SW

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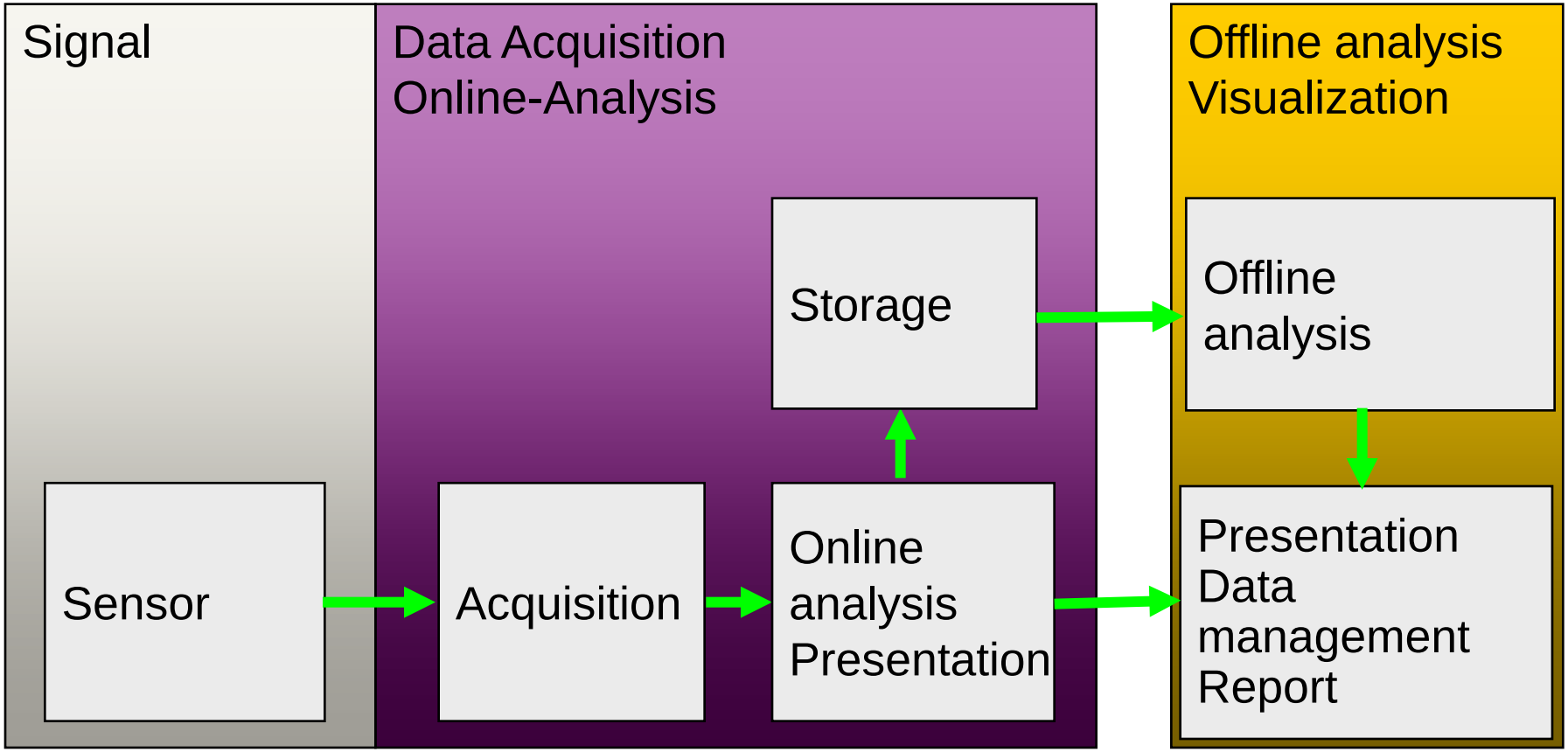
Tato prezentace je spolufinancována Evropským sociálním fondem a státním rozpočtem České republiky.

