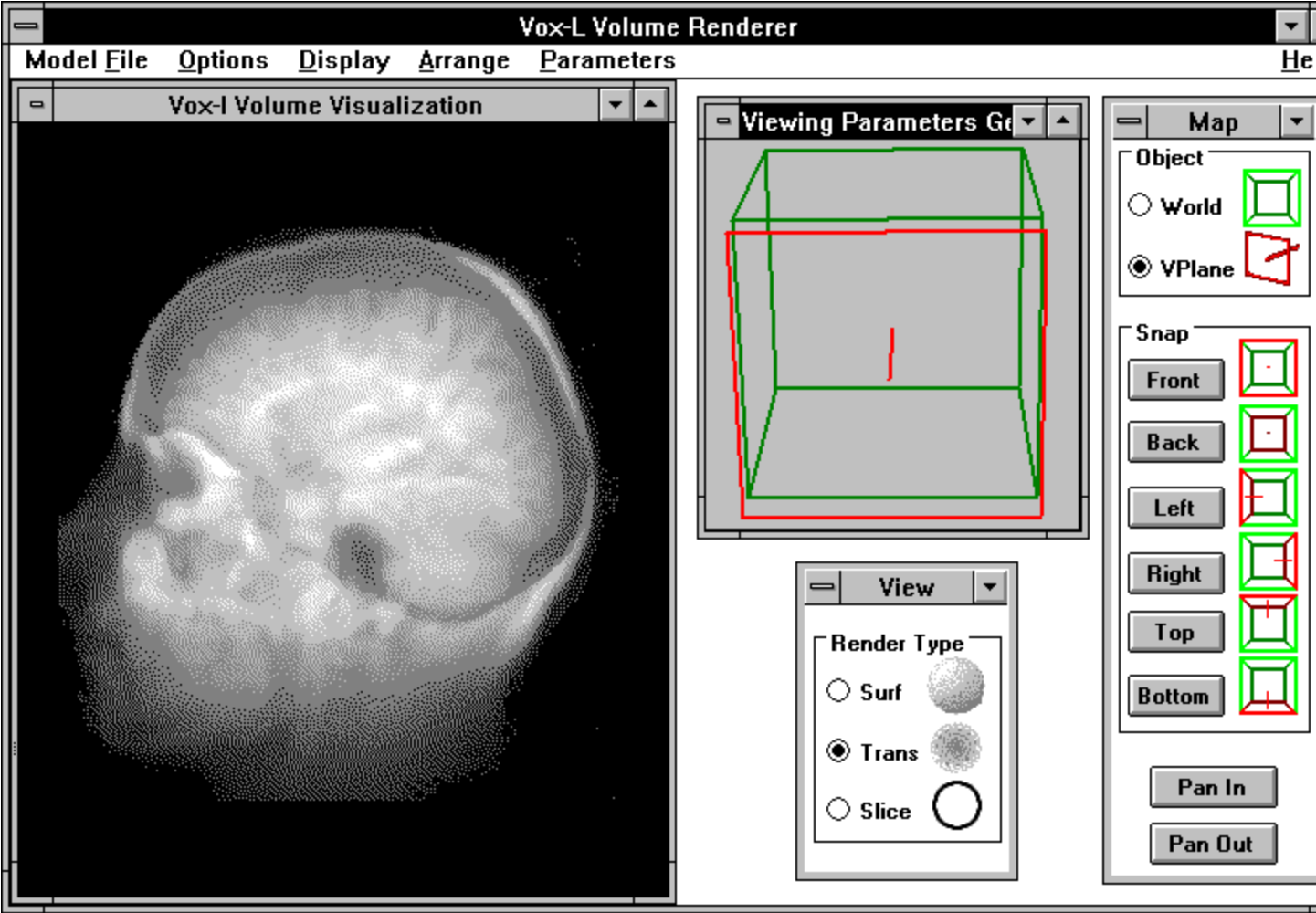
For More Information

Vox-L Inc.
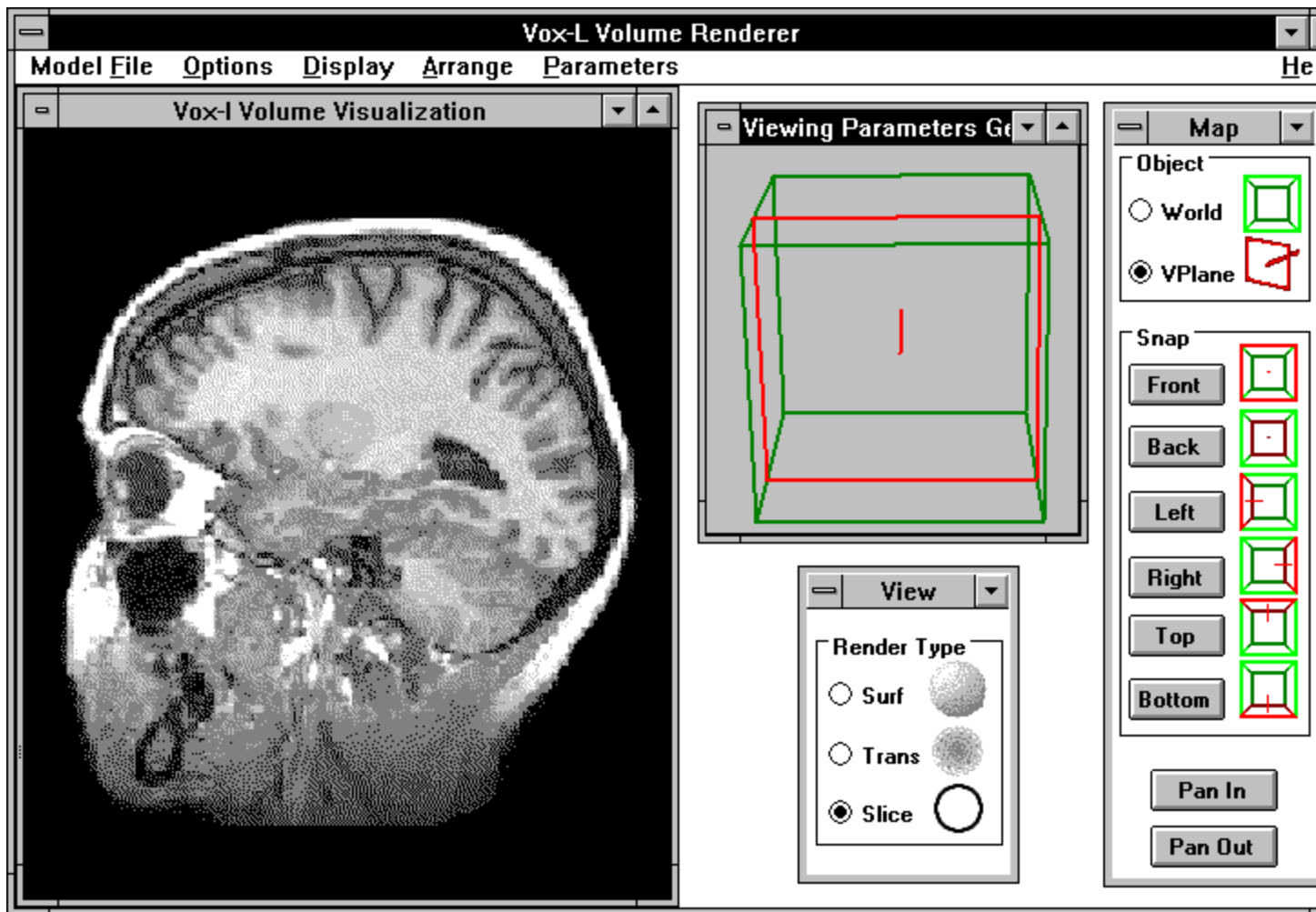500 West Cummings Park, Suite 1700
Woburn, MA   01801-6336

