ORIGIN®9
Data Analysis and Graphing Software

Feature List

*(Updated for version **9.0** on September 28, 2012)*

64 Bit Support

Overview
▫ Native 64-bit and 32-bit applications
▫ Import ASCII files bigger than 4GB with 64 bit application
▫ Memory capacity limited only by installed hardware with 64-bit application

Importing Data

Overview
▫ Drag-and-drop import of data and images
▫ Save import settings to a worksheet or external files for repeated use
▫ Use saved settings to re-import files with a single click
▫ Post-process imported data
▫ Import Wizard with visual feedback
▫ Handle non-standard files by programming
▫ Import multiple images into the same matrix sheet
▫ Customize File:Import menu by specifying which import types to display

ASCII Data
▫ Unicode support
▫ Support for delimited and fixed formats
▫ Multiple delimiter support
▫ Separate header and data lines
▫ Extract metadata from filenames and header lines
▫ Control treatment of leading zeros, quotation marks, missing data points and alternate numeric separators
▫ Partial data import support
▫ Many date and time formats recognized
▫ Support for categorical data
▫ Run script after each file or all files are imported

Third-Party Formats
▫ Binary and instrument formats:
  ▪ CDF, HDF5
  ▪ Data Translation (DCF, HPF)
  ▪ EarthProbe (EPA)
  ▪ Famos (DAT, RAW)
  ▪ ETAS INCA MDF (DAT, MDF)
  ▪ Heka (DAT)
  ▪ JCAMP-DX (DX, DX1, JDX, JCM)
  ▪ NetCDF (NC)
  ▪ NI DIAdem (DAT)
  ▪ NI TDM (TDM)
  ▪ pCLAMP (ABF, DAT)
  ▪ Princeton Instruments (SPE)
  ▪ Somat SIE (SIE)
  ▪ Sound (WAV)
  ▪ Thermo (SPC, CGM)
  ▪ EDF (EDF, BDF)
  ▪ MZXML
▫ Software-specific formats:
  ▪ IgorPro (PXP, IBW)
  ▪ KaleidaGraph (QDA)
  ▪ MATLAB (Mat)
  ▪ Minitab (MTW, MPJ)
  ▪ Excel (XLS, XLSX, XLSM)
  ▪ TDMS (LabVIEW 2009)
  ▪ Graphpad Prism

Image Formats
▫ Support formats: PNG, GIF, TIF, JPG, BMP, TGA, PCX, PSD, WMF (Convert to Raster)

Database Access
▫ Graphically construct SQL queries, save named SQL query with workbook or to disk
▫ Define SQL queries in Query Editor, which supports syntax coloring and LabTalk substitution
▫ Database connecting interface: ADO and ODBC

Digitizer
▫ Digitize graphs (get data values for points) that exist as images
▫ Rotate images before digitizing
▫ Support both linear and log axis types
▫ Add labels to picked points

Collaboration & Connectivity

Collaboration
▫ Share files such as templates, themes, custom tools, using group folder
▫ Share files using user files folder across multiple computers
▫ Pack selected files including toolbars and custom code to external file (OPX) for sharing
▫ Export toolbar and floating window configuration to a file
▫ Option to switch language of interface

Connectivity

- Import or directly open Excel 97-2007 workbooks (XLS, XLSX)
- Drag-and-drop data from an Excel book opened in Origin directly into a graph
- Copy-and-paste Origin graphs directly into MS Word and PowerPoint
- Send data directly to Origin from LabVIEW with Origin Sub Vi's; send results back to LABVIEW as well
- MATLAB Console and Mathematica Link allow data exchange with Origin
- Use Origin as an Automation (COM) Server to send commands and exchange data from any COM-enabled client application

Exporting and Presentation

Exporting Graphs

- Creating movies from Origin graph windows using GUI tool or script
- Raster formats: BMP, GIF, JPG, PCX, PNG, PSD, TGA, TIF
- Vector formats: AI, CGM, DXF, EMF, EPS, PDF, WMF
- Export dialog with settings for precise width/height and resolution (DPI)
- Save graph export settings as theme for repeated use
- Copy graphs or layout pages to clipboard and paste to other applications such as Microsoft Word or PowerPoint
- Paste link using Origin as an OLE 2 server
- Use layout page or worksheet with cell formatting to arrange multiple graphs and numeric data tables
- Batch print multiple graphs
- Master page for global annotation of graphs
- Transparency support for EPS files using raster elements
- Transparency support for PDF files

Exporting Data

- Export data to ASCII file with options to append to, or replace existing files
- Print entire worksheet/matrix sheet or a selected range
- Batch print multiple windows
- Export workbook as NI TDM/TDMS file
- Export worksheet data as wave file
- Export matrix as ASCII or image file
- Print Preview support for multiple windows