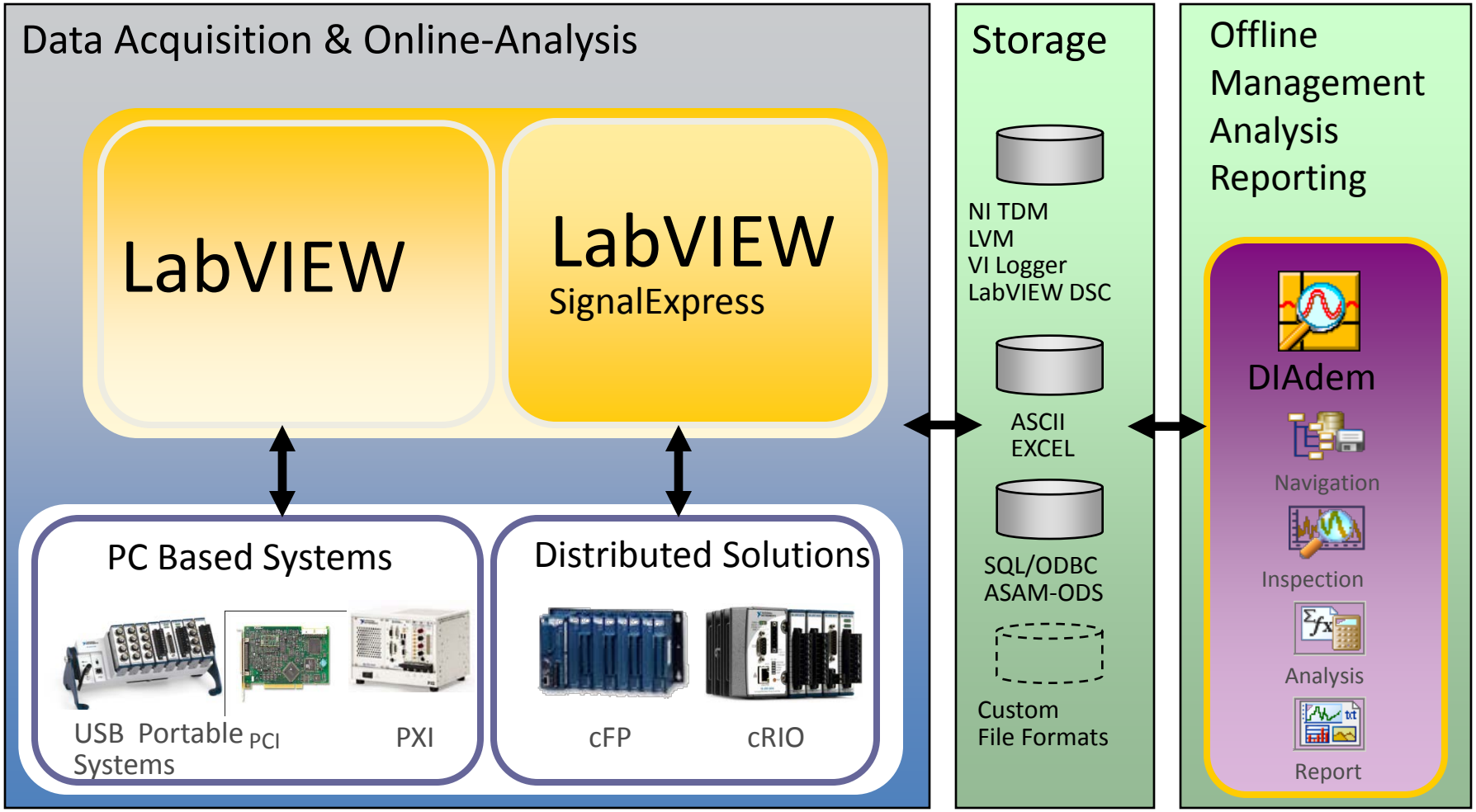
Agenda

- SW architecture of datalogging system
- Measurement services – “drivers”
- Interactive datalogging SW
- Development systems
- Datalogging and archiving
- Data-minig and Offline analysis

Structure of Data Logging Systems



One Platform – Many Data Logging Solutions



DAQ Software Options

Test and Data Management Software
NI TestStand, DIAdem

Interactive Tools
- SignalExpress

Application Development Software
- LabVIEW
  Graphical Development
- LabWindows/ CVI
  ANSI C Development
- Measurement Studio
  Visual Studio Components

