Science, Engineering and Graphics Tools

Revision 9.0

DOS

Revision 9.0 - Features include 3D Charting, Windowing, Controls, Dialog Boxes and Menus.

Science/Engineering 2D Charting - Linear, semi-log, and log graphs. Multiple graphing windows. Auto-scaling of axes, line, scatter, pie and bar charts. Error bars, multiple x and y axes for a single graph. Adjustable xy intercepts, grid lines, and text labeling routines.

Contour Plotting - Our Delaunay triangulation algorithm can handle contour plotting of data using a regular grid or arbitrarily spaced data points.

3D Charting - Surface Plotting, 3D Bar Charts, 3D Area Fill Charts, 3D Scatter Plots, 3D Area Range Charts, 3D Line Charts, arbitrary axis scaling for all three dimensions and fonts.

Mouse Support - Pixel and world coordinates.

Window Options - Windows can be moved, resized, hidden, iconized and closed using the mouse.

Control Objects - Push buttons, Multi-pole switches, and Scroll bars.

Dialog Boxes - File list, General input, Check-off box, General list, Text output and Message dialog boxes.

Menus - Pull-down graphics mode menu system with help and hot key support.

Statistics - Mean, mode, standard deviation, etc.

Multiple Regression, Polynomial and Cubic Splines Curve Fitting.

Simultaneous Equations - Real and complex.

Fourier Analysis - Forward and inverse FFT, windowing, 2-Dimensional FFT and Power Spectrum.

Matrix Math, **Eigen Values and Vectors, Integration.**

CRT Graphics Adapter Support - The graphics libraries use the graphics routines supplied with the respective compiler. EGA and VGA support for all versions.

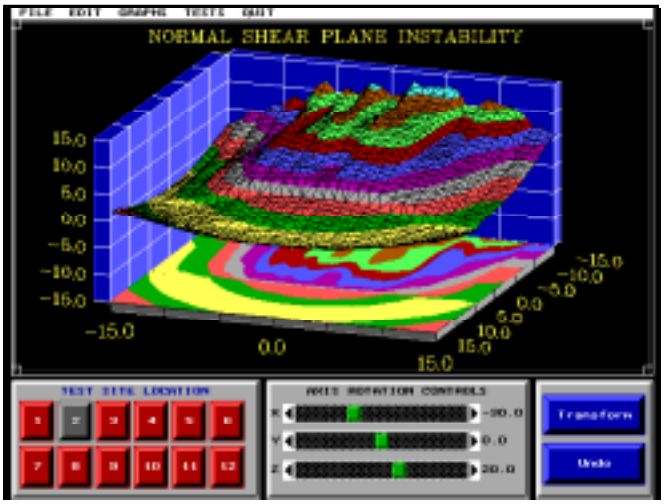
Hardcopy Support - High-resolution printer drivers (not a screen dump) for Epson 9-pin and 24-pin printers, HP LaserJet, HP DeskJet (B&W and color), HP PaintJet, PostScript printers and HPGL plotters.

Royalty Free - When used to create application programs.

Source Code - 100 % source code except for our BGI printer drivers (for Borland Compilers). Source code for printer drivers available as a separate package.

Versions Available for:

- Borland Pascal 7.0
- Borland C++ 4.x (16-bit protected mode supported)
- Microsoft C / C++ 7.0, Visual C++



Menus, 3D surfaces and controls can be combined on the screen at the same time.

The ***Science, Engineering and Graphics Tools*** (Rev. 9.0) combine an enhanced Quinn-Curtis Scientific Charting (2D and 3D) graphics library with a complete user interface library. These tools can be used to create a wide variety of scientific applications running under DOS. The tools are supplied in the form of procedures and functions and are supplied on disk in the source code of the target language. All of the routines can be used royalty free when compiled into an application program. A 400 page manual documents the software package. The ***Science, Engineering and Graphics Tools*** are available for Borland Pascal 7.0, Borland C++ 4.x, and Microsoft C / C++ 7.0 and Visual C++. It is essential that you are a C or Pascal programmer to utilize these tools.