Tel :   617.937.8330
Fax :   617.937.8331
Net :   info@dataspace.com
FTP: ftp.near.net in the members/dataspace directory

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Vox-L Volume Renderer

Model **F**ile   **O**ptions   **D**isplay   **A**rrange   **P**arameters   He

Vox-l Volume Visualization

Viewing Parameters Ge

Map

Object
- ○ World
- ◉ VPlane

Snap
- Front
- Back
- Left
- Right
- Top
- Bottom

Pan In

Pan Out

View

Render Type
- ○ Surf
- ○ Trans
- ◉ Slice

Vox-L Volume Renderer

Model File **Options** **Display** **Arrange** **Parameters**   He

Vox-l Volume Visualization

Viewing Parameters Ge

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Snap
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Right
Top
Bottom

Pan In

Pan Out

View

Render Type
◉ Surf
○ Trans
○ Slice
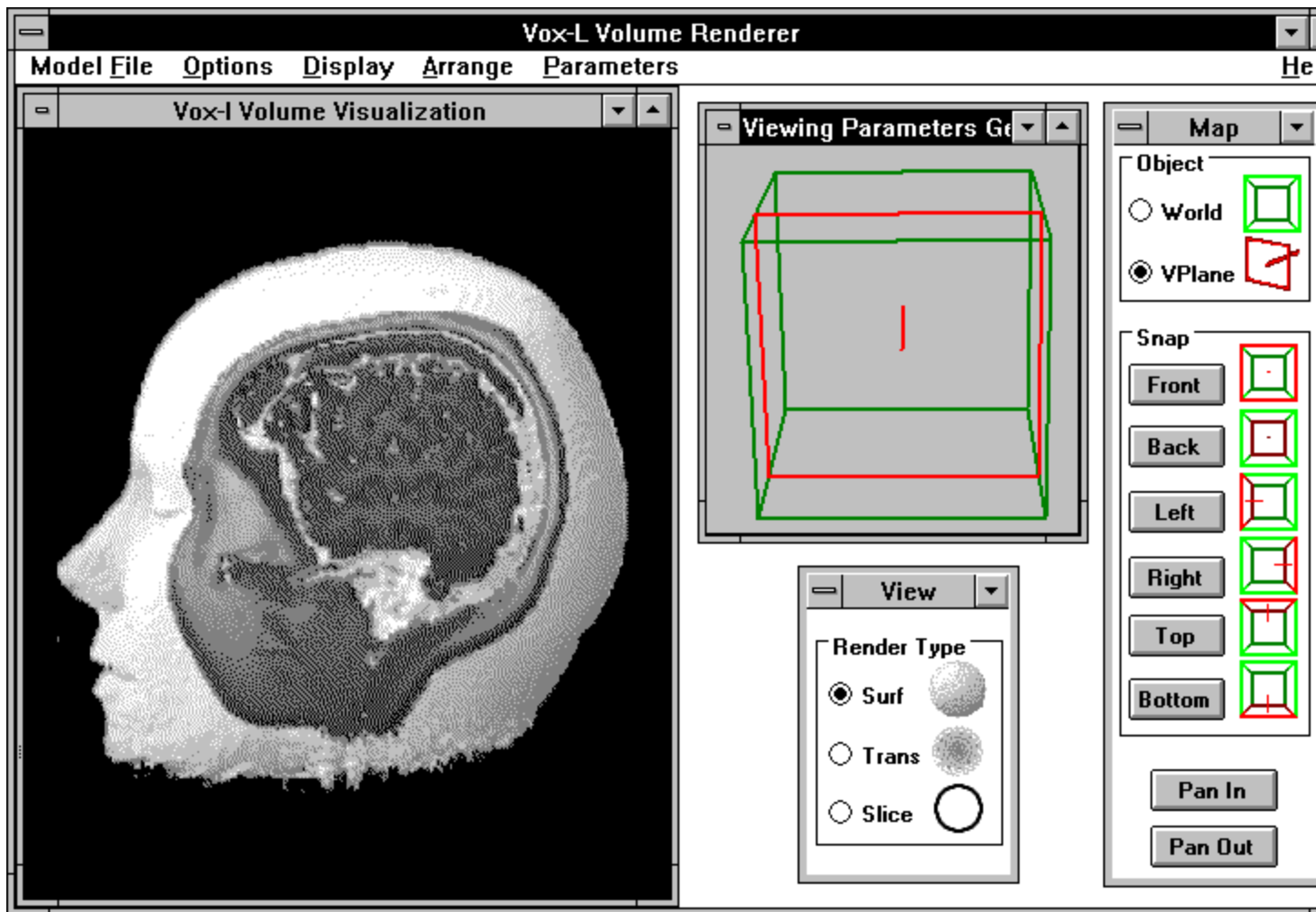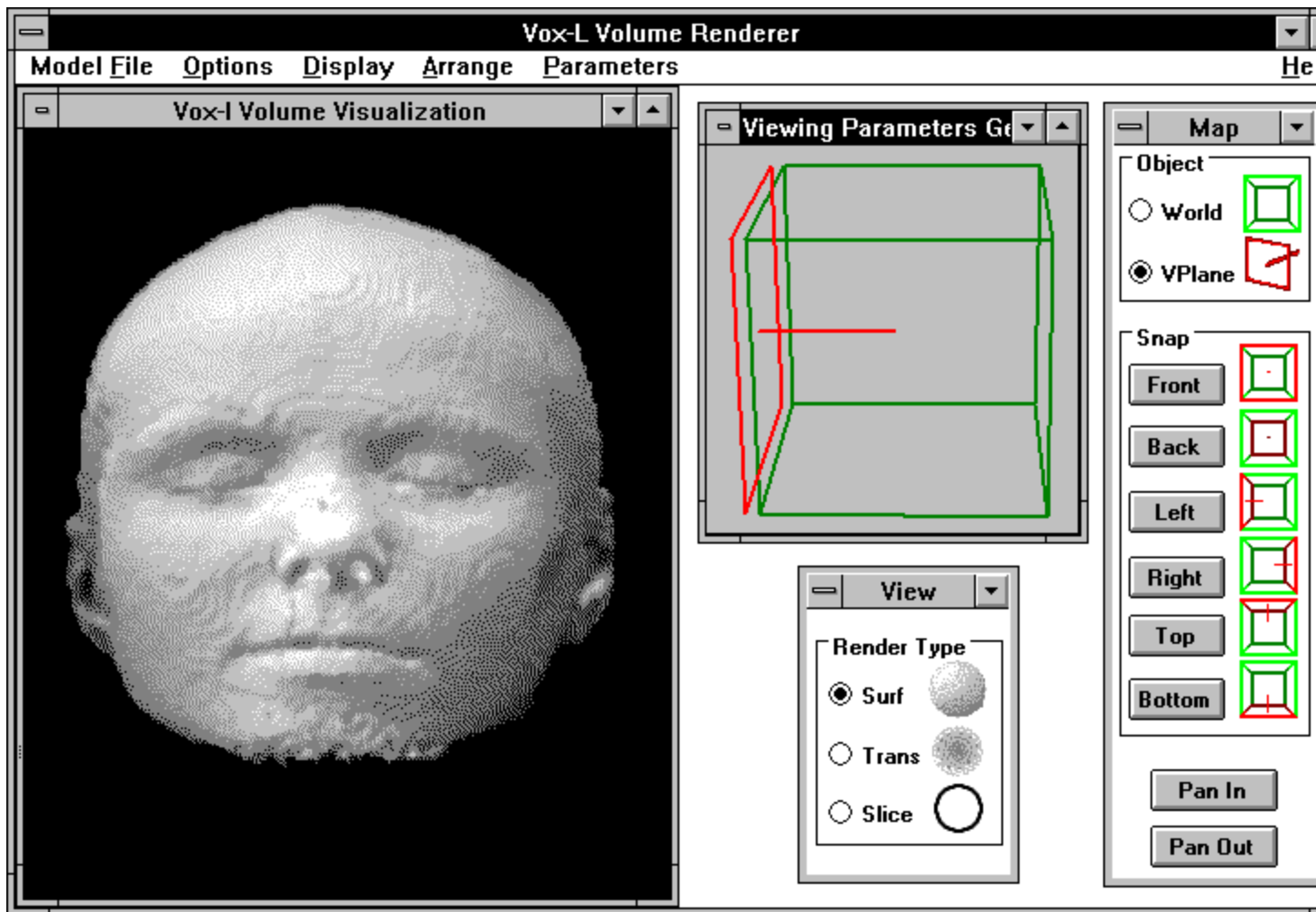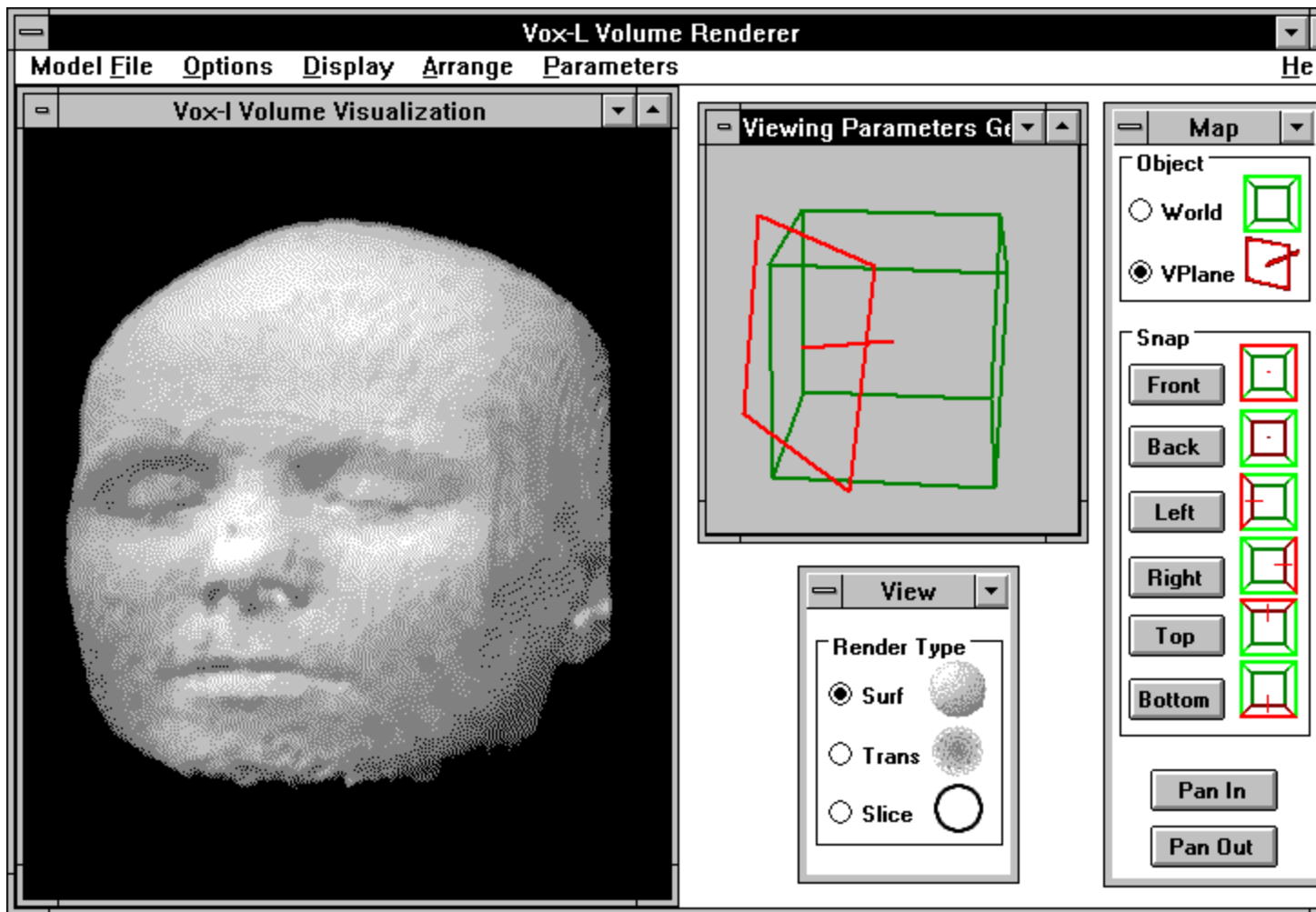
Disabled

