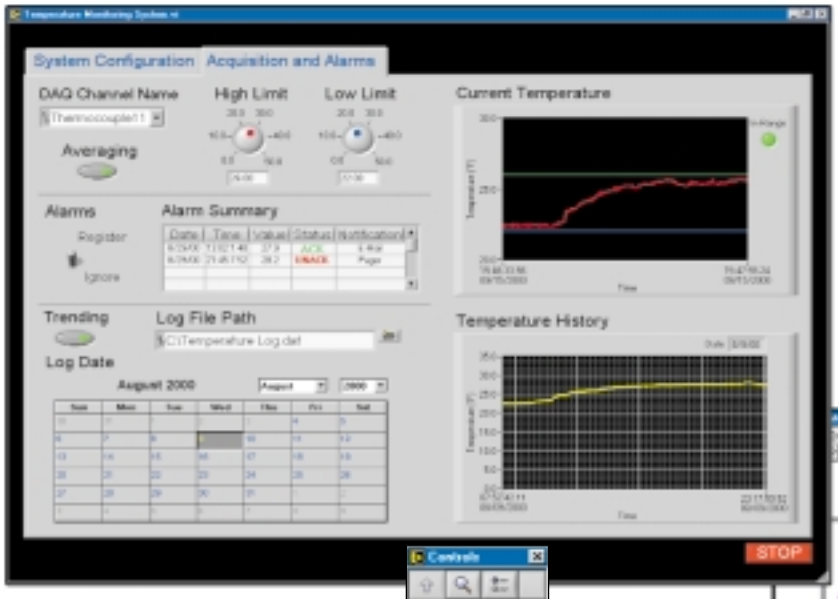
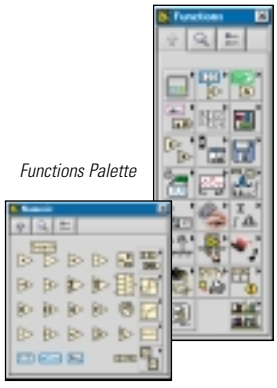
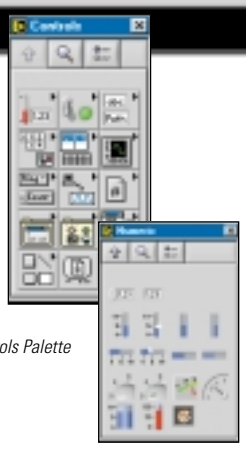
LabVIEW Graphical Development



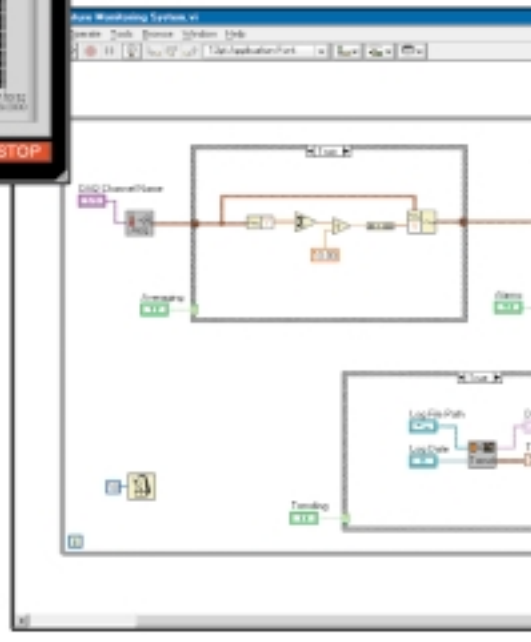
Front Panel



Functions Palette



Controls Palette



Graphical Block Diagram

Draw Your Own Solution

With National Instruments LabVIEW, you build a graphical program called a virtual instrument (VI) instead of writing a text-based program. You quickly create a front panel user interface that gives you interactive control of your system. To add functionality to the user interface, you intuitively assemble block diagrams – a natural design notation for engineers and scientists.