Exporting Reports

- Export a report sheet as a multi-page PDF document

Exporting Images

- Raster formats supported: BMP, GIF, JPG, PCX, PNG, PSD, TGA, TIF

Presentation

- Slide-show of selected, all, or dependent graphs
- Export graphs directly to MS PowerPoint

Data Management

Origin Project File (OPJ)

- Ideal for storing all of your data, graphs, and analyses
- 5 page types for data storage and display: Workbooks, graphs, matrix books, layout pages, and notes windows
- Attach external files to a project
- Store analysis results in worksheets or the Results Log
- Support for auto-save and backup for projects
- Password protection of project files
- Audit log of project saves, with optional password protection
- Auto-hide Project Explorer and other dockable windows
- Customize toolbar style

Project Explorer

- View and organize the contents of your Origin project (OPJ) using an interface similar to Windows explorer
- Organize and quickly access your work using hierarchical user-defined folders
- Create a favorites folder with shortcuts to important workbooks, graphs and notes

Workbooks & Worksheets

Data Storage

- Multiple worksheets per workbook
- Multiple matrix sheets per matrix book, and multiple matrix objects per matrix sheet
- Workbook size: Up to 121 sheets, and 65,535 columns versus millions of rows per sheet
- Matrix size: Up to 90 million cells, depending on data type (note that memory limitations may prevent these values from being reached)
- Column-oriented data type can be general or free form(cells can hold both numbers and text), or can be fix-sized array (numeric cells)
- Numeric cells can be time, date, or basic numeric types, including 4 or 8-byte float; 1, 2, and 4-byte, signed or unsigned integer; or 16-byte complex numbers
- Global setting for default significant or decimal digits

Data Organization and Metadata Support

- Reserved rows for long name, units, comments, sampling interval, sparklines, and user-defined parameters

- Sparklines on column headers display small graph of data for quick inspection
- Workbook organizer shows file import info including variables extracted from file header
- Manually or programmatically add meta data to workbook
- Sampling interval support for columns
- Drag range selection to auto fill data by extending or duplicating existing data
- Lock Icon on output columns to indicate recalculate mode for operations
- Support long name, units, comments and user-defined parameters for matrices
- Thumbnail on matrix to display small image of matrix data for quick inspection
- Drag and drop sheets to remove from, or add to, workbooks and matrix books
- Click-and-drag to adjust row height and column width in worksheets and matrices
- Extract worksheet data by condition
- Horizontal and vertical dividers for simultaneous viewing of different parts of worksheet
- Hide/Unhide columns and rows in worksheets
- Navigate Worksheets dialog for managing worksheets in the workbook
- Support for adding comments to worksheets. Comments will be displayed as tooltip on mouse-over of worksheet tab
- Floating Graphs in Worksheet

Formatting
- Support for rich text cell formatting
- Embed graphs, images, and notes in worksheet cells
- Merge cells to flexibly arrange and present graphs and numeric data
- Insert links in worksheet cells to other cells, including cells from analysis report sheets
- Auto-size option for worksheet and matrix Columns
- Save formatting of worksheet and matrix sheets to theme/template for repeat use
- New Worksheet/Matrix dialog to specify format/themes when create a new worksheet/matrix

Graphs

Overview
- Quick access to all built-in graph types from toolbars
- Page, Layer, Plot hierarchy to organize data plot
- Plot with graph templates and organize templates using Template Library
- Plot Setup dialog for quick plotting of data from multiple worksheets, common columns, Excel workbook and matrix book
- Create custom multi-panel plots

- Merge multiple graphs with preview
- Drag-and-drop data columns into graph
- Plot same column multiple times, such as different ranges, in a single graph layer
- Speed mode control for plotting large datasets
- Select and customize single data points in a plot
- Quick edit graph element style with toolbars; In depth editing of graph element details with Plot Details dialog
- Customize symbol color or size by column data (Can be used to represent another dimension)
- Custom color palettes and increment lists for grouped data and color map
- Customize the format increment lists and color palettes for grouped data
- Add tables to graphs, table cells may be linked to other worksheet and report cells
- Copy-paste cells from a worksheet to create a table
- Embed and edit MS-Word, Excel, and Equation objects inside Origin graphs and layouts
- Full-screen view for graphs, maintaining aspect ratio
- Contour or 3D plot from worksheet data (virtual matrix)
- Layer Content dialog for easy adding, removing, grouping, ungrouping and reordering of data plots
- Show and hide layer with the layer icon context menu