Try clicking on Snap Front.

Volume Visualization Window

The volume rendering produced by the
Vox-L Visualizer appears here.

Viewing Parameters Geometry

The viewing angle is determined in this window using a fly-through metaphor.   Imagine that the red viewing plane is your head, with the red line (the normal of the viewing plane) pointing in the direction of your nose.   This viewing plane can then be rotated or placed anywhere within or around the model space indicated by the green cube. Click in the center of the window to toggle between views, simulating movement of the view plane -- free movement has been disabled for the demo.

View Pallette

Use this floating pallette to determine the type of rendering
 -- surface rendering, slice extraction (includes orthogonal
and oblique slices), and translucent rendering, which includes
both virtual x-ray and opacity mapped, gradient shaded options.

Map Pallette

Use this pallette to control the position of the objects shown in the Viewing Parameters Geometry window.   Try Snap Front or Pan In.

Main Vox-L Visualizer Window

This window contains the sub-windows and pallettes used to perform interactive volume visualization and exploration using the Vox-L Visualizer.

Disabled for Demo

This option not accessible here.

Pre-Release Developers' Kit

Apply to become a reseller of Vox-L technology and gain early access to tools

If you are interested in integrating powerful *Vox-L technology* into your end-user products, Vox-L Inc. is making a limited number of pre-release developers kits available to selected sites.

Interactive volume visualization, the process of generating images from volume data, provides the highest bandwidth to the brain and the most efficient comprehension of complex data when compared with other visualization techniques. The software technologies that make the Vox-L Visualizer possible will be available in time as park of a Software Developers' Kit.   Before the final release is ready, selected sites will be able to begin development using a special pre-release Developers' Kit that can give you a head start in harnessing some of the world's fastest volume visualization algorithms.

Applications for Vox-L technology are numerous, ranging from the analysis of scientific datasets such as those generated by MRI, PET and CAT scanners, confocal microscopes, sonograms and a host of other devices to the visualization of vast abstract datasets like those generated by financial markets and various mathematical formulæ.   Potential markets include health care, financial institutions, geological exploration firms, and a variety of other leading-edge industries.

Application (to print a copy, select File..Print Topic)

The Pre-Release Developers' Kit Program allows selected sites to gain early access to Vox-L development tools as they are created and before such tools are available to the public.   If approved, Vox-L will make it possible to purchase a copy of the latest version of the Vox-L Software Developers' Kit for use in the development of specialized end-user systems based on Vox-L technology.   Users will receive updated software as it becomes available, up to and including the final release.

These are not the complete or official terms of the Pre-Release Developers' Kit Program, nor is this application in any way binding.   By completing this application, you are simply expressing an interest in being evaluated as a possible early development site.

Name_____ Company / Affiliation_____

Mailing Address_____

Telephone _____ Intended Application_____

If you are interested in reselling, what markets would you serve?
_____

_____

Mail the completed application to:

Vox-L Inc.
Developers Program
500 West Cummings Park, Suite 1700
Woburn, MA   01801-6336

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Vox-L Volume Rendering Technology
A Technical Overview   -- September, 1993

Vox-L's parent company, Lateiner Dataspace (LD) was created in early 1992 to develop leading three-dimensional computing technologies.   Vox-L Inc. was created in 1993 to handle the productization and marketing of LD's advanced volume visualization technology -- developed at LD's labs as part of the long term goal of creating a distributed, objectbased Dataspace computing environment.   Vox-L Inc. has become a leader in highspeed volume rendering, developing offtheshelf software and hardware packages.   Clients served are in a variety of fields, including geological exploration and medical imaging.