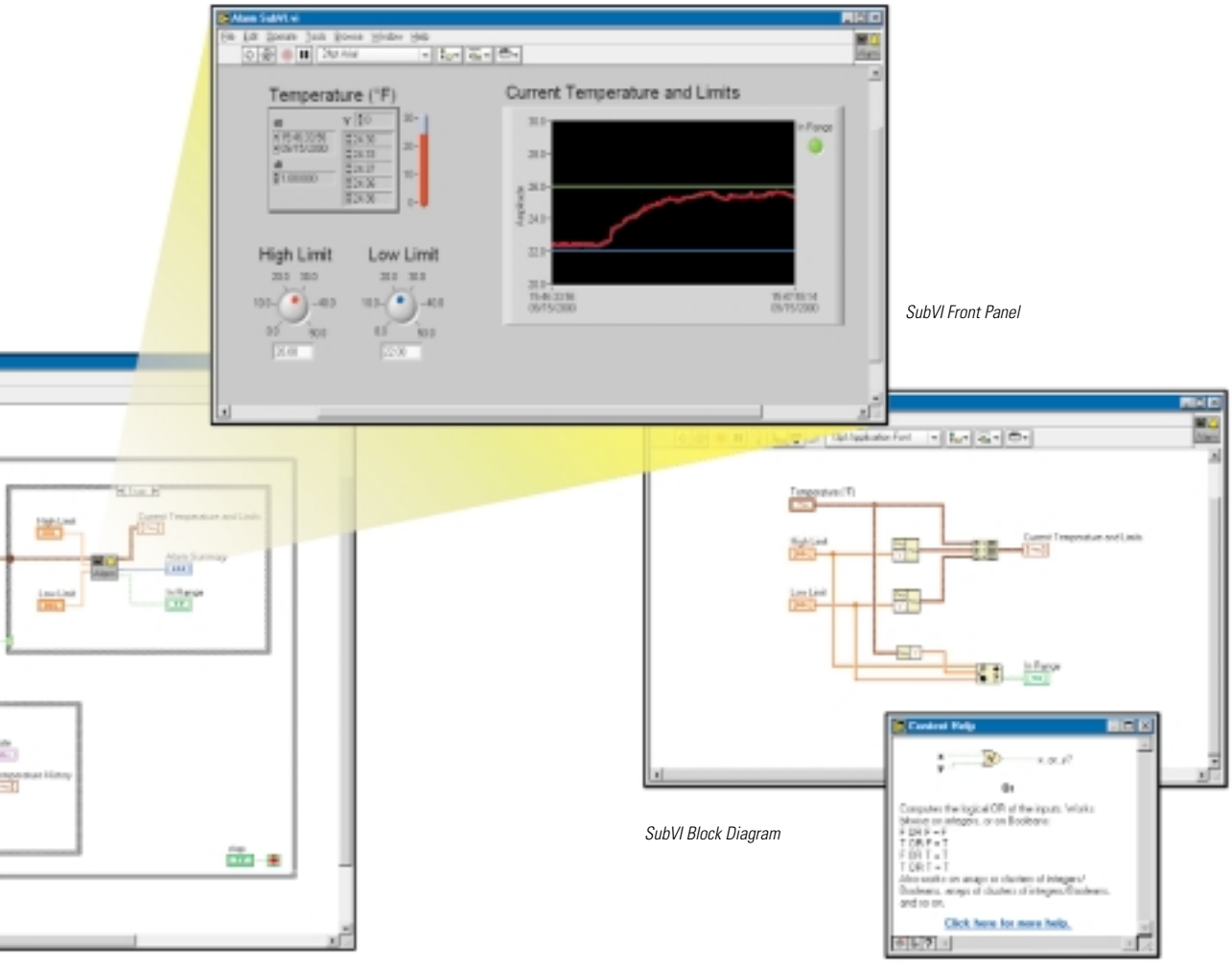
Create the Front Panel

On the front panel of your VI, you place the controls and data displays for your system by selecting objects from the Controls palette, such as numeric displays, meters, gauges, thermometers, tanks, LEDs, charts, and graphs. When you complete and run your VI, you use the front panel to control your system whether you move a slide, zoom in on a graph, or enter a value with the keyboard.

Construct the Graphical Block Diagram

To program the VI, you construct the block diagram without worrying about the syntactical details of text-based programming languages. You do this by selecting objects (icons) from the Functions palette and connecting them together with wires to transfer data among block diagram objects. These objects include simple arithmetic functions, advanced acquisition and analysis routines, network and file I/O operations, and more.