Ordering Information

Part #	Description	Price
IPC-TP-016	Borland Pascal	$175
IPC-TC-006	Borland C++	$175
IPC-MC-006	Microsoft & Visual C / C++	$175

Shipping Charges

UPS Ground	UPS Blue	UPS Red	DHL	Canada
9	15	26	38	12

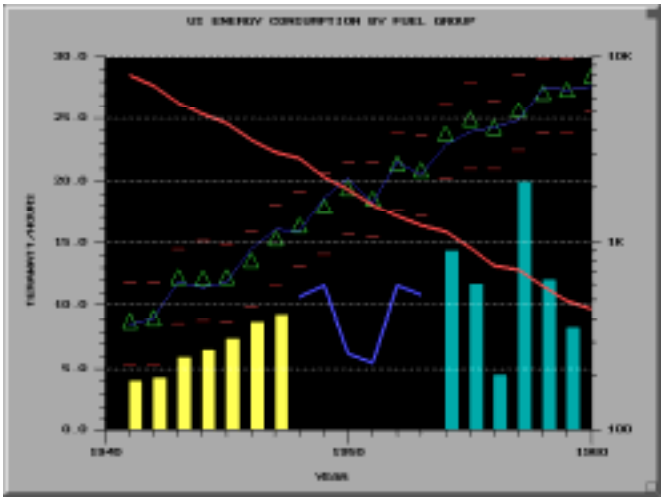
2D Charting Graphics

Create line plots, bar graphs, pie charts, scatter plots, contour plots, stacked line plots and bar graphs, grouped bar graphs, linear, log and semi log scaling by using specific routines included. High resolution printer support includes: Epson MX, FX and LQ printers, HPGL plotters, PostScript Printers, HP LaserJet, HP DeskJet, and HP PaintJet.

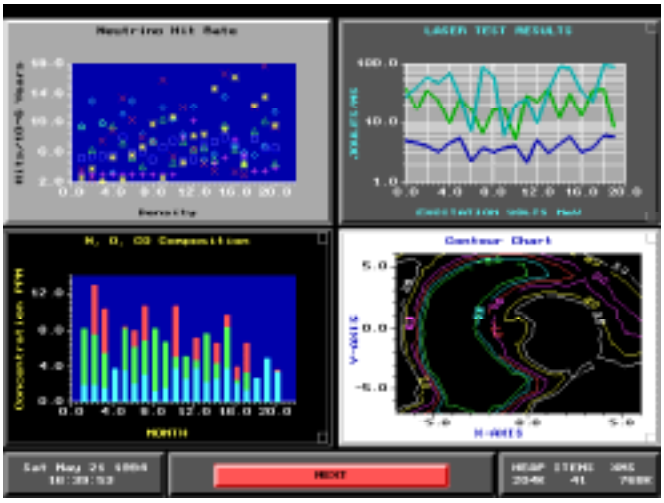
CRT Support - The Borland C / C++ and Pascal versions of this software use Borland's BGI device independent graphics drivers for CRT graphics, and BGI fonts (*.CHR). The Microsoft C / C++ version uses the Microsoft C graphics drivers and fonts (*.FON).

