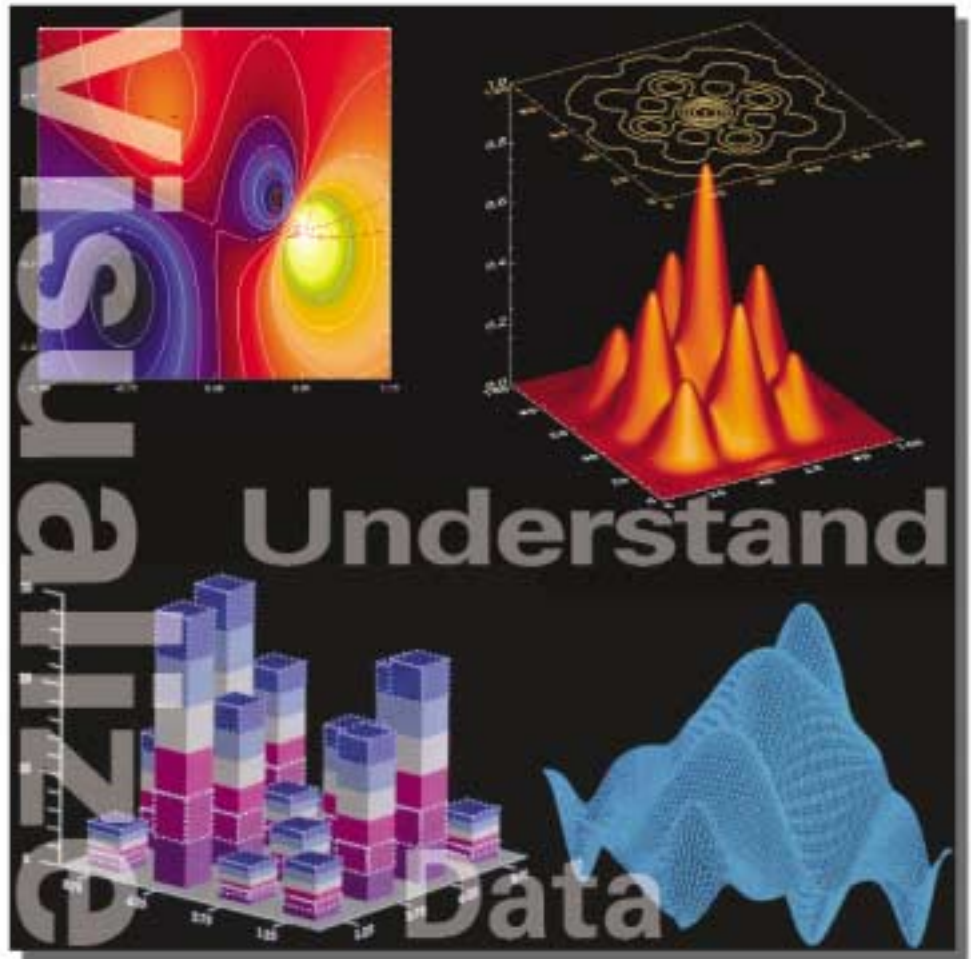




PV-WAVE<sup>®</sup> 7.5

P R O D U C T   B R O C H U R E





PV-WAVE<sup>®</sup> 7.5

HELPING

"We collect and analyze enormous amounts of data, and **PV-WAVE** gives us the ability to understand and compare this data in ways that other companies may not even consider. In my opinion, PV-WAVE is the **most powerful data analysis software** available today."

**Frank Hall** *Reed Tool Company*

CUSTOMERS

"With **PV-WAVE**, we spend less time reducing our data and more time interpreting results. We can do in **minutes** what used to take days."

**Rich Higgins** *American Association of Railroads*

**SOLVE**

"What I like best about **PV-WAVE** is the fact that I can **get results right away** without having to learn a lot of programming. I can build my own custom applications. What we're doing would not be possible without PV-WAVE."