What Is Volume Rendering?

Volume rendering is a means of visualizing vast amounts of data.   It is one of the techniques used in the field of scientific visualization, which is defined as the extraction of meaningful information from complex datasets through the use of interactive graphics.   Volume rendering generates images from volume datasets which consist of information defining the attributes of a model not only at the surface, but inside as well.   These datasets are made up of cubic *voxels* (three-dimensional VOlume piXELS) in much the same way a computer screen is made up of rectangular *pixels* (picture elements).   In a Dataspace model each voxel is treated like an object, where information about the characteristics of the model in each voxel region are stored along a voxel's descriptor string.

Direct applications of volume visualization can be found in the field of three-dimensional medical imaging, using data from CT (computed tomography), MRI (magnetic resonance imaging), PET (positron emission tomography), and ultrasound.   By making the three-dimensional data acquired from these sources more readily understood and analyzed, volume visualization can assist in clinical diagnosis, surgical planning and simulation, reconstructive surgery, radiation beam therapy planning, as well as medical training and research.

In fields that currently rely on surface representations of data (such as CAD -- computer aided design - and flight simulation) volumetric techniques are starting to find application. CAD models can be *voxelized* (the process of mapping a geometric object into a discrete voxel space, similar to what happens when a dot-matrix printer draws a circle made up of many tiny dots) in order to perform rapid collision and clearance detection.

It is much easier to perform collision detection on voxel models, as a simple logical operation can be used -- as opposed to the solving of many simultaneous equations necessary to perform collision detection on geometric objects.   This makes voxel-based collision detection is useful in flight simulation, where the images might be rendered in real-time from a geometric database while the collision detection is rapidly accomplished in the voxel domain.   In addition, once a geometric object has been voxelized, it is possible to place it in the context of another volume dataset: for example, a voxelized hip-joint created using a CAD workstation could be analyzed for proper fit by testing the voxelized object inside an MRI scan taken of the patient.

Volume visualization can also be used in other fields where volume data is generated, including biology (confocal microscopes), geoscience (computed mantel tomography), manufacturing (stress / fracture analysis of parts), molecular research (electron density maps), and naval applications (sonar).

Even where three-dimensional volumes are not directly acquired, volume visualization can be used as a means of visualizing vast multidimensional datasets.   Abstract data, from

financial markets or mathematical models can be mapped into the volume dataspace and visualized efficiently using the three-dimensional state-space diagram as a high-capacity extension to more traditional graphing techniques (such as bar graphs and scatter plots).
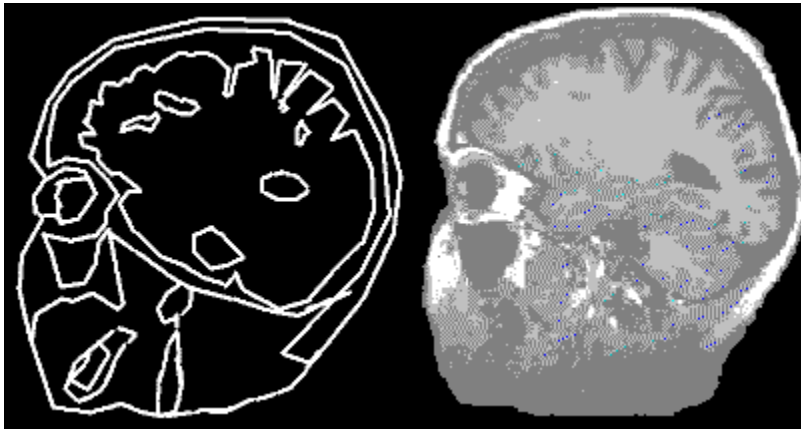
Left, a slice through an iso-surface representation of MRI data, and on the right, a slice through a complete volume representation

Volume data can be viewed by creating a direct representation of the voxel model as viewed from a given angle, or by first converting the volume dataset into a geometric one using isosurfacing techniques.   Although geometric representations may be rendered and rotated very quickly using conventional computer graphics techniques, surface rendering makes many assumptions about the underlying structure of the data, making it unsuitable where accuracy is of importance.

Although slightly more computationally expensive than other methods of volume rendering, ray-tracing produces images directly from the volume dataset by tracing rays into the model, closely emulating the manner in which real objects are viewed -- thereby producing the most realistic results.
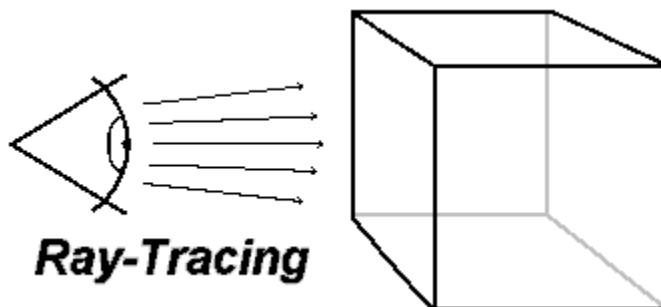

Vox-L Ray-Traced Volume Rendering

Lateiner Dataspace has developed a number of algorithms for performing high-speed, ray-traced volume visualizations without relying upon dedicated graphics hardware.   These efficient algorithms provide direct representations of volume data, and are implemented as highly scalable, portable standard C program code.   This collection of ray-tracing code - known as Vox-L   - forms the basis for VoxL's line of visualization applications and Vox-L Workstations..   Running on a standard i486 based PC, it can generate a gradient-shaded, ray-traced volume rendering of an MRI data set (with over two million voxels) in seconds;

without precomputation.

Building on Lateiner Dataspace's rendering algorithms,   Vox-L has produced one of the most efficient and easy-to-use volume visualization applications: the Vox-L Visualizer.   Available for a range of open platforms, from dekstop PC's and workstations to multi-processor servers running Unix or MS-Windows (3.1 or NT), the Visualizer provides interactive viewing of three-dimensional data, and has optional support for stereoscopic displays like StereoGraphics CrystalEyes -- enabling users to view volume data with heightened depth cues for increased comprehension.   All Vox-L products share an intuitive, "point-and-click" graphical interface allows scientists to manipulate their volume data with great ease.   VoxL has begun shipping versions of the Vox-L Visualizer to clients following a successful debut at Spring Comdex '93 in Atlanta.