2D Charting Function Summary

AutoAxes - Auto scale and display axes.
BargraphData - Display a vertical or horizontal bar graph.
BorderCurrentWindow - Border the current graphics window.
ClearGraph - Clear the plotting area.
ClearWindow - Clear the graphics wndow.
CloseSEGraphics - Exit graphics and return to previous text mode.
ContourChart2D - Display a contour plot.
ContourPlotLegends - Display contour plot legends.
ConvertNum - Convert a number to a string.
DrawGrid - Draw a grid, supports log grids.
DrawXAxis - Draw a x axis from low -> high or high -> low.
DrawYAxis - Draw a y axis from low -> high or high -> low.
DefGraphWindow - Define a window in pixel coordinates.
FindMinMax - Find minimum and maximum values for data set.
findwindowindex - Return first window number which contains a specific (x, y) pair.
GetPlotBackground - Return plotting area background color.
GetViewBackground - Return window area background color.
GroupPlotData - Display grouped bars or lines.
InitSEGraphics - Initialize the graphics routines for the video adapter specified.
inwindow - Determines if the (x,y) pair lies within a SE window.
LabelGraphWindow - Output a string in a graphics window.
LabelPlotArea - Output a string in the plotting area.
LabelXAxis - Label x axis tick marks.
LabelXAxWithStrings - Label x axis tick marks with strings.
LabelYAxis - Label y axis tick marks.
LabelYAxisWithStrings - Label y axis tick marks with strings.
LinePlotData - Display an (x,y) plot.
PieChart - Display a pie chart.
PlotErrorBars - Plot a series of error bars.
RealLegends - Display a legend with real numbers.
QCSetupprinter - Sets printer options, including: port, orientation, file output.
ScalePlotArea - Scale the plotting area for world coordinate data. The plotting area can be scaled in for increasing or decreasing axes.
ScatterPlotData - Display data as a symbol.
SetAxesType - Set the graph type to linear, log, or semi log.
SetCurrentWindow - Make a previously defined window the active window.
SetTextStyle - Set the text style.
SetPercentWindow - Define a graphics window as a percent of the video adapter.
SetPlotBackground - Set the plotting area background color.
SetViewBackground - Set the viewport area background color.
SetWin2PlotRatio - Control placement of graph in the viewport.
SetXYIntercepts - Set the x and y intercepts.
SortDataX - Sort arrays for x data.
SortDataY - Sort arrays for y data.
StringLegends - Display a legend with strings.
TitleWindow - Display a title in the window.
TitleXAxis - Display a x axis title.
TitleYAxis - Display a y axis title.
WinPixelToWorld - Convert an (x,y) pixel pair to its world coordinates.



Several 2D graphs are combined into a single complex chart.



Multiple Scatter Plots, Semi-log Graph with multiple Line Plots, Grouped Bar Graph and a Contour Plot.

3-D Charting Routines

A comprehensive collection of 3D charting tools is integrated into the SE Tools graphics library. Multiple graphs can be combined together in a single chart, creating composite images of great complexity. The 12 basic 3D graph types which are supported are listed below:

Ribbon Graphs	Line Graphs
Bar Graphs	Area Fill Graphs
Scatter Graphs	Area Range Graphs
Contour Plots	Surface Graphs
Surface Projection Graphs	Grouped Bar Graphs
Grouped Area Fill Graphs	Grouped Ribbon Graphs

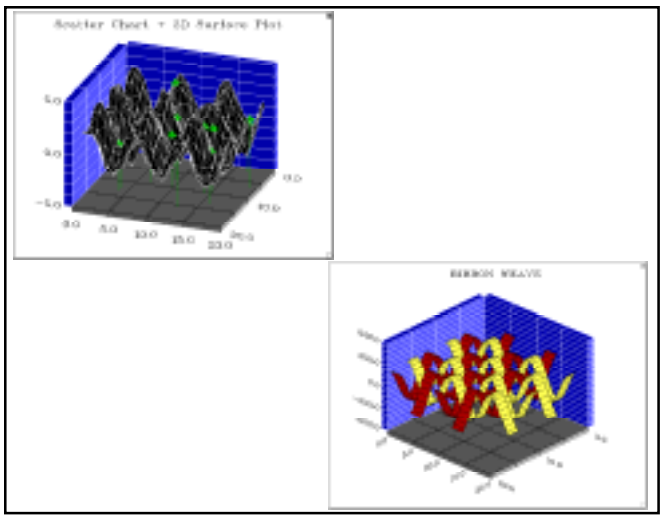
Hidden Line and Surface Removal

Three methods of hidden line and hidden surface removal are used in this package, and they are: the "Painters Algorithm", back face removal and Z-Buffer hidden surface removal.