LabVIEW Graphical Development



SubVI Front Panel

SubVI Block Diagram

Help Window

Dataflow Programming

NI LabVIEW uses a patented dataflow programming model that frees you from the linear architecture of text-based programming languages. Because the execution order in LabVIEW is determined by the flow of data between nodes, and not by sequential lines of text, you can create block diagrams that execute multiple operations in parallel. Consequently, LabVIEW is a multitasking system capable of running multiple execution threads and multiple VIs in parallel.

Modularity and Hierarchy

LabVIEW VIs are modular in design, so any VI can run by itself or as part of another VI. You can even create icons for your own VIs, so you can design a hierarchy of VIs and subVIs that serve as application building blocks. You can modify, interchange, and combine them with other VIs to meet your changing application needs.

Compiled Execution

In many applications, execution speed is critical. LabVIEW is the only graphical programming system with a compiler that generates optimized code with execution speeds comparable to compiled C programs. You can even use the LabVIEW profiler to analyze and optimize time-critical operations. Thus, LabVIEW increases your productivity without sacrificing execution speed.

LabVIEW Graphical Development

The following list covers only part of the functionality available in the complete LabVIEW development system. Contact National Instruments for FREE, fully functional NI LabVIEW evaluation software, or complete a request form on the Web at *ni.com/labview*

Controls and Indicators

Buttons/switches/LEDs
Slides/digital displays
Gauges/dials/knobs
Tanks/thermometers
Graphs/charts (analog and digital)
Tables/arrays
Intensity plots
Menus/lists/rings
Text boxes
Decorations
ActiveX controls
Tip strips
Tab dialog boxes

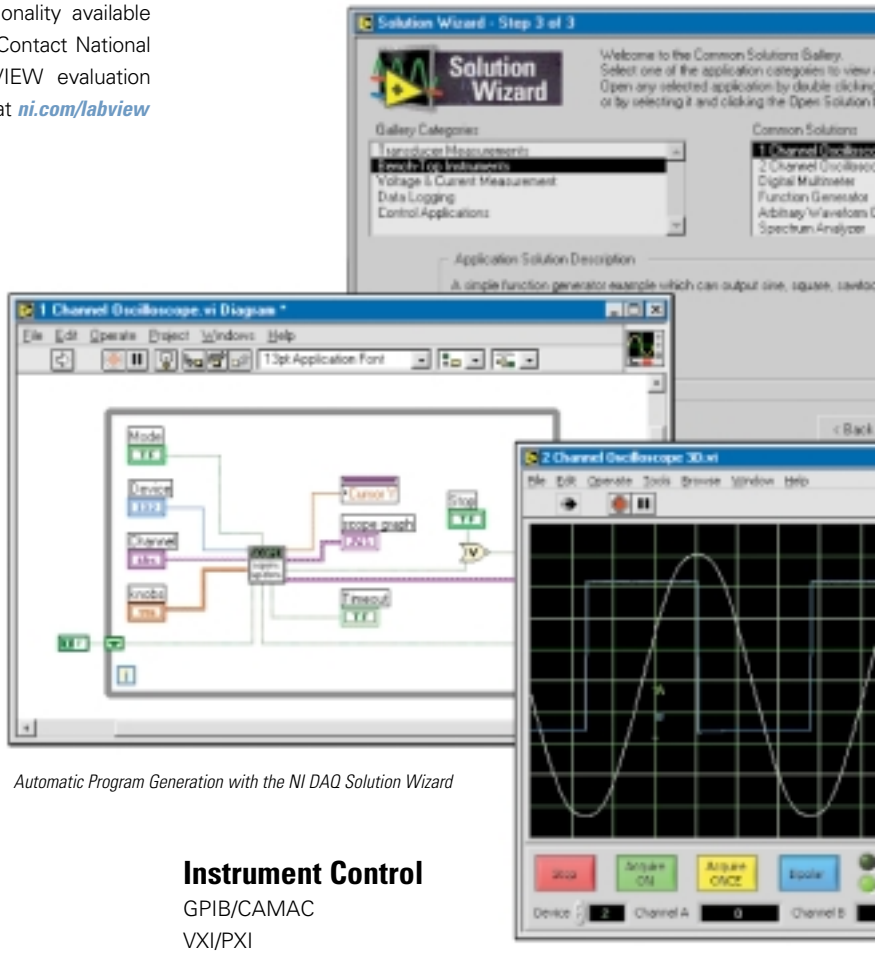
File I/O

Spreadsheet
Binary/ASCII
Datalogging

Open Connectivity

Internet/Networking
Databases*
NI DataSocket
TCP/IP
UDP
ActiveX
DLLs/shared libraries
Apple Events/named pipes
MATLAB**
NI HiQ**