Measurement and Control Services:
NI-DAQmx or NI-DAQmx Base

Data Acquisition Hardware



NI-DAQmx Measurement Services

- Easy multicore application development with LabVIEW and NI-DAQmx
- Optimizations for low latency and single-point control
- Easy multidevice synchronization and data logging
- Support for
  - LabVIEW 8.2 or later
  - NI LabWindows™/CVI and Measurement Studio
  - C/C++, C#, Visual Basic 6.0, and .NET

Measurement & Automation Explorer (MAX)

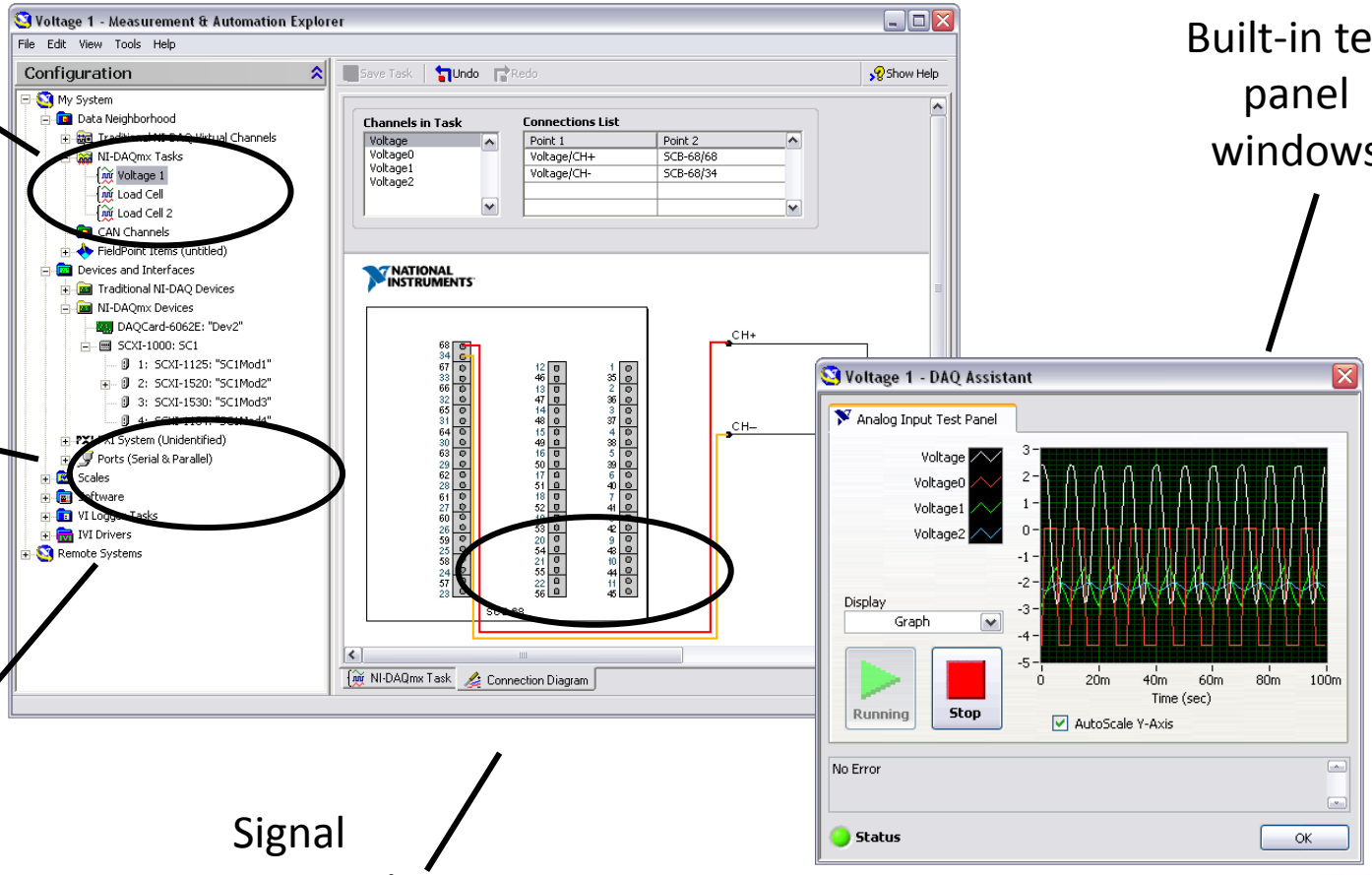
Task and channel creation

Simulated DAQmx devices

Device configuration and connection management

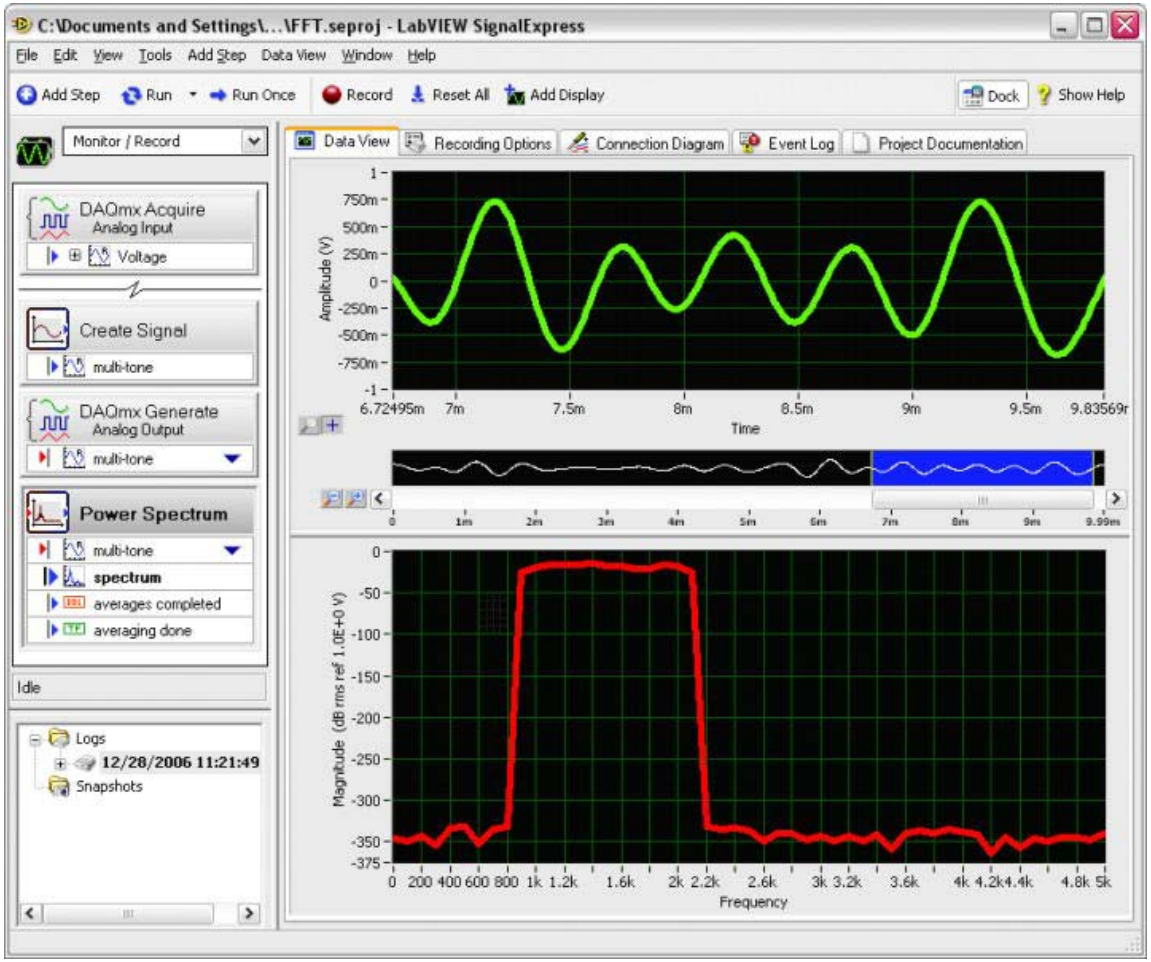
Signal connection diagrams

Built-in test panel windows