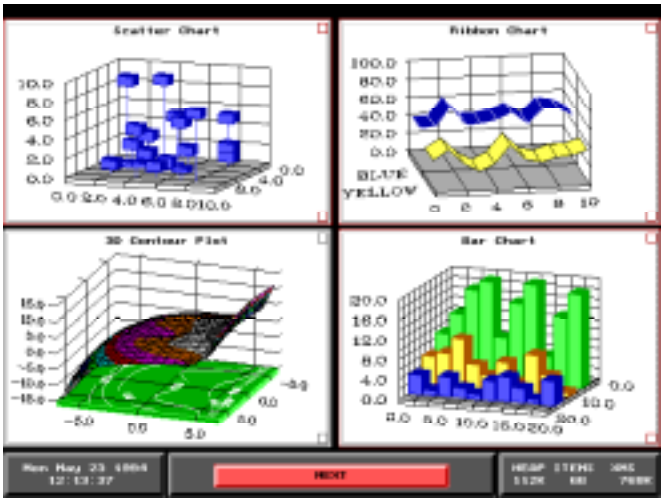
The Painters Algorithm states that if you draw the various elements of your 3D chart in the correct order, the foreground objects will be drawn over the background objects, thus creating a chart which looks as if all hidden planes and lines have been removed. This is the technique used in most 3D charting application packages specializing in what we call 2 1/2 D charts.

Back face removal is a hidden surface removal technique that can be used with all 3D objects which are closed. This includes bars, walls and objects with a filled area. Back face removal automatically calculates which sides of a 3D solid object are not visible from the viewing perspective, and only draws those sides which are visible.

The Z-Buffer hidden surface removal algorithm is the best technique to use on workstations which use raster based displays. It also works well with raster based output devices like laser jet, ink jet, and dot matrix printers. It will not work with vector oriented devices such as plotters.
The Z-Buffering method of hidden surface removal involves the testing of the visibility of surfaces one point at a time, determining that the surface with the smallest z coordinate at each pixel position (x, y) on the view plane is visible. Once Z-Buffering is turned on, all graphical output to the screen



Z-Buffer hidden surface removal is the best technique to use when dealing with complex surfaces.



Scatter Chart, Ribbon Chart, Surface Plot with corresponding Contour Plot, and a Bar Chart.

stops, and all graph commands are then written to a disk metafile, which records every drawing command. When Z-Buffering is turned off, the metafile is replayed one CRT scan line at a time, and the resulting image is displayed on the screen. Although this technique is slower than the simplistic Painters Algorithm, it results in much better hidden surface and line removal. It can handle many complex scenes which the Painters Algorithm cannot handle at all, including intersecting objects, objects overlapped in a complex fashion, and convex objects.

It is possible to use more than one hidden surface technique in a single graph. The back walls and grids of a chart can be drawn quickly with the Z-Buffer turned off. You can plot a complex poly surface object in the foreground with the Z-Buffer on, then label the foreground axes with Z-buffer off.

Independent Variable Mapping for Poly Surfaces
Independent variable mapping allows you to use color in a poly surface chart to denote a fourth dimension or variable in a chart, i.e., the effects pressure or temperature. The routine **SetIVRanges3D** will set the minimum and maximum values and the range of colors used for independent variable mapping.

3D Charting Function Summary

AddPolySurfacePolygon - Add a polygon to a poly surface object.
AreaFillChart25D, AreaRangeChart25D - Plot a 2D set of data as a 3D area fill graph or as a 3D area range graph.
AssignPoint3D, GetPoint3D - Assign or retrieve x,y,z realtype coordinates in a point record.
BarChart25D, RibbonChart25D - Plot a 2D set of data using a 3D bar graph or as a 3D ribbon graph.
CloseChartObject3D, ClosePolySurface - Free all of the memory associated with a chart object structure or a poly surface structure.
ContourChartPolySurface3D - Plot the contours of a 3D poly surface in a 2D plane.
ConvertRG2PS - Convert a regular grid array of points into a poly surface object.
CreatePolySurfaceFunction - Create a poly surface object using a user defined function.