Create HTML Reports From Your Application With No Programming



Automatic Program Generation with the NI DAQ Solution Wizard

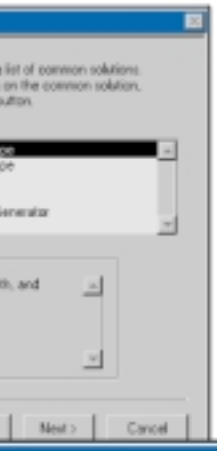
Instrument Control

GPIB/CAMAC
VXI/PXI
Serial
Industrial devices
More than 700 instrument drivers

Data Acquisition and Control Configuration

DAQ Solution Wizard
Single point input/output
Waveform acquisition/generation
Image acquisition
Motion control
Signal conditioning
Triggering/timing
TTL/CMOS input/output
Digital pattern generation
Digital handshaking
Pulse generation
Event counting
Edge detection
Period and pulsewidth measurement

LabVIEW Graphical Development

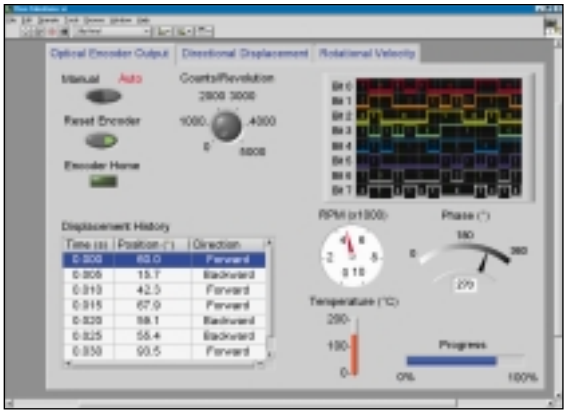


Programming Structures

While loops/for loops
Case structures
Sequence structures

Programming Fundamentals

Numeric computations
Boolean logic
Array/string manipulation
Time and date functions
Multidatatype structures
Custom subroutines



Easily Build Sophisticated User Interfaces

Waveform Measurements

DC/rms**
Single-tone analysis**
Harmonic distortion analysis**
SINAD analysis**
Power and cross power spectra**
Frequency response**
Power spectral density**
Limit mask testing**

Signal Processing

Signal generation**
Image processing*
Curve fitting**
Windowing**
Filtering**
Point-by-point and array based**

Math

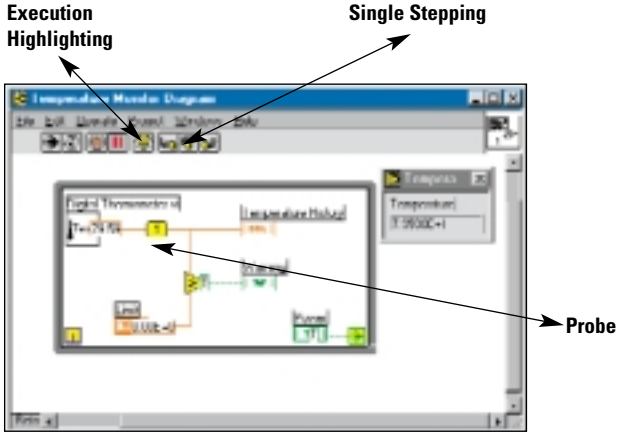
Text-based formula nodes**
Ordinary differential equations**
Optimization methods**
Root solving**
Gamma/Bessel/Jacobi/Beta and other functions**
Linear algebra
Probability and statistics

Optimization and Applications Management

True compiled performance on all platforms
Profiling of memory usage and execution speed***
Multithreading
Source code control/complexity metrics***
Hierarchy window
Full printed and online documentation set
Advanced report generation**
Documentation for quality standards***

Visualization

3D surface, line, and contour plots**
Custom graphics/animation**



Graphical Debugging Tools for Easy Code Analysis

Debugging

Breakpoints
Probes/custom probes
Single-stepping modes
Execution highlighting
Graphical differencing tools***