2D Graphs
- Line - 10 types
- Scatter - 9 types
- Line and Symbol - 6 types
- Column/Bar - 8 types (also 3D)
- Area - 7 types
- Bubble/Color Mapped - 3 types
- Multiple Panel - 5 types or create your own
- Multiple Axes Plot - 5 types or create your own
- Pie Chart
- Polar (r, theta)
- Ternary Diagram, with scale customization and optional axes direction
- Smith® Chart
- Stock Charts: High Low Close, Japanese Candlestick, OHLC Bar Chart, OHLC-Volumn
- 2D Vector - 2 types: XYXY and X, Y, Angle, Magnitude
- Stacked lines by Y offsets with customizable offsets
- Windrose: raw or binned data
- Radar/Spider Chart
- 2D Function graphs and 2D Parametric Function graphs for plotting mathematical equations

3D Graphs
- XYZ Scatter/Trajectory with optional drop-lines/projections/error bars
- XYZ Bars with optional error bars
- XYY Bars, Ribbons, Walls, and Waterfall
- Surface plot from both XYZ and matrix data
- Color map surface with optional projected contour
- Wire Frame and Wire Surface

- Surface with constant slices in X or Y direction
- Pie Chart
- 3D Vector – 2 types: XYZ-XYZ and XYZ-dxdydz
- Stretch any 3D graph axis to change aspect ratio
- Rotate 3D plots graphically by clicking and dragging
- Missing value and grid-line skip support for 3D surface plots
- Color mapping of 3D bar plots using Z values
- Major and minor level support for 3D surface plots
- Multiple intersecting surfaces supported
- Z-axis, including nonlinear scales, for waterfall plots
- Y- and Z-value color map support for waterfall plots
- 3D Function graphs and 3D Parametric Function graphs for plotting mathematical equations

Contour Graphs
- Create contour plot directly from XYZ data using triangulation
- Ternary contour
- Polar contour
- Color filled contour
- Black and white contour with Lines and Labels
- Gray scale map
- Custom level formatting using color, contour lines and labels
- Specify label prefix and/or suffix
- Set label decimal points
- Include color scale legend
- Individual contour line and level control
- Color palette support
- Specify custom boundary for contour graphs using datasets
- Extract data points for any or all contour lines

Statistics Graphs
- Probability plot including Weibull distribution
- Q-Q Plot
- Pareto chart with option to combine smaller values
- Box and/or column scatter - 2 types
- Rectangular box or diamond Box
- Display mean lines in box charts
- Histogram, Stacked Histograms, and Histogram + Probabilities
- Control the number of bins or bin sizes for histograms.
- Go to the binned data with a button in the Plot Details dialog box
- Checkbox to Scale distribution curve by % of tallest bar for histogram plot
- Output distribution curve data to Bin worksheet for histogram plot
- Scatter Matrix (Histogram/Box chart in diagonal cells, Linear fit, R-square, confidence ellipse options)
- QC charts
- Optional distribution curves

Image Graphs
- Image graph
- Enhanced image profile tool
- Image histogram

Customizing Graphs

Graph Themes
- Copy and paste the format of one graph or element onto another graph
- Save a collection of formatting elements as a graph theme
- Set system theme to apply desired settings to all newly created graphs

Data Plot Color
- Independently set color for page, axes, labels, symbols, lines, area or bar fill
- Independent custom color support for all properties
- Color-mapped or color-indexed symbol
- Color stretching for grouped data plots
- Apply built-in/user-defined color palettes
- Categorical data support for symbol color
- Color scale legends
- RGB color settings
- Labels on color scale legend can be showed on Major levels or by increments
- Transparency and gradient fill control for graph objects
- Color map from another matrix

Data Plot Labels
- Add or modify title text for layers
- Worksheet parameter row for annotating each curve in 2D Waterfall plot
- Associate dataset with data plot points, X, or Y axis
- Graphically attach text labels to individual data points
- Control color, font type, style, size, rotation, offset, background, and justification
- Tool to annotate a specific data point

Line Styles
- Data point connection types include: straight, b-spline, spline, step (horizontal, vertical, center), bezier, 2-point segment, 3-point segment, solid, dashed, dotted
- Customize line style for groups of data plots
- Customize dash and dot definitions (point values for widths)
- Masking support in line plots

Symbols
- Expanded set of over 100 built-in symbols
- Create custom symbols from bitmaps
- Offset Plotting of Duplicate Points
- Categorical data support
- Color-mapped, as well as indexed symbol color/shape/size - up to 8 dimensions

- Custom symbol lists for grouped data plots
- Individual symbol edit control, with display in legend for 2D graphs