DefineAxis3D - Define the tick mark spacing, the tick mark direction, and the centerpoint for a 3D axis.
DrawAxis3D - Draw a previously defined 3D axis.
FillColorAxesPlane3D - Fill the plane formed by two intersecting axes with a color.
GetAxisLength3D, GetAxisMax3D, GetAxisMin3D - Return the length, maximum, and minimun value of an axis.
GetOnePolySurfacePoint, SetOnePolySurfacePoint - Retrieve or define one point in a poly surface.
GetPolySurfacePolygon, GPSPolygon - Retrieve the vertices and colors for a poly surface polygon.
GetPSNumPoints, GetPSNumPolygons - Get the number of points or the number of polygons in a poly surface.
GridAxesPlane3D - Draw a grid on one of the axes planes.
GroupAreaFillChart25D, GroupBarChart25D, GroupRibbonChart25D - Plot a 2D set of data as a 3D group area fill graph, a 3D group bar graph, or a 3D ribbon graph.
IVMappingMode - Turn indep. variable mapping on / off.
LabelAxis3D - Label a 3D axis with numerical values.
LabelAxisWithStrings3D - Label a 3D axis with strings.
LineChart25D - Plot a 2D set of data as a 3D line graph.
LineChart3D - Plot a series of 3D points as a 3D line.
MakeWallAxesPlane3D - Draw the plane formed by two intersecting axes as a 3D wall.
OpenChartObject3D - Open a new 3D chart object.
OpenPolySurface - Open a poly surface object
OutTextXYZChart3D - Display 3D text in a 3D chart.
PolySurfaceChart3D - Draw a poly surface object as a 3D surface in a 3D chart.
ProjectionLineChart3D - Project 3D points onto a 2D plane.
ProjectionPolySurfaceChart3D - Project a poly surface object as a 2D plane in a 3D chart.
QCDelaunayTriangles - Calculate the poly surface polygon list based on the 3D points in a poly surface variable.
RotateAxis3D - Specify the 3D rotation of a 3D chart about an axis.
ScaleAxis3D - Specify the scaling for an axis of a 3D chart.
ScatterChart3D - Plot 3D points as a 3D scatter chart.
SetAutoShadeGlobal3D - Turn auto-shading of solid objects in a 3D chart on or off.
SetBackFaceGlobal3D - Turn automatic back face removal of solid objects in a 3D chart on or off.
SetCentroid3D - Set the center of rotation for a 3D axis.
SetClipFlagGlobal3D - Turn clipping on / off for a 3D chart.
SetColor3D - Set the current 3D drawing color.
SetIntercept3D - Specify an axis intercept in a 3D chart.
SetIVColorMap3D - Set the independent variable color palette.
SetIVRanges3D - Set the minimum and maximum values for independent variable mapping.
SetLightSourceVector3D - Set the direction of the current light source for the 3D chart.
SetPolySurfaceColors - Define the colors for a poly surface polygon.
SetPolySurfacePoints - Define all of the points (vertices) in a poly surface object.
SetTextStyle3D - Set the current 3D font and size parameters.
ZBufferHiddenSurface3D - Turn on / off Z-buffer based hidden surface removal.