Vox-L Workstations:

The Vox-L volume rendering engine is also the foundation for Vox-L's line of Vox-L Workstations provide complete, turnkey volume visualization environments.   A range of configurations are available; including a low-cost entry-level model and a complete stereoscopic visualization environment built from industry leading components including StereoGraphics CrystalEyes stereo glasses and Digital Equipment Corporation's 150mhz Alpha AXP processor.
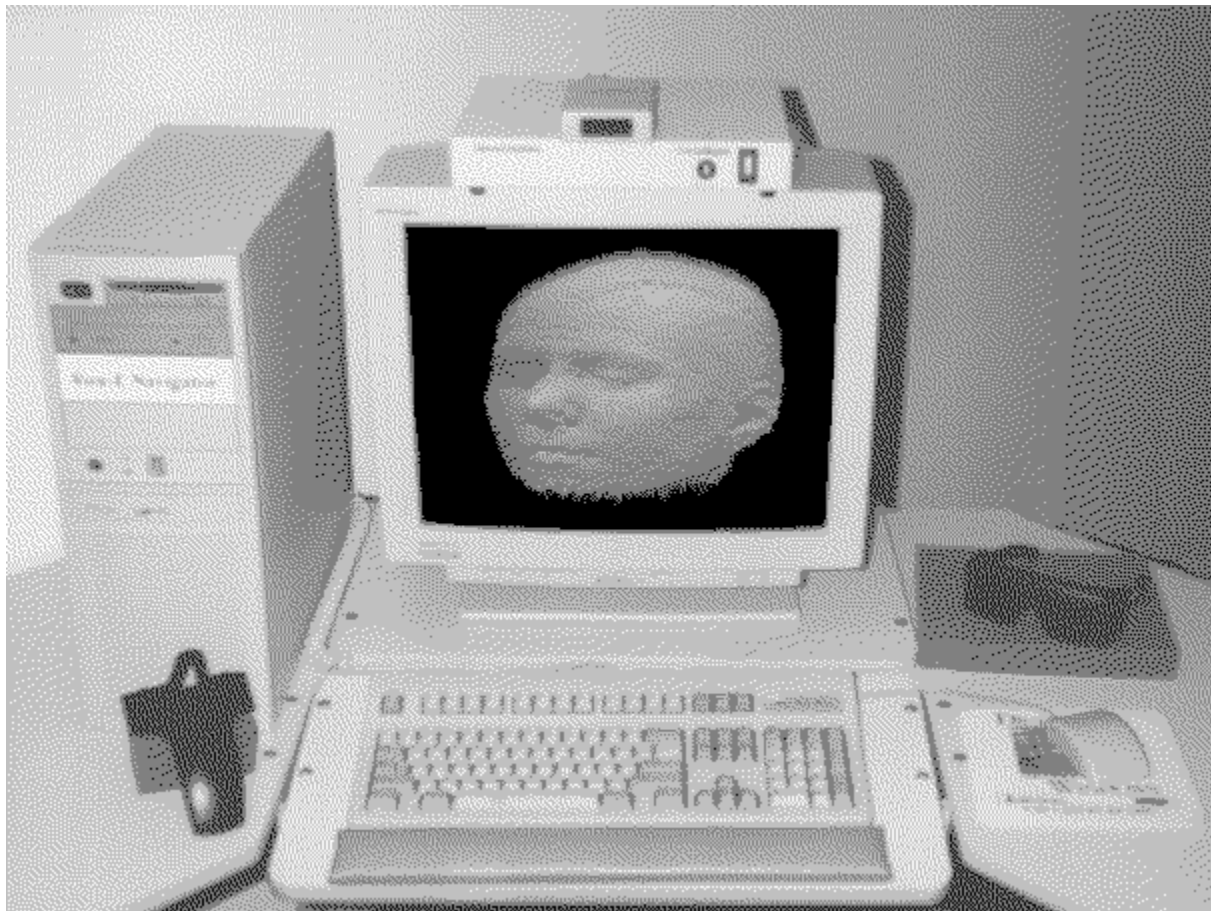
The Vox-L Stereoscopic Workstation: A complete volume visualization environment

By building Vox-L technology on open, general purpose computer systems is important, as it

allows the visualization environment to tap into the resources of existing applications.   This differs from the more traditional proprietary approaches of some visualization solutions, which rely on dedicated, proprietary hardware which does one task, and one task only. Communication between   the visualization application and other applications is often very difficult, due to differences in data formats between the proprietary visualization unit and the installed base of open computing solutions.   Building a modular, open visualization system makes it possible to export and import data from the best numerical analysis and database applications available -- without having to re-invent them.

Vox-L Workstations give users a rapid and intuitive means of manipulating large amounts of volume data.   Vox-L   Workstations run Microsoft Windows-NT, enabling the use of a wide range of existing DOS / Windows applications on the same machine, concurrently with volume rendering.   Builtin networking and TCP/IP support provides improved host connectivity.   On-line hypertext documentation and the familiar Windows interface enables users to avoid the hassle of steep learning curves.

Dataspace Volume Datastructures

Our unique Dataspace volume datastructure technologies, in which each voxel is treated as a complete object, enables users to manipulate their volume models in ways previously impossible, opening up a whole new range of applications.   Because our underlying models are that much more flexible, the volume manipulation technologies built on top of Dataspace models will be significantly more useful.

The Dataspace volume data format upon which VoxL's three-dimensional computing technologies are built allows the storage of a complete hierarchical Character Descriptor String (CDS) at each voxel location, allowing the assignment of complex characteristics right down to the individual voxel level.   Essentially, each voxel becomes an independent object, which can hold information beyond just the simple density and computed gradients, but information pertaining to the structure a given voxel belongs to, time variance between images for fast MRI or any information the user finds appropriate.

Once information is stored in Dataspace, the Vox-L renderer can augment the rendering of the model based on the information contained in the CDS.   This allows applications to be built in which individual voxels and structures within a volume model are assigned complex characteristics.   This method, whereby the information is stored as part of a spatially organized datastructure, makes it possible to perform a wider range of data manipulations more easily.

Dataspace's "voxel-centric" approach to three-dimensional data storage and handling makes Vox-L's products significantly different from other endeavors in the area, where more traditional means of storing information are used.   Traditional storage techniques involving geometric databases and cross-correlated structure lists afford some savings in the level of compute power and memory needed at a significant cost to the amount of flexibility.

Volume Rendering and Traditional Visualization Techniques

Traditionally, the visualization of three-dimensional data has been accomplished using geometric models due to limitations in available compute power.   This polygonal geometry rendering technology has been around for over a decade, and was designed specifically to provide interactive imagery of geometric constructs created on a computer, such as a wireframe CAD model.   The images it generates are based on models that consist of geometrically described surfaces oriented in space.

With the rise in use of volume imaging equipment during the subsequent years with the acceptance of techniques like MRI, vast quantities of volume data began to be generated by the scientific community.   In an attempt to visualize these volume datasets, polygonal renderers were used to draw pictures of   extracted isosurfaces; surfaces of similar density that are algorithmically derived from underlying volume models using techniques like marching or dividing cubes.   Because the resulting surface data set is orders of magnitude smaller than the volume data set, very fast image generation can be achieved using polygonal methods.

Although useful in generating beautiful images suitable for Hollywood special effects, surface representations may fail to accurately reflect the underlying data set, as there may be several different ways a surface can be created for a given volume data set.   In addition, the loss of information encountered in the transition from a model consisting of several million individual volume elements (voxels) into a model made up of several thousand surface polygons is enormous, making this type of rendering wholly unsuitable for use in the field of medicine, or any technical endeavor which relies upon the accurate, direct representation of volumetric datasets.

The Need for Volume Visualization and Dataspace:

Enormous resources are often allocated to the task of volume data acquisition; a single MRI machine can cost several million dollars.   Volume visualization is essential if the data collected is to be fully utilized.   Visualization in a full volume context provides maximum efficiency, as other techniques require more time for the same level of comprehension.

When one wishes to move beyond simply viewing a data set to co-registering it and performing complex analyses upon it, a rigorous framework for such manipulations should be used.   Today there is no coherent framework for complex manipulations, making it necessary to develop stop-gap measures suited to handle various specialized transformations; a phenomenon to be expected in a field as new as volume visualization. Dataspace models, visualized by Vox-L, will provide a proper foundation, by providing a rich framework that allows the storage of complex object descriptors for every voxel in the model.

Visualization techniques that make the most efficient use of the human perceptual system to increase the data bandwidth between the computer and the user allow users to comprehend and analyze data at a greatly enhanced rate.   The techniques that provide the highest bandwidth are ones using interaction to develop a feedback loop, thereby leveraging the interpretive strengths of the user and the computational strengths of the computer.