Text Labels and Legends

- In-place editing of text labels with Character Map access, TrueType fonts, bold, underline, italic, Greek, super/subscript or both, increase/decrease size, rotate, date/time stamp
- Easily insert import file header information and other meta data into text labels
- Add symbol shapes with the Origin TrueType font
- Unicode support for text labels
- Legends created automatically using metadata
- Customize legend to show desired data such as long name, comments, book/sheet name, and/or user-defined parameters in a customized format
- Automatically create a single legend for all layers in a graph
- Update or reconstruct legend at layer or page level
- Legend displays individually edited data points
- Link to LabTalk variables and specify the level of % and $ substitution in the Programming Control dialog for legends

Error Bars

- Display error bar as % of data, standard deviation, or from a dataset
- Asymmetric error bar support
- Specify X and/or Y and/or Z error bar
- Error bar support on 3D graphs
- Control error bar color, line width and cap width
- Error bars can go up to or through symbols
- Set as absolute or relative error bar
- Skip points allowed for error bars
- Connect error bars with lines and fill the area under the lines
- Support scaling factor when adding error bars to graph using standard deviation of data
- Support for adding error bar to graph using square root of data
- Auto update of error bar columns when source data changes

Axes

- Double-Log Reciprocal Axis scale, ln(-ln(1-x)), for Weibull plot
- Custom color support for axes and grid Lines
- Technical types: Linear, Log10, Probability, Probit, Reciprocal, Offset Reciprocal, Logit, Ln, Log2, Polar, Smith®, Double-Log Reciprocal(ln(-ln(1-x)))
- Special tick mark types: Draw from a column of values
- Scale options: set rescale mode to normal, auto, or fixed from/to; specify increment, # of major ticks, # of minor ticks, first tick; reverse axis scales
- Control color, line style, and thickness

- Axis titles use long name and units from worksheet
- Offset Axes - Multiple based on percent or axis position
- Grid Lines: Control color, line style, thickness, and density of major and minor grid lines for X, Y, and Z axes
- Axis Break: Define break region, break position along axis, scale type and increment before/after break
- Frame Options: 2D or 3D Axis Graph Page
- Display layer icons on visible axes for each layer
- Add axis scrollbar to zoom or pan graph
- Manually specify tick marks and tick labels
- Multiple Y axes customization
- Flexible ternary scale
- Specify tick locations using datasets
- Zoom or scroll in both X and Y inside graph layer using keyboard or mouse
- Supporting for arbitrary zero and direction (CW/CCW) for polar graphs

Layers

- Up to 121 layers per page
- Align and size multiple layers and text using Object Edit toolbar
- Support for naming layers
- Merge multiple graph pages (select graphs using Graph Browser)
- Add and arrange multiple layers using Layer Management dialog
- Create inset layers
- Link axes: specify formula for relationship
- Support layer title

Tick Labels

- Basic Types: Numeric, Text from Dataset, Time (includes IRIG), Date, Month, Day of Week, Column Headings, Indexed from Dataset, Categorical (binned text data)
- Special Types: Specify a user-defined formula or draw from a column of values
- Control the direction (In, Out, Both, None) and length of major and minor tick marks for X, Y, and Z axes
- Control color, font, size, number of decimal places, rotation, offset, display of first, last, and custom tick labels
- Align, rotate, offset, show/hide
- Include minor tick labels
- Apply a divide by factor
- Include a prefix and suffix
- Include plus and minus signs
- In-plane axis title and tick labels for 3D graphs

Drawing objects

- Line types: straight, poly line, freehand
- Line styles: solid, dashed, dot
- Begin/end arrow control
- Shapes: rectangle, ellipse, polygon, region

- Fill types: hollow, fill color, fill pattern
- Resize/rotate/skew all lines/shapes
- Align, send to front/back
- Group/ungroup objects

3D
- Manually move 3D planes along the axis direction
- Ability to shift 3D plot in Z direction using percent of scale range
- Lighting effect, mesh for 3D surface
- Move, rotate and resize 3D graphs in an intuitive way

Data Analysis

Overview
- Standardized analysis tools with tree structure for settings
- Analysis markers to indicate range used for analysis
- Preview of results in most analysis dialogs
- Analysis report sheets with collapsible tables

Recalculation
- Manually or automatically update the results of any previously run analysis operation when data or parameters change

Analysis Themes
- Save settings of analysis dialogs to theme for repeat use
- Access saved analysis themes from fly-out menu or script

Analysis Templates
- Save workbook as Analysis Template, with desired analysis routines and custom settings, including custom report sheets to present results
- Re-use Analysis Template manually or in Batch Processing mode, to analyze multiple files or datasets

Analysis Results
- Keep analysis results organized in same workbook as source data
- Embed graphs and analysis to create custom reports
- Create separate reports per dataset for same analysis routine, or combine in one results sheet
- Report results to Results Log to establish analysis history
- Residual Analysis (Linear, Polynomial, Multiple Regression, Nonlinear Fitting)- 4 residual types (Regular, Standardized, Studentized, Studentized deleted) and 5 plot types