User Interface Routines

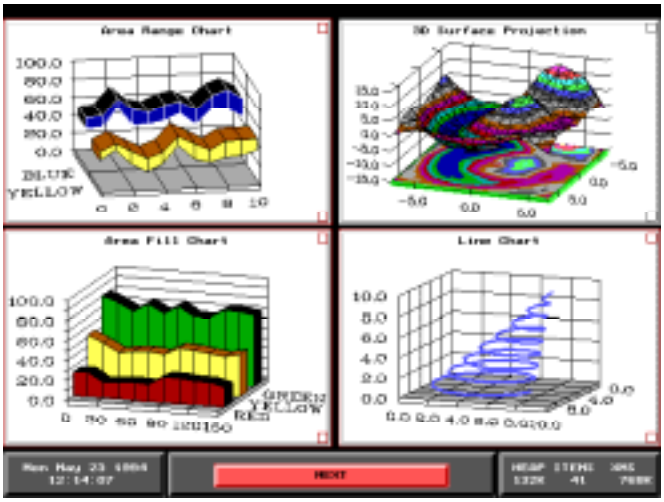
SE Tools Window Options

An extremely powerful set of SE Tools window options is included in the software. Each SE Tools window can be created with one or more of the following control options:

Value	Meaning
SE_MOVEABLE	Window is movable by dragging the mouse within the title area.
SE_RESIZE	Window is resizeable by dragging the 'resize handle' in the lower, right corner.
SE_MAXIMIZE	Window can be maximized by clicking the 'maximize handle' in the upper, right corner.
SE_CLOSE	Window can be closed by clicking the 'close handle' in the upper left corner.
SE_HIDE	Window can be hidden by clicking the 'hide handle' in lower left, and is reduced to a numbered box at the bottom of the screen. This box can be clicked to redisplay the window.
SE_ICONIZE	Will display an icon containing a window number if a window is hidden with the 'hide handle' or with rthidewindow.
SE_SAVEWINIMAGE	Saves underlying window images for future update. This attribute should be set if any of the attributes defined above have been selected.
SE_BORDER	Draws a window border.
SE_3DBORDER	Draws a 3D border around the window in a highlight color corresponding to the window background color.
SE_3DINNER	Draws the inner cells of certain SE Tools windows in 3D. Used with buttons, switches, and scroll bars.
SE_WINSTD	Window is drawn with the standard options: SE_MOVEABLE, SE_RESIZE, SE_MAXIMIZE, SE_3DBORDER, SE_3DINNER, SE_SAVEWINIMAGE.

Control Objects

There are 4 different control objects which can be placed in SE



Area Range Chart, 3D Surface Projection with Independent Variable Mapping, Area Fill Chart and a 3D Line Chart.

windows. These are: single scroll bars, scroll bar banks, switch banks, and button banks. Each control object is created in a unique SE window and can be assigned any of the window options (MOVEABLE, RESIZE, etc.) described in the section above. All of the SE control objects use callback functions to process control inputs.

Single Scroll Bars - A single scroll bar works in the same fashion as the scroll bars found in many DOS and Windows application programs. Scroll bars can be scaled to return engineering units rather than simple integer values.

Scroll Bar Banks - A scroll bar bank is a collection of up to 16 scroll bars in a single SE Tools window. It is useful for applications where a large number of related user inputs need to be grouped together. The slider inputs for a stereo equalizer or level controls for a sound mixing panel are examples of typical applications.

Switch Banks - A switch bank has between 1-16 switches in a single SE Tools window. Switches are used to select between several different ranges, options or discrete values. The switches are multi-pole, each having between 2-16 poles.

Button Banks - A button bank has 1-36 buttons in a single SE Tools window. Buttons are used to select between several different ranges, options or discrete values. A button can display different colors and text depending on the state.

Pull-Down Menus

Our libraries provide menu support in graphics mode. The entire menu system is controlled using only 5 function calls. It makes extensive use of callbacks as menu selection processing functions. The menu system can be operated with the mouse or the keyboard cursor control keys.

Menu Bar Options - The size, color, text and position of the menu bar is program selectable. A menu bar can have up to 10 selections printed horizontally across it.

Pull Down Menu Options - Each item on the menu bar can have a pull-down menu box with up to 25 additional items. Each menu item has a user specified callback function associated with it. Menu items can be selected using program definable hot keys, mouse clicks, or by pressing the Enter key. The pull-down menu system automatically saves and restores graphics images underneath menu boxes. A help file can be assigned to each menu item.

