# IDL 6.4 Functional Summary

## Supported Operating Systems

Windows XP, Vista (32-bit & 64-bit)
Windows 2000 SP4 (32-bit)
Mac OS X 10.4 (32-bit) Power PC & Intel
Linux kernal 2.4 & 2.6, glibc 2.3 (32-bit & 64-bit)
Sun SPARC Solaris 9, 10 (32-bit & 64-bit)
IBM AIX 5.1 (32-bit & 64-bit)
SGI IRIX 6.5.1 (32-bit & 64-bit)

## Data Formats

Data structures
- Scalar
- Vector
- Array
- Aggregate structures

Data types
- Byte
- 16, 32, 64-bit signed/unsigned integer
- String
- Single & double-precision float
- Single & double-precision complex

Pointers - circular, self-referential data structures
IEEE support
- Infinity
- Missing data (IEEE NaN)

Save/Restore facility (binary format)
Direct access unformatted binary I/O
Formatted I/O (default or user-specified)
Scientific data formats
- CDF 3.1
- HDF 4.1r5
- HDF5 5-1.6.3
- HDF-EOS 2.8
- netCDF 3.5

BMP (Microsoft Windows Bitmap)
DICOM version 3 part 10 support
DXF (AutoCAD)
ESRI ArcView Shapefiles
GeoTIFF
JPEG
JPEG 2000
Motion JPEG 2000
MPEG
MrSID
GIF
PICT
PNG
SRF
SYLK
TIFF, ITIFF
XML
VRML
WAV Audio files
WMF
XDR
XWD
Zip file compression/decompression

## Remote Access

Socket support (client-side TCP/IP)
HTTP and FTP server access
OGC WMS and OGC WCS server access

## Multi-threaded Computations

Binary & unary operations
Mathematical routines
Image processing routines
Array creation routines
Array manipulation routines
Out-of-process server (IDL_IDL Bridge)

## 2-D Plotting & Graphics

Intelligent Tools (iTools) for interactive image analysis contouring & plotting
OpenGL accelerated image rendering
2-D transformations
Opacity and layering control
Animation
Image tiling
RGB, HLS, HSV, indexed color display
Zoom & pan
Image annotation
Interactive contrast enhancement
Double precision plotting with date/time support
Contour plots, automatic boundary close, unlimited contour levels, filled contours
Line plots, scatter plots, histograms, bar graphs, polar plots, error bars, dendrograms
Linestyle, patterns, plot symbols
Log, semi-log & linear scaling
Overplot multiple data sets
Vector flow diagrams

## Surface Plotting & 3-D Graphics

Intelligent Tools (iTools) for interactive 3-D graphics, surfaces & volumes
OpenGL accelerated 3-D graphics
3-D transformations
4-D data display of gridded or non-gridded elevations with overlaid image or user-specified shading
Interactive DXF (AutoCAD) viewer
Interactive light object editor
Isosurface & isocontour
Mesh generation (tetrahedral mesh from volumetric data)
Mesh surface plots with hidden line removal
Mesh operations (polygonal & tetrahedral meshes)
- Clipping
- Decimation
- Smoothing
- Surface area & volume
- Validation

Particle trace & streamline
Volume rendering
3-D plot symbols & text
Flat & Gouraud shading
Lighting model effects
Opacity controls
Texture mapping (high resolution)
Multiple clipping planes

## Graphics Architecture

OpenGL accelerated 3-D graphics
OpenGL Shading Language
Highly efficient rendering
Real-time interactivity
Support for multiple monitors
Z-buffered graphics (8-bit, 24-bit)

## Color Systems

Convert to/from: CMYK, HSV, HLS, YUV, YIQ, YPbPr, YCbCr
Convert true-color to pseudo-color
Color mapping functions

## Printing & Fonts

High-quality, scalable TrueType® fonts
Hershey fonts
Native print dialogs - page set-up, print job
Printing directly to a printer device
Vector & bitmap printing & clipboard
Printer support: PS, PCL, HPGL2, HP-RTL
PostScript preview
User-extensible font set
WYSIWYG printing

## Curve & Surface Fitting

Multiple linear regression
Nonlinear least-squares
- Gradient-expansion
- Levenberg-Marquardt
- Singular value decomposition

Polynomial spatial warping
Polynomial surface
Weighted/unweighted least-squares polynomial
Thin plate spline

## Image & Signal Processing

Intelligent Tools (iTools) for interactive image display and processing
Adaptive Fast Fourier Transform
- Mixed Radix
- 1 to 8 dimensions
- Multi-threaded

Bi-level, pseudo- & true-color thresholding
Butterworth filter
Canny filter
Convolution & frequency-domain block convolution
Edge Enhancement
- Roberts
- Sobel

Edge detection filters: Difference of Gaussians, Emboss, Laplacian, Prewitt, Shift difference
Unsharp masking
Frequency domain filtering & analysis
Generalized image arithmetic
Geometric transformations: magnification, reduction, rotation, polynomial warping
Hough transform
High- & low-pass filtering
Histogram equalization & processing
Adaptive histogram equalization
Image statistics
Impulse Response filter
Lomb periodogram
Median filtering
Morphological operators: erode, dilate, distance mapping & thinning
Noise functions: hurl, pick, scatter, slur
Radon transform
Region growing
Region of interest (ROI) utility
Savitsky-Golay filter
Spectral analysis
Time-series analysis
Watershed segmentation
Continuous & discrete wavelet transform

## Differentiation & Integration

Differential equations: adaptive & Runge-Kutta
Iterated Gaussian quadrature
Newton-Cotes integration of tabulated data
Romberg integration over an open or closed interval
Simpson integration over a closed interval