**Becky Wiggins** *Weyerhaeuser*

COMPLEX

PROBLEMS

# PV-WAVE

## pv-wave

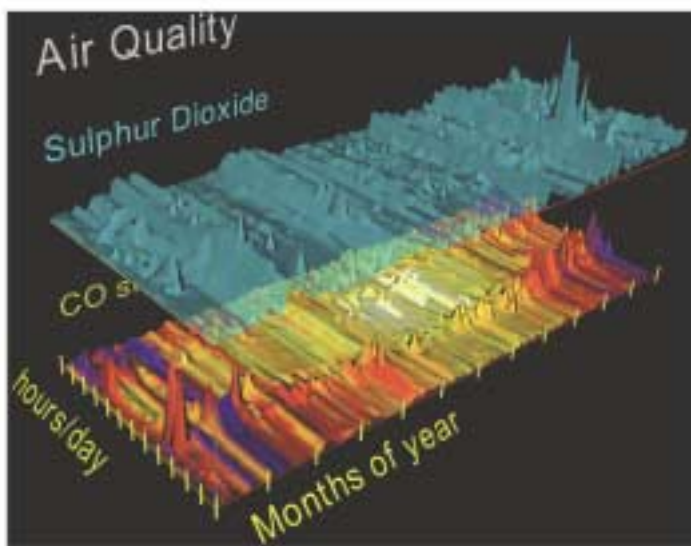
### PV-WAVE 7.5

PV-WAVE® is an array oriented fourth-generation programming language used by engineers, scientists, researchers, business analysts and software developers to build and deploy Visual Data Analysis applications. These applications let users manipulate and visualize complex or extremely large technical datasets to detect and display patterns, trends, anomalies and other vital information.

PV-WAVE allows you to obtain data from a multitude of sources. It offers many options to visualize your data. And since PV-WAVE includes a sophisticated set of analysis routines based on the IMSL Libraries, it provides more than 30 years of confidence and reliability unmatched by other packages.

Additional PV-WAVE features include image and signal processing, data import and export, 3D surface, plot, histogram, contour, animation, color editor and a database table display. Rapid data analysis and visualization combined with flexibility and power make PV-WAVE the choice among experts.

By increasing productivity, accelerating development and illustrating key knowledge contained in your data, PV-WAVE gives your business a competitive advantage. Discover how PV-WAVE is helping customers solve complex problems.



## PV-WAVE ADVANTAGE FEATURES

### → ARRAY-BASED LANGUAGE

- Loosely-typed and extensible 4GL with an interactive command line interface to an event driven interpreter
- Commands can be interactively interpreted or compiled into programs
- Sessions can be saved and restored
- Support for functions, subroutines, global and local variables
- Complete set of data types for constants and variables (byte, integer, long integer, floating point, complex, double precision, double precision complex, string, date/time) in a variety of structures (scalar, array, table, structure, list, associative array)
- Arrays of up to 8 dimensions
- Operators work on both scalars and arrays
- Looping and branching constructs
- Arrays can be subscripted conventionally or subscripted with other arrays
- Execute commands contained in strings
- Graphical User Interface for debugging
- Powerful and convenient array creation/manipulation functions
- Complete set of utilities for processing string and date/time variables
- Trap and handle errors
- SQL-like query functions for tables
- Context-sensitive on-line help
- Full on-line documentation set

### → NUMERICS

# IMSL®

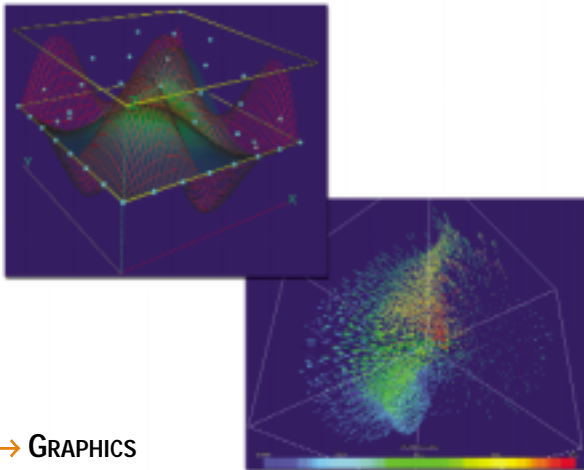
- Integrated IMSL C Numerical Library
- Operators (array-enabled): numeric, relational, Boolean
- Common Functions (array-enabled): abs, min, max, trigonometric, hyperbolic, etc.
- Special Functions (array-enabled): Bessel, error, gamma, etc.
- Tensor Functions: generalized tensor products, traces, transpositions
- Filters: multidimensional, convolution, parametric, polynomial, relational, Boolean
- Linear Systems: inversion, determinants, decomposition, roots, least-squares, full and sparse matrix support, generalized eigensystems
- Nonlinear Equations: systems, roots of polynomials and functions
- Transforms: Laplace, multidimensional FFT
- Quadrature: multivariate differentiation and integration
- Differential Equations: systems, ODEs, PDEs
- Optimization: multivariate, linear and nonlinear, constrained and unconstrained
- Interpolation and Approximation: multidimensional gridding, n-linear interpolation, multivariate polynomials, multivariate splines