Dialog Boxes

Our user interface libraries provide dialog box support in graphics mode. There are 5 standard dialog boxes which can be used individually or combined together into complex forms. Buttons (OK, CANCEL, HELP, and MORE), colors and size are all programmable options for dialog boxes. Dialog boxes can also be made moveable.

File Dialog - The standard file dialog box supports entering a file name, drive and directory. DOS wild cards are supported in file names and all matching names are listed in a file list box. File names can be selected from the file list box using the mouse or the cursor keys.

List Dialog - A list dialog box can display a list of text strings in a scrolling window. List items can be selected with the mouse or the cursor keys.

General Input Dialog - General string and numeric input is handled through general input dialog boxes. A general dialog box can have up to 16 fields for entering string and numeric data. Input error checking is handled by user written callback functions.

Check-Off Dialog - This dialog box can have up to 32 check-off boxes. Each check-off box has its own identifying string. Check-off boxes can be made mutually exclusive, though this does not have to be the case. Check off boxes are selected using the mouse or cursor keys.

General Text and Message Dialog - A very useful dialog box for help displays. Text strings of arbitrary length can be displayed in a scrollable window. String wrap options allow text strings which are too long to appear in the current dialog window to wrap around to the next line. This dialog box can be maximized, filling the whole screen.

Hardcopy Support

Rev. 9.0 uses the Quinn-Curtis, high resolution printer drivers. These drivers can reproduce a SE screen at the maximum resolution of the output device. Printer drivers are included for the following printers: Epson 9-pin, Epson 24-pin, HP LaserJet family and HP DeskJet family (including color) and the HP PaintJet family (B&W and color). Printers compatible with those listed above will also work. The printer drivers leave the CRT in graphics mode while sending output to a printer or a file. The contents of any SE Tools window, including control objects and static graphs, can be output to a printer. Dialog boxes and menus cannot be reproduced on a printer.

Mouse Routines

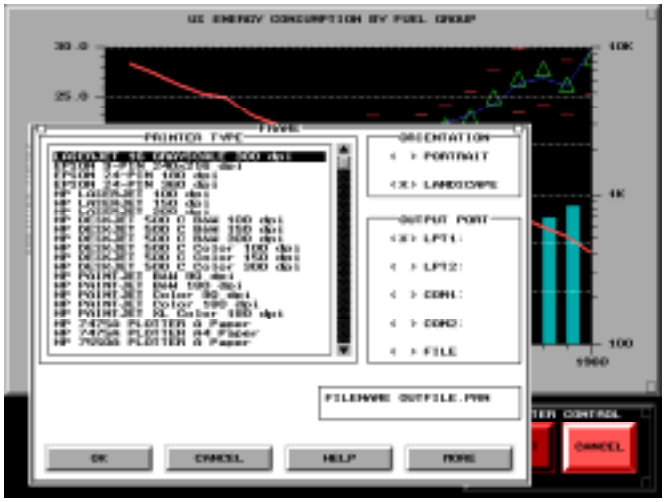
A complete set of mouse routines will let you integrate mouse support into your science and engineering applications. These mouse routines can initialize the mouse driver, return button pressed information, set the mouse range of movement, etc. Mouse position information can be expressed in either pixel or world coordinate information.

Numerical Analysis

Numeric Data Types

A generic floating point numeric type is defined (realtype)

Button Bank, Switch Bank, and Scroll Bars.



Dialog boxes can be used to set up printer parameters.

which can be set to float or double (SINGLE, REAL or DOUBLE for Pascal) in one include file. All libraries in these tools reference this numeric type and automatically compile in proper floating support for the numeric type chosen. Since these tools are in full source code, coprocessor support is handled through simple compiler flags when you compile.

Data Reduction
Calculate summary statistics for a set of data- minimum and maximum value, range of data values, variance, standard deviation, mode, histogram and error of the mean. A typical application includes: Statistical process control.