## Linear Algebra

LAPACK & Numerical Recipes routines
Condition number
Determinant
Generalized inverse
Transpose
Infinity & Euclidean norms
Eigenvectors & eigenvalues
Singular value decomposition
Cholesky, Gauss-Seidel, LU, Cramer's, least

squares & tridiagonal methods for solving systems of linear equations

## Sparse Linear Systems

Dense-to-sparse & sparse-to-dense conversions with thresholds
Iterative biconjugate-gradient algorithm for solving linear equations
Multi-dimensional optimization
Row-indexed sparse storage format
Sparse format file I/O
Sparse matrix-matrix & matrix-vector multiply

## Nonlinear Systems & Root Finding

Broyden's & Newton's globally-convergent algorithms
Laguerre's algorithm for polynomial root-finding
Muller's algorithm for real & complex root-finding

## Multi-Dimensional Optimization

Davidon-Fletcher-Powell minimization
Gradient-free Powell minimization
Simplex method

## Special & Transcendental Functions

Beta & incomplete beta functions
Error & exponential integral functions
Exponentials & logarithms
Forward & inverse Chebyshev polynomial expansion
Gamma, incomplete gamma & logarithmic gamma functions
I-, J-, K- & Y-Bessel functions
LaGuerre & Legendre polynomials
Spherical harmonics
Trigonometric, inverse trigonometric & hyperbolic functions

## Correlation Analysis & Forecasting

Auto & cross covariances/correlation
Autoregressive modeling/forecasting
Cluster analysis
Differencing/box-car smoothing
Discrete auto/cross correlation
Exponential, geometric, Gompertz, hyperbolic, logistic & logsquare growth models
Kendall & Spearman rank correlations
Lagged auto & cross correlations
Least-absolute-deviation fitting
Linear, multiple & partial correlations
Moving averages/smoothing
Multiple linear regression
Multiple correlation
Nonlinear least-squares fitting
Partial correlation
Principal components
Statistical fitting of data

## Hypothesis Testing

Chi-square test
Contingency test for independence
Cumulative binomial (Bernouli)
Gaussian (normal)
F test
Kruskal-Wallis H-test
Lomb frequency test
Mann-Whitney U-test
Median delta test
Normality test
Random numbers
Normal & uniform
Single & double precision
Runs test for randomness
Sign test
Student's T tests
Wilcoxon rank-sum test

## Multi-Dimensional Gridding & Interpolation

1-, 2- & 3-D nearest-neighbor & linear
1-, 2- & 3-D cubic convolution
2-D parametric cubic splines
N-D Delaunay triangulation, convex hulls & Voronoi polygons
2-D interpolation
- Inverse distance
- Faulting
- Kriging
- Linear
- Miniumum curvature
- Modified Shepards
- Natural neighbor
- Nearest neighbor
- Polynomial regression
- Quintic
- Radial basis function

3-D minimum curvature surfaces
3-D polar (r, theta, z) to rectangle
4-D smooth fit
Spherical gridding
Non-uniform gridding

## Mapping

Intelligent Tools (iTools) for interactive exploration of georeferenced image and contour data
High-resolution map database
30+ geographic mapping transformations (includes USGS GCTP)
Warp images onto arbitrary projections

## Development & Programming Tools

Support for large files (>2GB)
Programming language features similar to C
Macintosh Altivec acceleration
Callable UNIX sharable object library & Windows DLL
Out-of-process server (IDL_IDL Bridge)
Extensible: add FORTRAN or C code with child processes or dynamic linking
Export IDL objects into COM/Java
Import COM/Java objects into IDL
Immediate execution of interactive statements
Object oriented programming interface
System constants
File manipulation routines
Unlimited compiled program size
Unlimited number of variables
Unlimited program file names
Unlimited structure tags
Distribution options, including free IDL Virtual Machine™

## Integrated Development Environment

Build cross-platform IDL applications
Build, execute, debug
Chroma-coded source code editor
Cross-platform consistent user interface
Customizable via macros
Full-featured debugger
IDL projects for file organization
IDL session command line access
Interactive, "Drag & Drop" GUIBuilder

## User Interface Toolkit

Cross-platform tools for creating graphical user interfaces (GUI) with native look & feel
Animation tool
Annotation tool
Interactive file selector
Interactive color palette editor
Tab key navigation and button accelerators
Widgets/Controls
- Base
- Button
- Tab
- Tree (with drag and drop)
- Context-sensitive shortcut menu
- Push button, toggle button
- Drawable (expose, click, drag & wheel events)
- Droplist/Combobox
- Label
- List
- Message
- Slider
- Table
- Text
- Property Sheet

## IDL DataMiner™ Module

Same API for all platforms & databases
Create, delete, query tables
Execute arbitrary SQL statements
Get/set/query/add/delete records
Drivers for: Oracle, Informix, Sybase, MS SQL Server

## Wavelet Toolkit Module

Interactive interface
Multiresolution analysis

## ION (IDL On the Net) Module

IDL-powered Java applets, applications & dynamic Web documents
Common browsers & Web servers
ION server supported on Microsoft Windows, SGI Irix, SPARC Solaris & Linux

## DICOM Read/Write Module

Read, clone & create DICOM part 10 files
Public & private attributes including sequences & groups
JPEG compression (Windows & UNIX)
Windows, SPARC Solaris, Mac OS X & Linux

## DICOM Network Services

Query/Retrieve SCU
Storage SCU, SCP
Echo SCU, SCP
Windows, SPARC Solaris, Mac OS X & Linux

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