Batch Processing
- Batch processing with summary report using Analysis Templates™

- Batch peak analysis of multiple datasets using theme (PRO)
- Repeat analysis on all plots in graph, or all columns in worksheet

Data Exploration
- Read data point coordinates, screen coordinates
- Inspect data point values/distances on/between curves using customizable data information display window and Cursor tool
- Graphically attach data labels with pinned connecting lines to individual data points
- Zoom in and Pan simultaneously on graphs, worksheets, matrices and layouts
- Launch separate graph with movable zoomed in region
- Vertical and horizontal scroll bars to scroll and pan
- Move individual data points graphically
- Mask/Unmask data points on all or active data plot
- Data/Mask selection can be restricted to active plot or expanded to all plots within selection window
- Toolbar for data markers and locks

Data Manipulation

Setting Column Values
- Large collection of categorized functions for setting column values, including date/time and string functions
- Easily define variables from meta data and other books and sheets for use in setting column values
- Auto update Set Column Values output when source data changes
- Set column values with LabTalk functions

Worksheet
- Data filter to find and work with a subset of worksheet
- Sorting, including support for nested sort
- Trim missing values in a worksheet
- Remove duplicate data in a column
- Find and Replace numeric and text values
- Unstack and stack worksheet columns using grouping variables
- Pivot Table
- Reduce data: Remove duplicate values, remove every Nth point or remove points at a specified X increment (PRO)
- Normalize data across multiple columns
- Merge XY Data According to X Values (worksheet only)
- Convert XYZ worksheet data to matrix using XYZ Gridding: Regular, Sparse, Random - Renka-Kline, Shepard, Thin Plate Spline, Kriging, 2D B-spline
- Convert worksheet data directly to matrix
- Convert matrix data to XYZ worksheet data
- Convert matrix data directly to worksheet
- Shrink and expand matrix
- Transpose data, and paste transpose

▫ Split a worksheet into multiple worksheets by number of columns/rows, or by column label information

Curve

▫ Average multiple curves
▫ Translate curves (vertical/horizontal)
▫ Subtract straight line or reference data

Gadgets

▫ Gadgets for quick and easy exploratory analysis of a region of interest (ROI) on graphed data
▫ Results displayed on graph, and update immediately when ROI object is moved
▫ Save custom settings as theme for repeat use

Quick Fit Gadget

▫ Easy fitting of graphed data using ROI
▫ Fit parameter values update as ROI is moved on graph
▫ Fit multiple datasets and send results to a consolidated report sheet
▫ Easily change fitting function and other settings
▫ Easily switch to NLFit for complete control
▫ Standard Error is reported for Derived Parameters

Other Gadgets

▫ Statistics: Basic statistics, including display of mean and standard deviation lines inside ROI
▫ Integration: Peak parameters with choices for baseline
▫ Rise Time (PRO): Compute rise or fall time with options for setting high and low levels
▫ FFT: View frequency spectrum of data inside ROI in a separate window
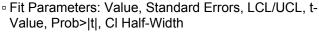Cluster: Basic statistics and simple operations (copying, clearing, deleting and masking) to data points inside or outside ROI.
▫ Differentiation: Graph the desired order derivative curve of the input data set specified by a ROI
▫ Interpolation: Interpolate a dataset within an ROI using one of three methods (linear, cubic spline and cubic b-spline), and display the new curve
▫ Quick Peaks: Pick a peak within the ROI, integrate it, and perform fitting to it.
▫ Quick Sigmoidal Fit Gadget for fitting selected data using a sigmoidal function
▫ Vertical Cursor Gadget for reading X and Y coordinate values for data points on stacked panel plots
▫ Intersection Gadget for calculatinge the intersection points of data plotsthe input curves

Curve Fitting

General Fitting Features

▫ Analysis report sheets with collapsible tables
▫ Analyze multiple datasets independently (consolidated or separate reports) or as a concatenated dataset
▫ Weighted Fitting with multiple weighting methods
▫ Confidence/prediction bands

▫ Fit Parameters: Value, Standard Errors, LCL/UCL, t-Value, Prob>|t|, CI Half-Width
▫ Fit Statistics: Number of points, DOF, R value, Residual Sum of Squares, R-Square (COD), Adjusted R-Square, Root-MSE (SD), Norm of Residuals, ANOVA Table, Covariance Matrix, Correlation Matrix
▫ Residual Analysis (PRO) (Linear, Polynomial, Multiple Regression, Nonlinear Fitting)- 4 residual types (Regular, Standardized (PRO), Studentized (PRO), Studentized deleted (PRO) and 5 plot types (PRO)
▫ Generate result using same X values as the original data, uniform linear, or uniform log X values
▫ Find X/Y values for new Y/X values based on fit parameters