Solutions of Simultaneous Equation
Solve a system of linear equations using the Gauss-Jordan technique. The procedure returns the system solution vector, the inverse of the x-variable coefficient matrix, and the determinant of the x-variable coefficient matrix. Two different functions are provided, one for real and one for complex numbers. These routines automatically adapt to changes in the standard floating point numeric type. A typical application includes: Circuit analysis.

Multiple Regression
Fit a least squares linear multiple regression to a set of data. The function returns the regression equation coefficients, estimated y-values, residuals, standard error of the estimate, standard error of the regression coefficients, coefficient of determination (R squared value), and the correlation coefficient (R value), and mode. This routine automatically adapts to changes in the standard floating point numeric type. Typical applications include: Econometrics, forecasting, and multivariable curvefitting.

Curve Fitting
Two different techniques are provided for fitting experimental data to a smooth curve: polynomial curve fitting and cubic splines curve fitting. These routines automatically adapt to changes in the standard floating point numeric type. Applications: Thermocouple linearization, data interpolation, data smoothing, computer graphics.

Numerical Integration
Calculate the area under the curve for experimental data or an arbitrary function. The algorithms used are Simpson's 1/3 rule and Simpson's 3/8 rule. Typical applications include: Chromotography, mass spectroscopy.

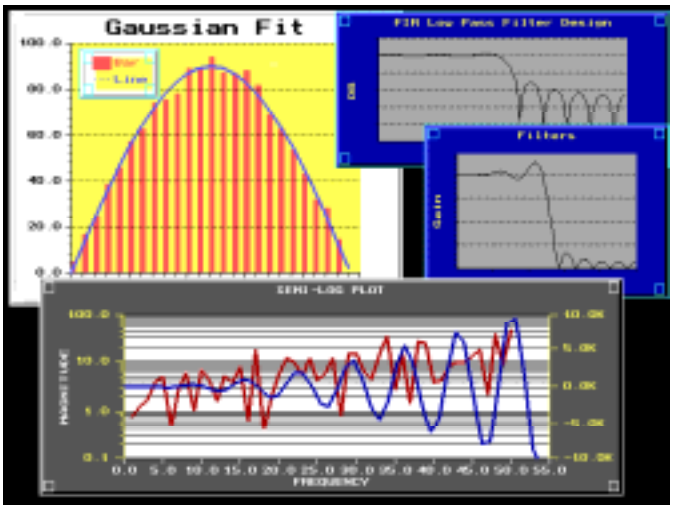
Solutions of Differential Equations
Solve initial value problems involving first order differential equations. The Runge-Kutta-Fehlberg technique is used with varying step size. Solves differential equation problems classified as initial value problems.

Fourier Analysis
Includes the most common algorithms used in digital signal processing. Functions are supplied for FFT's, including the Inverse Fourier Transform, power spectrum calculations, windowing, 2-D FFT's, and simple digital filter design. These routines will carry out a 1024 real FFT in 34 milliseconds on a 33MHz 486.

Matrix Math
Includes procedures for calculating common matrix math functions. Functions are supplied for handling both real and complex numbers, and include routines to calculate the product of two real matrices, the product of a matrix times a scalar value, add two matrices, calculate the transpose, determinant, or inverse of a matrix, and calculate the eigenvalues and eigenvectors for a real symmetrical matrix using the cyclic Jacobi algorithm.

Complex Number Math
Routines provided handle basic complex number arithmetic functions (+,-,*,/,invert). You can add, subtract, multiply, and divide complex numbers or matrices, and calculate the transpose or inverse of a complex matrix. Also, calculate the complex exponent, magnitude, and polar angle of a complex number.

Data Smoothing
Use the Savitzky-Golay function to reduce the amount of noise in a set of experimental data. A generalized convolution function is also included where the user can set up unique weighting coefficients and normalization factors.



SE Tools windows can be moved, overlapped and resized using the mouse.