Interactive volume visualization using the Vox-L Visualizer or a Vox-L Workstation allows the user to make more efficient use of the human visual system by moving beyond simple two-dimensional images or surface representations.   Human beings exist in a volumetric world, and are thus best adapted to interpret volume data that can be manipulated interactively, much the way physical objects can.   While it may be possible, with a proper graphical interface, to make it almost effortless to navigate a volume space -- Vox-L remains committed to exploring more advanced forms of interaction through the integration of three-dimensional interaction and display technologies and other forms of advanced computer-human interfaces.

Strategy and Implications

Due to the highly scalable, portable nature of Vox-L technology, Lateiner Dataspace is able to work towards the implementation of a real-time volume-rendered virtual environment - Voxel-VR ; a grant for Voxel-VR has been proposed by Lateiner Dataspace and Kendall Square

Research, makers of shared-memory parallel supercomputers.   By working towards producing a Voxel-VR system which combines the elements of immersive visualization, high-speed stereoscopic volume rendering, rigorous three-dimensional data manipulation, and discrete element simulation, not only will we be expanding the frontiers of scientific visualization, but the individual components will reap great rewards in and of themselves.   It is expected that technologies developed for Voxel-VR will be incorporated into products by Vox-L.

Real-time volume-visualization will also be of enormous importance in the field of "Fast-MRI" (echo-planar NMR imaging).   Currently, computational limitations have required that the complexity of the visualization be severely limited to projections of maximal intensity from various viewing angles in order to allow visualization at the same time as the acquisition. The ability to perform more complex visualizations will be necessary as research into brain functionality begins to make expanded use of new scanning technologies, which generate several complete volumes of data per second -- allowing researchers to view the activity in the brain in response to various stimuli in real-time.

Of great import in the field of medicine is the cross correlation of multi-modal data.   The inherent ability of Dataspace models allowing the storage of a great wealth of information at the level of the individual voxel.   Combining Dataspace with Vox-L, one can interactively augment volume renderings during the process of correlation, providing a firm foundation for a new generation of cross-correlation tools.   Providing interactive volume visualization is crucial to efficiently performing tasks involving the manipulation of volume data, as Vox-L technology allows users to experiment with a multitude of possibilities and see the results immediately.

Commercial Appications:

Vox-L technologies have applications spanning a broad horizontal market that encompasses all industries that work with vast datasets, especially - but not limited to - three-dimensional data.   This is already being accomplished by low-cost implementations of VoxL's Vox-L rendering engine on PC and workstation platforms.   From the perspective of vertical market integration, the power of Vox-L based solutions to three-dimensional data utilization will be realized at all levels of image generation, from high-end solutions based on parallel computing platforms to interactive visualization on a PC platform can all be accomplished using the same scalable technology embodied in Vox-L.

VoxL's Vox-L Visualizer is the only commercially available interactive volume visualization technology available across a broad range of open computing systems, using the advanced, efficient Vox-L volume rendering algorithms.   The Vox-L technology was developed from the start in the form of modular, scalable, portable C code, without relying on customized graphics hardware or proprietary graphics libraries.   The Vox-L Visualizer and our line of Vox-L Workstations continue to generate substantial interest in the scientific and computing community since their introduction in mid 1993.

Areas of Impact:
Although the initial impact of Vox-L and Voxel-VR technologies will be on the health-care industry, by allowing greater utilization of data gathered through medical imaging technologies, any endeavor which makes use of vast datasets stands to benefit. Voxel-VR will proved an unsurpassed method for interacting and analyzing volume datasets generated in fields ranging from:

Geological Exploration (data generated by computed mantel

tomography)

Naval Exploration (Minehunting and other sonagraphic applications which may generate datasets not easily representable as simple surfaces)

Analysis of three-dimensional radar datasets

Abstract visualization of sonagraphic datasets in the frequency domain

Manufacturing Quality Control using CAT scans of damaged pieces for

Performing fracture analysis and enhanced testing and verification

Bio-medical applications which make use of confocal microscopes

Physical simulation, ranging from pre-production testing (virtual manufacturing) to virtual windtunnels and other design tools (finite element analysis in the voxel domain)

Another important area of will be in the application of voxel technology to augment polygonal models. Geometric models can be transformed into the voxel domain, where collision detection can be more easily be performed. This form of voxel-based collision detection is used by some NASA flight simulators.

Market Information:

Estimates of the size of the opportunity provided by this technology are enormous. In 1991, industry analysts predicted that the Medical Visualization market would grow from a quarter of a billion dollars in 1991 to an estimated $1.7 billion by 1996 (John Gantz in Computer Graphics World, December, 1991).

Again, in 1992, the same analyst sized the market for scientific visualization, not including medical and CAD/CAM markets, at a half of a billion dollars in 1992 with growth up to 300% of that by 1996.

Carl Machover of Machover Associates Corp., White Plains, N.Y., estimated market size at $1.5 billion with a 2022% growth rate per year. Over the next few years, VoxL aims to become a significant contender in the arena of volume visualization applications.

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Choose your selection:

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Demonstration Version User Manual

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QuickTour

QuickTour will take you rapidly through the steps necessary to get up and running with the Demonstration Vox-L Visualizer.   For more complete information, see the Demonstration Version User Manual

Installation Procedure   (Use this if you do not yet have the Vox-L Visualizer Demonstration installed)

Quick Tour of Demonstration

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Installation requirements

OS supported: MS WINDOWS NT and Windows 3.1 (via Win32s)
Unix / Motif for most platforms (Sun, Silicon Graphics, and more)
(Check the label of your demo disk to determine what platform's
executables are available.   If you received your demonstration
via floppy diskette, you probably have only one version for a
specific platform).

Processor   : Intel 386 (does not function interactively)
Intel 486, Pentium
Mips R4000, Mips R4400
Digital Equipment's Alpha AXP

Memory   : The application should be run on systems with at least
8MB of RAM.   Useful visualizations require at least 12MB
In any case, if you find that the hard drive is spinning
excessively (meaning Windows is using the drive
as virtual memory) you should select a smaller model
or, perferably, a computer with more memory, if possible

Video   : Currently only 8-bit video cards are supported, true
color (24-bit) will be soon be supported.   Lesser video
cards will show dither patterns to simulate the real
colors assigned to the volume model.

Continue with Installation Procedure

Installation Procedure

INSTALLING WIN32S:

If you are not running Microsoft's Windows NT it is necessary to install the Windows 32-bit Subsystem (Win32s) in order to run the Vox-L demonstration.   Insert the Win32s diskette, from the Program Manager select File, then Run, enter A:\SETUP.EXE as the program to start. (you may need to change the drive and path designation if the setup files are to be found elsewhere -- if your 3.5" drive is your B: drive, or you are installing from CD-ROM).   The Vox-L Visualizer can now be installed after Windows has been restarted (which installing Win32s will require you to do).

INSTALLING THE VOX-L VISUALIZER DEMONSTRATION:

Place the diskette containing the DEMO version of Vox-L in your floppy drive.   From Program Manager select File, Run and type A:\INSTALL.EXE as the program to start.   (you may need to change the drive and path designation if the setup files are to be found elsewhere -- if your 3.5" drive is your B: drive, or you are installing from CD-ROM). The installation program will prompt you for a path in which to install the program, sample dataset and documentation.

SYSTEM RESOURCES:

Because of the large system requirements (see below) we have included an interactive HELP file which demonstrates a small subset   of the features offered by the Vox-L Volume Visualizer.   In the event of minimal system resources (storage space, limited memory, etc.) one may manually install
the HELP file (approximately 800KB) by using the EXPAND command in DOS. Thus, assuming the file VOX-L.HL_ was in drive A, one would type:

EXPAND a:\VOX-L.HL_   c:\PATHNAME\VOX-L.HLP

We suggest the minimum configuration should be a 486 DX-33 with at least
8MB of RAM.   However, non-interactive visualization is possible on lesser configurations, for example on a 386SX with a math coprocessor with 6MB of RAM.