** Included in the Full and Professional Development Systems
*** Included in the Professional Development System

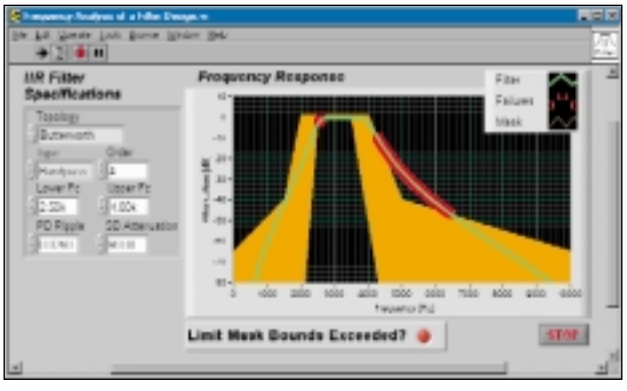
LabVIEW Measurement Analysis and Digital Signal Processing

Built-In Measurement Analysis and Digital Signal Processing

With National Instruments LabVIEW, you have the built-in digital signal processing, analysis, and visualization capabilities you need for your measurement applications.

High-level measurement analysis tools simplify development of applications that require common measurement analysis routines such as spectral analysis, filtering, and statistics. At the same time, you still have the flexibility to construct custom analysis algorithms using lower-level tools such as linear algebra, FFT, and curve fitting.

The following describes a few highlights of the measurement analysis capability of LabVIEW. Visit ***ni.com/analysis*** for a complete list and more details; a partial listing appears on page 75.



This graph shows the frequency response of a band-pass IIR filter designed with NI LabVIEW. Limit mask testing checks the design that the controls on the left side of the front panel specify.

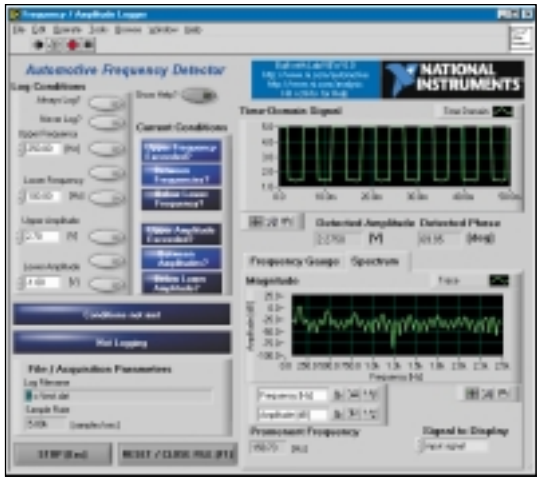
Measurements and Mathematics

NI LabVIEW includes a variety of other measurement analysis tools. Examples include curve fitting, signal generation, peak detection, and probability and statistics. Measurement analysis functions can determine signal characteristics such as DC/rms levels, total harmonic distortion (THD/SINAD), impulse response, frequency response, and cross-power spectrum. Using LabVIEW, you can also deploy numerical tools for solving differential equations, optimization, root finding, and other mathematical problems. In addition, you can extend these built-in capabilities by entering MathWorks MATLAB or NI HiQ scripts directly in your LabVIEW programs.

For charting and graphing, you can rely on the built-in LabVIEW 2D and 3D visualization tools. 2D tools include features such as autoscaling X and Y ranges, reconfigurable attributes (point/line styles, colors, and more), and cursors. Microsoft Windows users can employ OpenGL-based 3D graphs and then dynamically rotate, zoom, and pan these graphs with the mouse.

Complex Measurements Made Easy

Despite the complexity of the underlying algorithms that implement these functions, you will find them easy to use. For example, a set of built-in measurement functions uses the new waveform data type to accept real-world, time-domain signal inputs directly from DAQ hardware and reports results ready for charting, graphing, or the next stage of signal processing.



With NI LabVIEW, you can quickly build virtual instruments with measurement analysis capabilities. This front panel is a data logger that triggers based on the frequency content of a signal.