Linear and Polynomial Fitting

▫ Linear fit: Fix Intercept or slope
▫ Linear fit: Support for x-error values (PRO)
▫ Polynomial fit: Fix Intercept
▫ Apparent Fit
▫ Confidence bands, Prediction bands, Confidence Ellipse (PRO)

Multiple Dataset Linear Fitting

▫ Partial leverage plot in multiple regression
▫ Fix intercept

Nonlinear Fitting

▫ Nearly 200 built-in fitting functions
▫ Organize all fitting functions by category in an intuitive dialog, with equation and sample curve preview
▫ Create and edit user-defined fitting functions
▫ Define derived parameters that are computed using fit parameter values
▫ Global Fitting with sharing of parameters
▫ Multiple Peak Fitting with auto initialization
▫ Automatic parameter initialization for built-in function, and support for adding initialization by value or by code, for user-defined functions
▫ Simulate curve or surface using desired function and parameter values
▫ Levenberg-Marquardt and simplex algorithms for iteration
▫ Weighting - 13 methods including several iteratively reweighted least squares methods
▫ Control number of iterations, tolerance, derivative delta
▫ Fix parameter values, set bounds, or linear constraints
▫ Replicate (Concatenate) Data Fitting - Fits all data, not an average, then present result as average curve with SE or SD error bars
▫ Display parameter values in date/time formats.
▫ Fit Comparison (PRO): Compare two datasets fit with one model, or two models fit to same dataset (AIC and F-test
▫ Surface (XYZ or matrix) fitting (PRO)
▫ Rotated 2D Gaussian function for surface fitting (PRO)

- Find-Z tool for nonlinear surface/matrix fitting
- Fitting function builder to help to define new fitting functions
- Fit multiple peaks in surface fitting using Replicas (PRO)
- Orthogonal distance regression for fitting implicit functions (PRO)
- Standard error reported for derived parameters
- Specify X Data range From and To values using X values
- Use the specified row range/X range to order data during the analysis
- Ability to fit one dataset at a time when performing independent fit on multiple datasets, Ability to copy fit values from one dataset to all other datasets.Fitting with integral function in NLFit
- Improve fitting speed for LabTalk script based fitting function

Baseline and Peak Analysis

Baseline
- Create baseline using multiple methods including user-defined anchors, and existing dataset

Peak Finding
- Find and mark positive and negative peaks
- Multiple methods for peak detection

Peak Integration
- Integrate peaks with fixed or arbitrary window width for each peak

Peak Fitting (PRO)
- Find and fit multiple peaks
- Multiple methods for peak finding including hidden peak finding
- Use built-in or user-defined peak fitting functions
- Assign same or different peak functions to different peaks
- Support for linear constraints and bounds on parameters
- Batch peak analysis using pre-defined theme

Signal Processing
- Correlation
- Coherence (PRO)
- 2D Correlation (PRO)
- Convolution and deconvolution
- Create upper and lower envelopes for curves
- Decimation to reduce data

Transforms
- FFT/IFFT
- STFT (PRO)
- Hilbert Transform (PRO)
- 2D FFT/2D IFFT (PRO)

- Image Profiling: Simple Line Profiling: Horizontal, Vertical, Straight Line

Filtering
- FFT Filter: Low Pass, High Pass, Band Pass, Band Block, Noise Threshold
- IIR filter design (PRO)
- 2D FFT Filter (PRO): support 3 types of filter windows: Ideal, Gaussian, Butterworth, Blackman, 4 filter types for each filter window: low-pass, high-pass, band-pass, band-lock, and filter defined using spectral power threshold

Smoothing
- Smoothing: Savitzky-Golay smoothing, Adjacent Averaging (running average), FFT filter smoothing, Percentile Filter (including Median Filter)

Wavelet Analysis
- Decompose (Discrete Wavelet Transform - DWT) (PRO): 1D and 2D
- Reconstruct (Inverse DWT - IDWT) (PRO): 1 and 2D
- Continuous Transform (PRO)
- Wavelet Smooth (PRO)
- Denoise (PRO)

Image Processing

Image Adjustment
- Color Adjustments: Intensity (Brightness, Contrast, Gamma), Color (Hue, Invert, Saturation, Color Balance)
- Equalizer (PRO): Histogram Equalize, Histogram Contrast, Auto Level
- Conversion
- Select region of interest: cut, copy, create new matrix
- Channels (PRO): RGB Split, RGB Merge
- Color Resolution Conversions: Color to Gray, Color to B/W (Binary, Dynamic Binary (PRO), Thresholding (PRO)
- Image Scale: Reset X/Y Coordinates (PRO)