If you have any difficulties, proceed to **Product Support** .

To see a quick run through of the features, proceed to **Quick Tour of Demonstration**

To learn more about the commands available, proceed to the **Command Reference**

Product Support

We hope that your use of the Vox-L Visualizer Demonstration will be enjoyable and trouble-free.
It is our intention to provide the best possible product and documentation.   We would like to be
informed of any problems that you may be experiencing, to better improve our product and its'
usability.

You may reach our Product Support staff in several convenient ways.

   E-mail: techhelp@dataspace.com

   FAX   :   617.937.8331 -- Fax Back product support

   VOICE SUPPORT:
   For urgent problems/questions, or if you have only limited access to the above contact our main
   offices at 617.937.8330

Information to Give

When contacting Lateiner Dataspace Technical Support in any of the above methods, please be
prepared to provide as much information about the problem as possible.   Include the
command(s) you have tried to use, and what the results were and note why you feel you have a
problem.

When faxing a problem, a print out of any error messages is often helpful in determining a
solution.

Helpful information to include:

Problem Description

Be sure to include the following.   Use as many additional sheets as necessary

-> What you are trying to do

-> What do you expect to happen?

-> What did happen and why it is a problem

-> Copies of any error messages

--

Lateiner Dataspace Corp.
500 West Cummings Park Suite 1700

Woburn, MA 01801-6336
617.937.8330
617.937.8331 FAX
ftp.near.net (in the /member/dataspace directory)

Command Reference

When run, Vox-L creates an Multiple Document Interface (MDI) along with two floating dialog boxes.   These floating dialog boxes allow the user to manipulate the volume for the desired affect.   The MDI parent window creates two windows when activated via a file load/model request.   One window displays the 2D projection of the model, while the other is a cube used to
rotate and pan into/out of the "model space".

Click on any portion of the illustration below to find out more about the functionality of the Vox-L Visualizer's fully graphical user interface.   For example, clicking on the main title bar will give you an opportunity to explore the pull down menus.
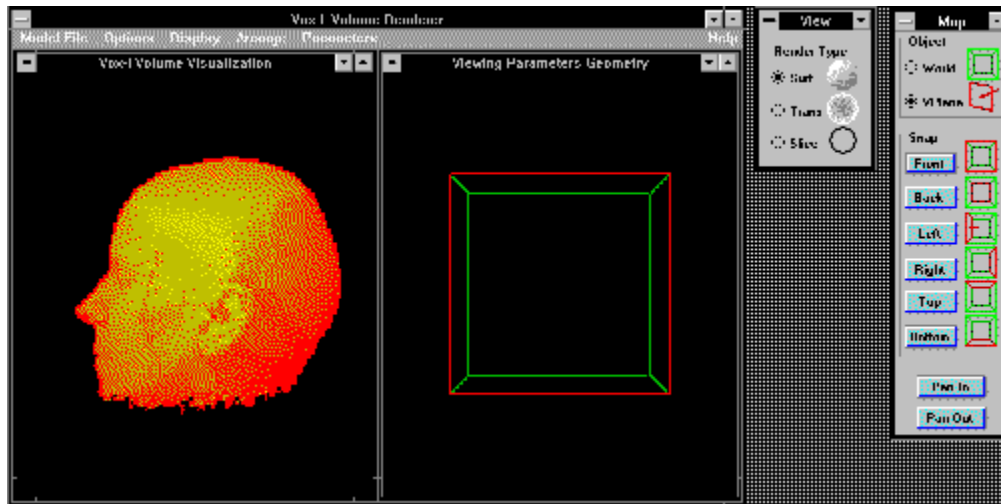
Return to User Manual Contents

Quick Tour of Demonstration

Click Here to Run the Vox-L Visualizer   (This will start the demonstration application, and then allow you to continue viewing this help file).

Once the Visualizer is running (also may be accomplished by running it from the Program Manager group Vox-L Visualizer), try the following actions -- in sequence.   You may need to use the scroll bar located to the right of this window in order to view the complete text.

You may also simply press the lowercase "d" key to begin a rotation sequence which will gradually rotate your perspective and re-render from each new angle.   The rotations may be stopped by pressing uppercase "D".

Select "Model File" from the main menu
   Select any model (the first three models require less system resources)
Move the mouse into the "Viewing Parameters" child window
   Hold down the left mouse button to rotate the green cube (model space)
   Hold down the right mouse button to rotate the red viewing plane
      (note: this will trigger a re-render, please allow some time to complete)
Select "Surf" in the "View" floating dialog box < What will I see? >
Select "Pan In" 5 to 6 times from the "Map" floating dialog box
Select "Surf" again in the "View" floating dialog box < What will I see? >
Select "Slice" from the "View" floating dialog box < What will I see? >
Select "Trans" again in the "View" floating dialog box < What will I see? >
Select "Left" from the "Map" floating dialog box < What will I see? >
Select "Front" from the "Map" floating dialog box < What will I see? >

(The following instructions can be tried with the rendering mode set to either "Surf" or "Trans".   You may wish to explore both possibilities -- for math models, "Trans" works best).

From the main menu select "Options"
   Select "Render Type"
      Select "Threshold Value"
         Move the button of the Sliding Bar to 30% < What will I see? >
         Click on the "Preview" button of the Slide Bar control
         Move the button of the Sliding Bar to 60% < What will I see? >
         Click on the "Preview" button of the Slide Bar control

Select "Model File"
   Select "Exit"

Double click on the upper left hand corner of this window to return to the main file.

The Map Dialog Box

This dialog box contains radio buttons for the VIEWING PLANE and the WORLD.   The Viewing
Plane is represented by a red plane set flush to the face of the cube upon initialization.   This
Viewing Plane is the user's perspective relative to the "model space" or World.   The Viewing
Plane may be rotated by holding down the right mouse button and releasing when in a
desired
location.   Upon release the program will re-render the volume from the given perspective,
this
may require several seconds.

The World is represented by the green cube and may be rotated with the left mouse button.
The
release of the left mouse button will not trigger a re-render since there has been no change
in
the user's perspective.   Thus the rotation of the World is mainly a visual aid for the user to
re-
orient herself within the context of a particular view of the volume.

The SNAP buttons allow the user to quickly move to a generic view of the volume.   One may
move either the Viewing Plane (represented in red) or the World (represented as the green
cube).   Again moving the Viewing Plane will cause a re-render which may take several
seconds.
The user controls which object will be "snapped" by selecting the radio button of that object
(either the Viewing Plane or World). For example, snapping the World to the front will orient
the
green box so that its front face is facing you.   If you then snap the View Plane to the left, the
red
viewing plane which determines the rendering angle will appear on the left hand side of the
green box, thus producing a rendering of the model as if one were "looking into the box from
the
left hand side."

By depressing either Pan In or Pan Out, the Viewing Plane will be moved either into or out of
the green box; effectively cutting into the model space.   This method of clipping the model,
known as "render-plane clipping," allows the Vox-L Visualizer to maintain interactive speeds
while giving the user complete control over the viewing parameters.

The View Dialog Box

This dialog box allows the user to select the type of rendering she wishes to use on the given volume.   This may be changed at any time. There are four different types of rendering available.

   Surface rendering   -- rays are traced through the world until a
                                 surface is hit
   Transparent rendering -- (only when the Slider Bar is set to 0)
                                 A virtual x-ray of the volume
   Translucent rendering -- Allows the surface to be viewed according
                                 to the most distinct data points.   This is
                                 controlled via the slider bar (from 1% --
                                 100%=Surface rendering)
   Slice rendering   -- View a slice of the 3d dataset -- will be blank unless the user has
"panned into" the model.   See information on the the Map Dialog Box
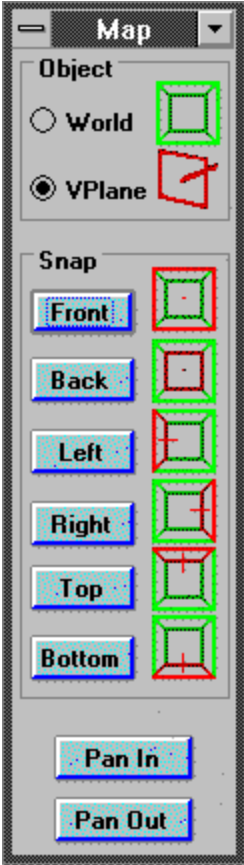
Main Menu

Click on any portion of the illustration below to find out more about the functionality of the Vox-L Visualizer's pull down menus.