# Visualize



- Regression: multivariate, linear, polynomial, nonlinear
- Basic Statistics: simple summary statistics, histograms, nonparametric statistics, goodness-of-fit tests, tabulation, sorting, ranking
- Correlation and Covariance
- Analysis of Variance
- Categorical and Discrete Data Analysis
- Time Series and Forecasting: autocorrelation, autoregression, lack-of-fit, GARCH
- Multivariate Cluster and Factor Analysis
- Survival Analysis
- Probability Distribution Functions and Random Number Generation



### → GRAPHICS

- OpenGL via the Visualization Toolkit (VTK)
- Plotting: 2D and 3D line, 2D and 3D scatter, 2D and 3D vector, 2D and 3D bar, 2D and 3D contours, meshed and shaded surfaces
- Basic Image Processing: equalize, scale, shrink, expand, warp, zoom, pan, copy, rotate, threshold, profile, smooth, convolve, erode and dilate images; filters (predefined and user-defined); define and analyze irregular regions of interest; algebraic operations; 3D projection
- Animation
- Polygonal Rendering: 3D mesh generation, iso-surfaces, light source control
- Volume Rendering: isosurfaces, opacity, diffusivity, shading, slicing, light source control
- Mapping: comprehensive geopolitical world database; wide variety of projections; overlay lines, images, contours and vectors; support for user-supplied databases and projections
- Annotation: flexible axis, line and symbol styles; scalable/rotatable software/hardware fonts
- Comprehensive Colortable Control
- 3D View Control
- VRML Support

### → DATA IMPORT/EXPORT

- Formatted and unformatted read/write; XDR read/write; HDF read/write; powerful ASCII read/write; 8- and 24-bit image import/export (support for wide variety of image formats)

### → OPEN ARCHITECTURE

- Spawn sub-tasks, transfer data via bi-directional pipes
- Call PV-WAVE from a C or FORTRAN program
- Call C or FORTRAN code from PV-WAVE
- Communicate between PV-WAVE and another application via Remote Procedure Calls
- Create an optional PV-WAVE module using the Options Programming Interface

### → GRAPHICAL USER INTERFACE DEVELOPMENT

- Comprehensive set of high-level and low-level widgets
- Resource file support and string services

### → VISUAL DATA ANALYSIS TOOLS

- "Super-widgets" allow non-programmers to do animation, image analysis, line plots, scatter plots, surface plots, contour plots, histogram plots, color table manipulation, variable manipulation and data import/export

## PV-WAVE EXTREME ADVANTAGE

### → ADVANCED SIGNAL PROCESSING TOOLKIT

- Filter Analysis: complex frequency response, analog and digital transfer functions
- Classical Filter Design: bilinear transform; windowed FIR and IIR
- Advanced Filter Design: least squares and optimal FIR and IIR
- Multirate Filter Functions: decimation, interpolation, quadrature
- Filter Realization: FIR/IIR causal and anticausal, multi-rate
- Statistical Signal Processing: filter design, Toeplitz matrix factorization, autocorrelation
- Transforms and Spectral Analysis: spectrogram, power spectrum analysis, wavelet transforms
- Polynomial Manipulation: spectral factorization, stabilization, algebraic operations
- Specialized Plotting Routines: zero-pole plot of filter; comb plot of digital signal



→ **ADVANCED IMAGE PROCESSING TOOLKIT**

- Graphical User Interface (GUI)
- Image file formats: import/export, most common formats
- Support for multi-layered images, volumes, signals, animation and regions of interest
- Point Operations: algebraic, Boolean, trigonometric, logarithmic, thresholding, slicing
- General Filtering: edge, noise removal/generation, linear (convolutions, user-defined)
- Advanced Filtering: spatial (nonlinear, adaptive), frequency (butterworth, ideal, etc.)
- Morphological Image Processing: erode/dilate, open/close, outline, skeletonize
- Mensuration: shape (moments, major axis, perimeter), statistical, distance mapping
- Representation and Description: histograms, spatial/spectral textural analysis
- Image Transforms: FFT, DCT, PCT, Hough, Slant, Radon, Wavelet
- Geometric Transforms: scale, rotate, translate, interactive warp
- Color: linear and nonlinear conversions between grayscale and 8-bit/24-bit color
- Classification and Segmentation