Geometric Transformations
- Geometric Transforms: Rotate, Flip (H/V), Shear, Auto Trim, Crop, Resize, Offset (PRO)

Spatial Filters
- Spatial filters: Blur (Average, Gaussian), Noise (Add Noise, Median), Sharpen (Sharpen, Unsharp Mask), Edge Detect, User Filter (PRO)

Arithmetic Transform
- Lookup Table (PRO): Function LUT, User Define
- Arithmetic Transforms (PRO): Pixel Logic, Math Function, Image Combine, Alpha Blend, Background Subtract, Extract to XYZ, Morphological Filter, Replace Background, Subtract Interpolated Background

- ▫ Color Detect (PRO): Detect, Segment, Replace

Mathematics

Simple Math

- ▫ Simple math between datasets: =, +, -, x, ÷
- ▫ Subtract reference data or straight line
- ▫ Normalization across single/multiple columns or curves

Interpolation/Extrapolation

- ▫ 1D Interpolation/Extrapolation - Linear, Cubic Spline, B-Spline
- ▫ Interpolate XY dataset to find Y values based on an existing set of X values
- ▫ 2D Interpolation (PRO) - Nearest, Bilinear, Bicubic, Spline, Biquadratic
- ▫ Trace Interpolation (PRO)
- ▫ 3D Interpolation (PRO)

Calculus

- ▫ Calculus: Integration and differentiation including Savitzky-Golay smoothing during differentiation

Matrix Mathematics

- ▫ Matrix Inverse
- ▫ Compute surface area of matrix data

Statistics

Descriptive Statistics

- ▫ Column and row statistics
- ▫ Analyze input data independently (consolidated or separate reports) or combined
- ▫ Support for grouping and weighting with row/column statistics and many other statistical analyses
- ▫ Flat sheet output for column statistics
- ▫ Moments: N total, N missing, Sum, Mean, Mode, Geometric Mean, Geometric SD, Lower CI of the Mean, Upper CI of the Mean, Standard Deviation (SD), SD*2, SD*3, Standard Error of Mean, Variance, Coefficient of Variation, Skewness, Kurtosis, Mean Absolute Deviation, Uncorrected Sum of Squares, Corrected Sum of Squares, Sum of Weights (Statistics on Columns only)
- ▫ Quantiles: Minimum, Index of Minimum, 1st Quantile (Q1), Median, 3rd Quantile (Q3), Maximum, Index of Maximum, Interquartiles Range (IQR = Q3 - Q1), Range (Maximum - Minimum), Custom Percentile(s)
- ▫ Extreme Values
- ▫ Variance Divisor of Moment: DF, N, WDF, WS, WVR
- ▫ Interpolation of Quantiles (PRO): Weighted Average Left, Weighted Average Right, Nearest Neighbor, Empirical Distribution (None), Empirical Distribution with Average, Tukey Hinges
- ▫ Frequency Count

- ▫ Discrete Frequency (PRO)
- ▫ 2D Binning (Also Support Periodic Data)
- ▫ Normality Tests: Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors, Anderson-Darling, D'Agostino-K squared, and Chen-Shapiro
- ▫ Correlation(PRO): Pearson R, Spearman R, and Kendall Coefficients
- ▫ Grubbs test and Q-test to detect outliers

Parametric Hypothesis Tests

- ▫ One and Two Sample t-tests
- ▫ Paired Sample t-test
- ▫ Welch Corrected t-test
- ▫ One Sample Chi-Square Test for Variance (PRO)
- ▫ Two Sample F Test for Variance (PRO)
- ▫ Confidence Levels for One Sample Chi-Square Variance (PRO)
- ▫ Confidence Levels for Two Sample F Variance (PRO)
- ▫ Indexed or raw data

ANOVA

- ▫ One-way and Two-way ANOVA
- ▫ One-way and Two-way Repeated Measures ANOVA (PRO)
- ▫ Indexed or raw data
- ▫ Means Comparison Tests: Bonferroni, Scheffé, Tukey, Dunn-Sidak, Dunnett (Repeated Measures only) , Fisher LSD, Holm-Bonferroni, Holm-Sidak
- ▫ Tests for Equal Variance: Levene, Levene Square, Brown Forsythe
- ▫ Power Analysis

Nonparametric Hypothesis Tests

- ▫ Wilcoxon Signed Rank Test (PRO)
- ▫ Mann-Whitney Test (PRO)
- ▫ Wilcoxon Matched Pair Test (PRO)
- ▫ Kruskal-Wallis ANOVA (PRO)
- ▫ Friedman ANOVA (PRO)
- ▫ Sign Test (PRO)
- ▫ Kolmogorov-Smirnov Two-Sample Test (PRO)
- ▫ Mood's Median Test (PRO)
- ▫ Indexed or raw data