LabVIEW Add-On Toolsets for Analysis

For additional signal processing and analysis functionality, see these other National Instruments toolsets:

- Sound and Vibration Toolset (see page 92)
- Order Analysis Toolset (see page 93)
- Signal Processing Toolset (see page 94)

LabVIEW Measurement Analysis and Digital Signal Processing

LabVIEW Data Analysis and Math Libraries

Listed below are the analysis tools available for the LabVIEW Full Development System and Professional Development System. The LabVIEW Base Package (Windows only) contains a subset of these functions (denoted below by a single asterisk). For additional information on LabVIEW add-on tools for analysis, please refer to our add-on software guide on page 68 or visit *ni.com/analysis*

Measurement

Waveform-Based**

Averaged DC/rms
Signal noise and distortion (SINAD) analyzer
Harmonic distortion analyzer
Averaged DC/rms
Cross spectra (Mag + Ph)/(Re + Im)
Extract single tone information
FFT Spectrum (Mag + Ph)/(Re + Im)
Frequency response function (Mag + Ph)/(Re + Im)
Power spectrum
Power spectral density

Array-Based

AC and DC Estimator
Amp and frequency estimate
Amp and Phase spectrum
Auto power spectrum
Cross power spectrum
Harmonic analyzer
Impulse response
Network functions (avg)
Power and frequency estimate
Power spectrum
Scaled time domain window
Spectrum unit conversion
Transfer function

Signal Monitoring/ Triggering

Waveform-Based**

Basic level trigger detection
Limit testing
Limit specification
Limit specification by function
Waveform peak detection

Array-Based

Peak finding
Pulse parameters
Threshold peak detector

Signal Generation

Waveform-Based**

Basic multitone
Basic multitone with amplitudes
Function generator
Formula waveform
Triangle waveform
Square waveform
Sawtooth waveform
Multitone generator
Uniform white noise
Gaussian white noise

Array-Based

Arbitrary wave
Chirp pattern
Impulse pattern
Periodic random noise
Pulse pattern
Ramp pattern
Sawtooth wave
Sinc pattern
Sine pattern
Sine wave
Square wave
Triangle wave
Uniform white noise
Gaussian white noise

Windowing

Waveform/Array-Based

Blackman
Blackman-Harris
Cosine tapered
Exact Blackman
Exponential
Flat top
Force
General cosine
Hamming
Hanning
Kaiser-Bessel
Triangle

Digital Filters

Waveform-Based**

FIR/IIR

Array-Based

Bessel
Butterworth
Cascade
Chebyshev
Elliptic
Equiripple
FIR/IIR
Inverse Chebyshev
Median
Parks-McClellan

Statistics

1D, 2D, and 3D ANOVA
Chi square distribution
Contingency table
erf(x) and erfc(x)
F distribution
T distribution
General histogram
Histogram*
Inverse chi square Distribution
Inverse F distribution
Inverse Normal distribution
Inverse T distribution
Mean*
Median*
Mode*
Moment about mean
Mean squared error (MSE)
Normal distribution
Polynomial interpolation
Rational interpolation
Root mean square (rms)
Spline interpolant/interpolation
Standard deviation*
Variance

Signal Processing

Autocorrelation
Convolution
Cross power
Cross correlation
Decimate
Deconvolution
Derivative x(t)
Fast Hilbert transform
Fast Hartley transform
Integral x(t)
FFT/inverse FFT (Re + Im)
Inverse fast Hilbert Transform
Unwrap phase
Y[i]=Clip{X[i]}
Y[i]=X[i-n]

Curve Fitting

Exponential fit
General least squares linear fit
General polynomial fit
Linear fit
Nonlinear lev-mar fit
1D and 2D linear evaluation*
1D and 2D polynomial evaluation*
Numeric integration
Polar to rect/rect to polar
Scale 1D/2D
Find polynomial roots

Linear Algebra

Real/complex A X B*
Real/complex A X vector*
Determinant*
Dot product*
Inverse matrix*
Linear equations
Normalize matrix/vector
Outer product*
Trace
Unit vector
LU factorization
Cholesky factorization
QR factorization
SVD factorization
Eigenvectors/eigenvalues
Matrix condition number
Matrix norm and rank
Pseudo inverse matrix
Complex factorization
Complex inverse matrix
Complex linear equations
Complex eigenvectors/values
Complex determinant
Complex matrix condition number
Complex matrix norm and rank
Complex pseudo inverse matrix
Complex dot product
Complex outer product
Complex vector norm
Generate special matrix
Test positive definite matrix

Mathematics/Numerical Methods

Ordinary differential equations
Optimization
Root solving
Special functions

*Denotes VIs that ship with the Base package of LabVIEW for Windows 2000/NT/Me/9x.†
**Waveform VIs input a time-domain signal and output a scaled measurement.
†Visit *ni.com/info* and enter winxp for the latest operating system information.