**OPTIONAL PRODUCTS**

→ **ADVANCED GRIDDING TOOLKIT**

- Minimum curvature solutions even for data with creases, tears and faults
- User control over sensitivity to discontinuities, gridding accuracy, level of smoothing
- Choose between bilinear interpolation or advanced adaptive and convergent techniques
- Algorithms: scatter, cluster, weighted, direct

→ **DATABASE CONNECTION TOOLKIT**

- Direct link between Oracle, Sybase or ODBC database
- Use standard SQL syntax to interactively open, query, subset, sort and filter null values
- Support for multi-row fetches with adjustable row counts for Oracle and Sybase connections
- User control over commits and rollbacks for ODBC connection

**PLATFORM & SYSTEM REQUIREMENTS**

PLATFORM	OPERATING SYSTEM
Digital Alpha	Digital UNIX 5.0
Digital Alpha	Digital OpenVMS 7.1
HP 9000/s700	HPUX 11.0
IBM RS/6000	AIX 4.3.3
Intel x86	Microsoft Windows NT 4.0 SP 6
Intel x86	Microsoft Windows 98
Intel x86	Microsoft Windows 2000
Linux	Red Hat 7.0
Silicon Graphics	IRIX 6.5.3
SPARC	Solaris 2.7 & 2.8

**A TEAM OF PROFESSIONALS**

Behind every PV-WAVE license is a team of professionals recognized to be among the best in the industry, ready to help you build your applications. Our consulting team provides a wide variety of services including building your application or helping with part of the project. Often new PV-WAVE customers will use Visual Numerics consultants to work with their development team to build the first application or prototype. Using the Visual Numerics consulting team accelerates the initial development effort and provides excellent training to the internal development team. Our technical support teams provide expert answers to your questions. In addition to phone, fax and email, our support options include product maintenance, consultation, online tips, white papers and list server forums. Our team of support specialists are always ready to give you the answers that you need.

## PV-WAVE 7.5 ENHANCEMENTS

### → Accelerated 3D graphics using OpenGL

- Produce 3D interactive graphics without having to understand the intricacies of OpenGL through the use of the Visualization Toolkit (VTK). A single command produces surfaces, scatter plots or line plots. High level functions are provided for ease of use and lower level functions to create more complex visualizations.
- This new functionality provides users all of the benefits of the VTK toolkit including:
  - A wide variety of visualization algorithms like scalar, vector, tensor, texture and volumetric methods.
  - Advanced modeling techniques like isosurfaces, streamlines, implicit modeling, cutting planes, swept surfaces, hedgehogs, glyphs, texture mapping, clipping transparency, and Delaunay triangulation.
  - Many imaging algorithms allowing mixing of 2D imaging, 3D graphics algorithms and data.

### → New features for data manipulation and rapid prototyping

- Over 30 new standard library features for manipulating data and making rapid prototyping and developing even easier.
- Expanded the Navigator to include pie charts and bar charts.
- New mathematics and statistics functions to help solve time series problems, financial problems and perform Monte Carlo simulations.

### → Integration of the recently released IMSL C Numerical Library Version 5.0\*

- Build PV-WAVE applications with accurate and reliable analysis.
- A new time series routine useful in navigation, surveying, vehicle tracking (aircraft, spacecraft, missiles), geology, oceanography, fluid dynamics, steel/paper/power industries, and demographic estimation.
- 50 new functions in the area of finance and bonds. The new functions will help perform financial modeling to analyze various risk factors associated with business. Included are routines for calculating depreciation of assets, internal rates of return, bond amortization, and net present values.
- New routines to compute low discrepancy series of random points, which are valuable in Monte Carlo simulations.
- A new algorithm for efficient multi-dimensional quadrature offers a much more efficient and robust approach than previously available in CNL.

\* IMSL is also available in C and Fortran as standalone libraries.

### → Additional new features

- Updated support for Oracle and Sybase
- Null data support for Oracle
- DICOM reader/writer
- GUI debugger

Discover how **PV-WAVE 7.5 can help you solve your complex problems!**  
Contact your representative today for information on the power of PV-WAVE.

**Visual Numerics®**  
[ [www.vni.com](http://www.vni.com) ]

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