Multivariate Analysis

- ▫ Principal Component Analysis (PRO)
- ▫ Hierarchical Cluster Analysis (PRO)
- ▫ K-Means Cluster Analysis (PRO)
- ▫ Discriminant Analysis (PRO)
- ▫ Canonical Discriminant Analysis (PRO)

Survival Analysis

▫ Kaplan-Meier Analysis (PRO)
▫ Cox Proportional Hazards Model (PRO)
▫ Survival Function Comparison (PRO): Log-rank, Breslow, Tarone Ware
▫ Weibull Fit (PRO)

ROC Curves

▫ ROC Curves (PRO)
▫ Support test direction, including Positive vs High (larger test measurement values indicates more positive test) and Positive vs Low (smaller test measurement values indicates more positive test)
▫ Output cut off values

Power and Sample Size

▫ One Sample t-test (PRO)
▫ Two Sample t-test (PRO)
▫ Paired-Sample t-test (PRO)
▫ One Way ANOVA (PRO)

Programming

LabTalk Scripting

Overview

▫ High-level, full-featured, easy-to-learn programming language
▫ More than 15 years of language stability and progressive development
▫ Access to Origin objects and operations to easily automate or customize Origin
▫ Detailed documentation and practical examples shipped with Origin
▫ Wiki site available to offer timely updated documentation
▫ Large Origin user community participating in LabTalk programming forum

LabTalk Features

▫ A variety of basic data types including Numeric (integer, double, constant), Dataset, String, StringArray, Tree
▫ Variables can be strongly and dynamically typed
▫ Range notation for flexible data access
▫ Organize script by sections or files
▫ Define variables with different scopes: project, Session, Local
▫ LabTalk Variable Viewer to view, update, or delete variables including support for tree variables
▫ System variables for controlling various options in Origin
▫ Internal and external objects with methods and properties

▫ C-like programming with loops (repeat, loop, for), and decision structures
▫ Define macro with arguments
▫ Support for event-driven execution
▫ Easy increment of objects using ": " operator and "end" keyword
▫ Interactively execute scripts
▫ Debug script using Code Builder
▫ Protect multiple lines of code using "{ " and "}"
▫ Over 60 built-in commands for data manipulation, display control, and user interface
▫ Built-in immediately programmable GUI construction
▫ Built-in functions for string manipulations, dates and times processing
▫ Create user-defined function
▫ Add or customize menu commands
▫ Create buttons to execute any built-in or user-defined task
▫ Perform batch processing
▫ Easy access to Origin C functions from script
▫ Access to hundreds of built-in X-Functions for performing various tasks in Origin
▫ System Variables dialog to customize system variables and save them as default settings

Origin C

Overview

▫ Code builder for building and debugging Origin code created in either LabTalk or Origin C
▫ Advanced programming language that supports ANSI C and some C++, C# features
▫ Easy access to Origin objects and operations to automate and customize Origin
▫ X-Functions framework that provide a structured programming environment for building Origin tools
▫ Detailed documentation and practical examples shipped with Origin
▫ Wiki site available to offer timely updated documentation
▫ Large Origin user community participating in Origin C programming forum

Origin C Features

▫ Origin C supports a nearly complete ANSI C language syntax
▫ Supports a subset of C++ features including mid-stream variable declarations, overloaded functions, built-in and user-defined classes, references to variables and default function arguments
▫ Supports a subset of C# features including Collections of objects, *foreach* and *using* statements
▫ Built-in C++ classes for programmatic access to most Origin objects
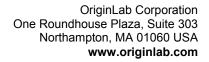▫ Built-in immediately programmable user interface development

- Immediate vector, matrix, tree structures programming
- Immediate access to all routines in the 64 bit NAG® Mark 9 function libraries for a wide range of mathematical and statistical functions
- Built-in global functions organized in 25+ categories
- Create complex user-defined curve fitting functions for use in Origin's advanced curve fitting tool
- Support error and exception handling using Throw, Try, and Catch statements
- Support for database access
- Easy integration with LabTalk scripts
- Hundreds of built-in X-Functions can be easily accessed and extended
- Create user-defined X-Functions
- Call external DLLs created with other languages such as C, C++ and Fortran

Origin as Automation (COM) Server

- Access Origin as an automation server from client applications such as Microsoft® Excel®, National Instruments™ LabVIEW™, or any COM-capable client application
- Run Origin visible or hidden
- Send data and commands to Origin for graphing and analysis tasks fetch results back to client application
- Utilize Origin's Analysis Template capability to automate routine tasks
- Large collection of Classes to access various Origin objects and properties
- Run LabTalk script or Origin C code

OriginLab®