Return to Main Window
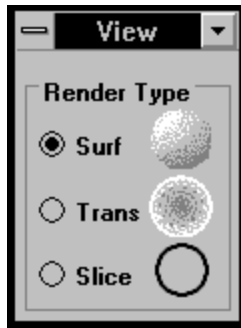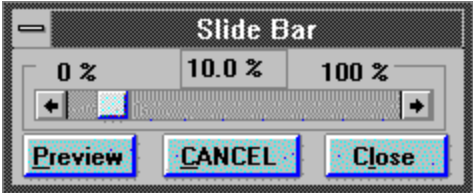
Map Box

Map

Object
- ○ World
- ◉ VPlane

Snap
- Front
- Back
- Left
- Right
- Top
- Bottom

Pan In

Pan Out

View Box

Slide Bar

Slide Bar	
0 %	10.0 %	100 %
Preview	CANCEL	Close

File Import

Volume File Import

Dimensions

X (width) `128`

Y (height) `128`

Z (depth) `128`

Order of Dimensions

[▼]

Aspect Ratio

`1` : `1` : `1`

Type of File

⦿ Binary

    Bytes per Voxel `1`

    ☒ Reverse Byte Ordering

◯ ASCII

    ASCII data type

    ◯ Long Integer

    ◯ Integer

    ◯ Float

[**OK**]

[Cancel]

[Preview Slice]

[HELP!]

File Menu

   The Mathematical Models:
      Hyperboloid -- a voxelized hyperboloid
      Cone   -- a voxelized cone
      Monkey   -- voxelized mathematical "monkey point" also known as a triple
saddle point
      Combined   -- Union of Cone and Monkey models

      Note: These mathematical models take a few moments to generate so
            please be patient!

   Volumetric data files
      Load File   -- uses Microsoft's common dialog for opening files to
                                open a volumetric data file and it's associated info
                                file (.inf)
      Note: -- The Demonstration version has the Load File option disabled
                            with the Small MRI Head menu option included for viewing.
                      -- The only volumetric data file included with this version
                          is a specially compressed, low resolution sampling of an MRI
(Magenetic Resonance
                          Imaging) data set of a human head.   It has been specially created to
distribute on small
                          media (1.44MB 3.5").

      In the complete version of the Vox-L Visualizer, when Load File is selected, the user is
presented with a   Volume File Import Dialog.

< Click Here to View File Import Dialog >

      The Volume File Import dialog shown below allows users of the complete Vox-L
Visualizer to
easily load files written in most standard data formats.   The ASCII option facilitiates the
generation of user-created macros which translates from otherwise unreadable data files
into
files the Visualizer can import.

Return to Main Menu

Options Menu

Options -
Grab ViewPlane (Rt. Mouse Button)
Grab World   (Left Mouse Button)

Reminder of which mouse buttons to use to manipulate various objects in the Map window.

Snap World/ViewPlane
-- place the World/Viewplane to orthogonal view relative to original position. For example, snapping the World to the front will orient the green box so that its front face is facing you.   If you then snap the View Plane to the left, the red viewing plane which determines the rendering angle will appear on the left hand side of the green box, thus producing a rendering of the model as if one were
"looking into the box from the left hand side."

Front
Back
Left
Right
Top
Bottom

Rendering Type -
Transparent   -- Translucent mode/X-ray mode (when Slider=0)
Surface   -- Surface rendering
Slice   -- Slice rendering

Threshold Value -- manipulate the slider bar.

< Click Here to View Slider Bar >

The slider bar controls the the translucency of the model (when in Transparent rendering mode) or the values of the voxels shown, thus a thresholding bar (only in surface rendering mode).   To access the slider bar, use <Alt> O, R, T to select the Options Menu, Rendering Type, and Threshold selections, which brings up a slider bar.   Press Preview to show the result of your change, and   CANCEL to close the dialog box and undo changes. Close hides the dialog box and makes your change current.

Return to Main Menu

Display Menu

Display -
    Render   -- trigger a re-render (redraw)

    Show/Hide View Control -- show/hide floating dialog boxes
    Show/Hide Map Control   -- show/hide floating dialog boxes

Arrange Menu

Arrange -
  Cascade -- basic MS Windows functionality - cascades windows
  Tile -- Tiles windows, the default mode
  Icons -- arranges icons at the bottom of the main window

Parameters Menu

Parameters -

Stereo   on/OFF   -- Stereoscopic visualization on/off (will see two images without a stereo

monitor, default OFF)

Interp   on/OFF   -- For interpolating images -- higher quality -- longer rendering times (default

is OFF)

Grad Shad ON/off -- Gradient shading (default is ON)

Note: Stereo and Interpolation have been disabled for the demonstration.

Help Menu

Help -
   Contents   -- Vox-L Help File
   About...   -- Displays version information

Run the Vox-L Visualizer

The Vox-L Visualizer should now be running.   This will fail if:
        1) You are running this help file from the installation media instead of from the installed Program Manager Icons (which run the help file in the same directory as the executable).
        2) The Vox-L Executable is corrupt, missing, or of the wrong format.

Click Here to Return to the Quick Tour

Surface Rendering

You will see a ray traced image in which the rays stop at the first surface they encounter (100 % opacity).   What is considered a surface is controlled by the Slider Bar (see the Demonstration User Manual for information on controlling the rendering threshold).

Render Plane Clipping

You will see a surface rendering, similar to the one you saw before pressing Pan In, but with part of the model removed via the clipping technique known as Render Plane Clipping.   Only the model "in front" of the viewing plane is considered (with the normal -- the line in the middle of the red viewing plane -- determining what direction the plane is facing).

Slice Rendering

You will now see the portion of the model which lies directly against the viewing plane.   This allows the Visualizer to act as a volume slicing tool as well as a ray-tracer.   Slicing is significantly faster, but obviously presents less information to the viewer.

Translucent Clipping

This is simply a translucent rendering of the model which disregards parts of the model which lie "behind" the viewing plane. Only the the model "in front" of the viewing plane is considered (with the normal -- the line in the middle of the red viewing plane -- determining what direction the plane is facing).

View From the Left

This option snaps the Viewing Plane to a position orthogonal to the left hand side of the green Model Box; this creates a rendering as if one were "looking in" to the model space from the left hand side.

View From the Front

This option snaps the Viewing Plane to a position orthogonal to the front   of the green Model Box; this creates a rendering as if one were "looking in" to the model space from the front.

Threshold 30%

If "**Surf**" is selected:

> You will see a surface rendering of the model where all portions of the model with a density below 30% of the highest density are ignored.

If "**Trans**" is selected:

> You will see a translucent rendering of the model where the opacity of the gradient boundaries encountered by the ray as it traverses the model space (a high gradient might be a boundary between bone and fat, or bone and air in a medical model) is 30% of full opacity.

Threshold 60%

If "**Surf**" is selected:

> You will see a surface rendering of the model where all portions of the model with a density below 60% of the highest density are ignored.

If "**Trans**" is selected:

> You will see a translucent rendering of the model where the opacity of the gradient boundaries encountered by the ray as it traverses the model space (a high gradient might be a boundary between bone and fat, or bone and air in a medical model) is 60% of full opacity.