LabVIEW SignalExpress

Interactive Measurement Software

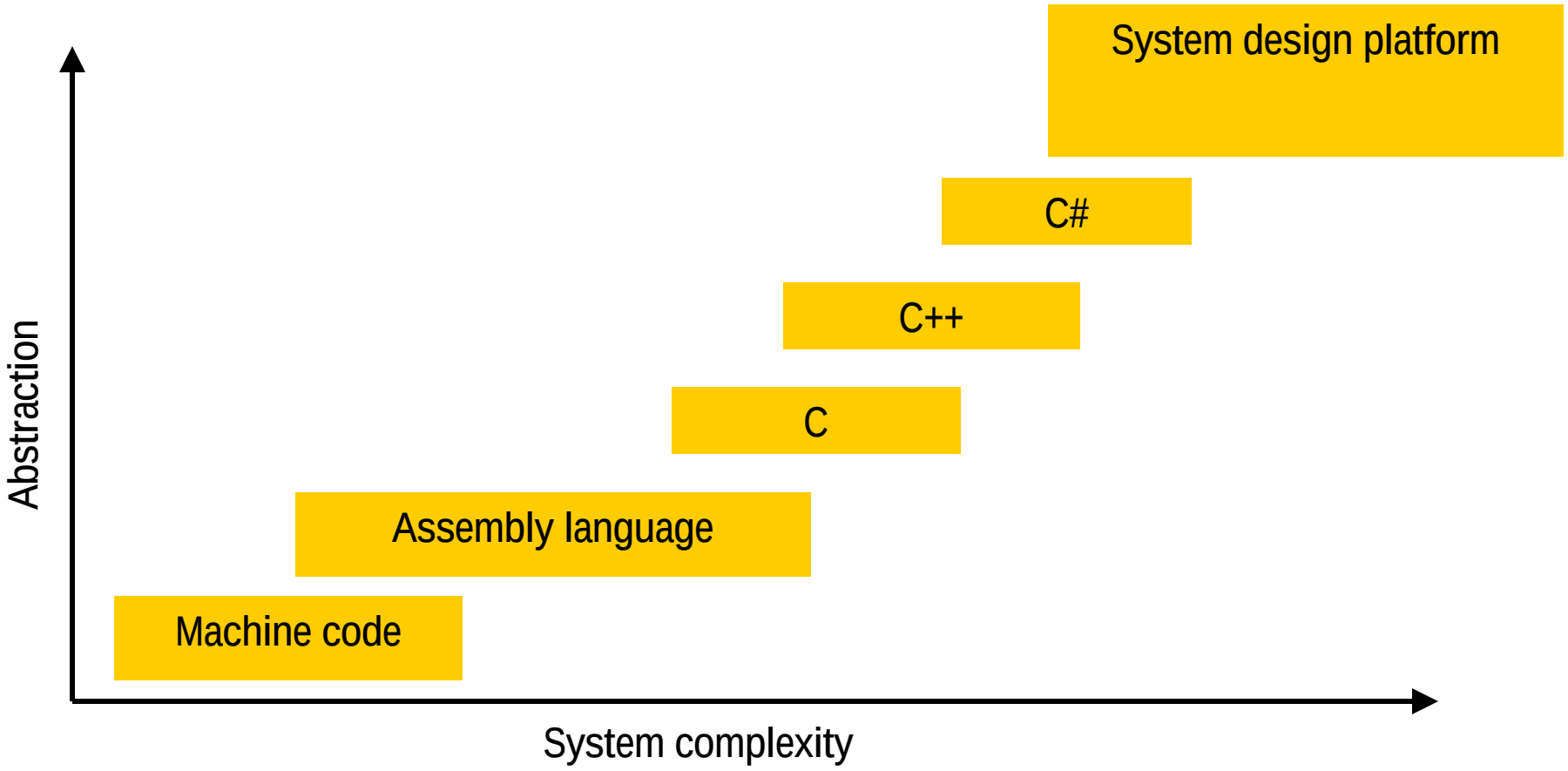


Project View

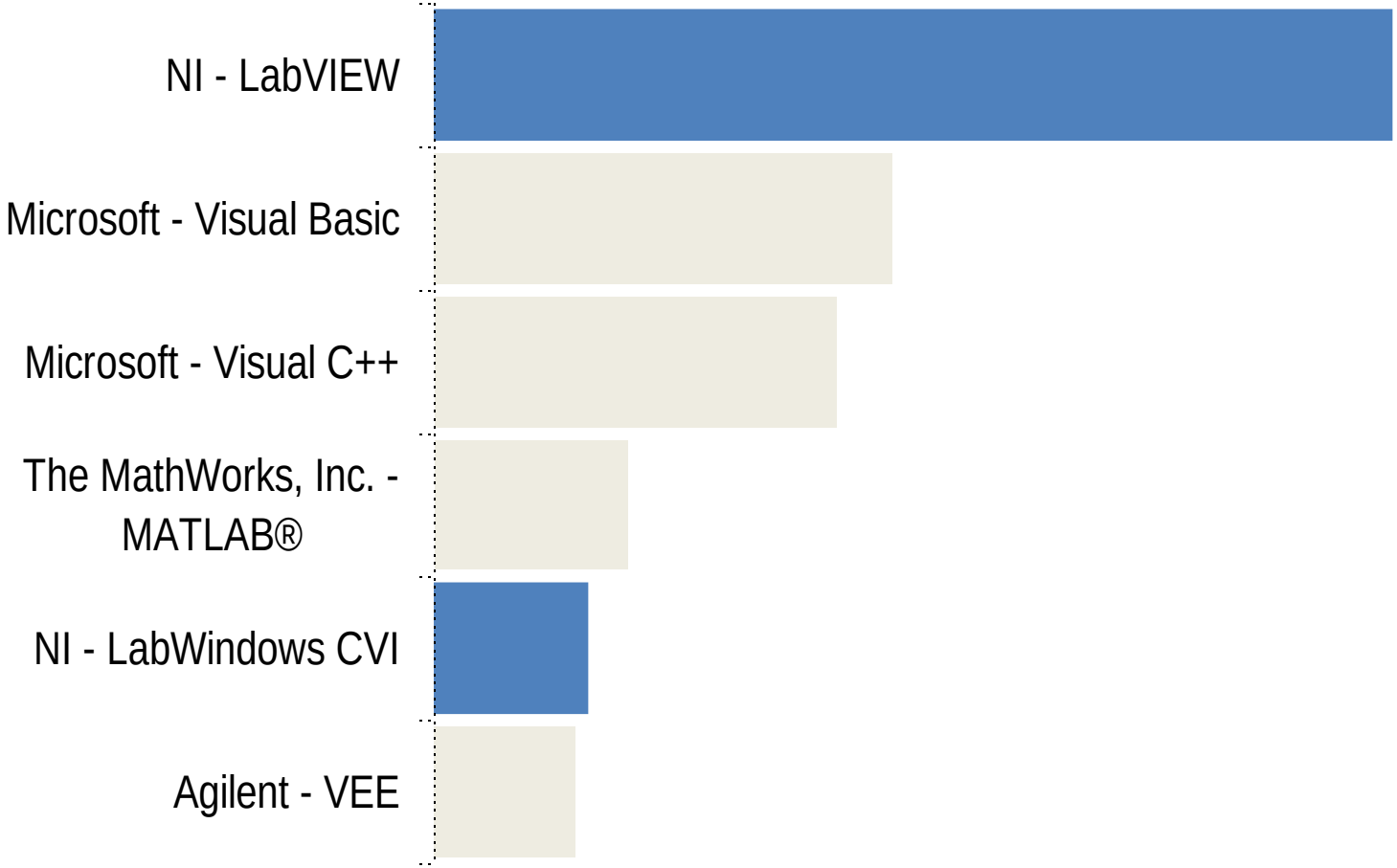
Data View

NATIONAL INSTRUMENTS LabVIEW SignalExpress

Evolution of Software Abstraction



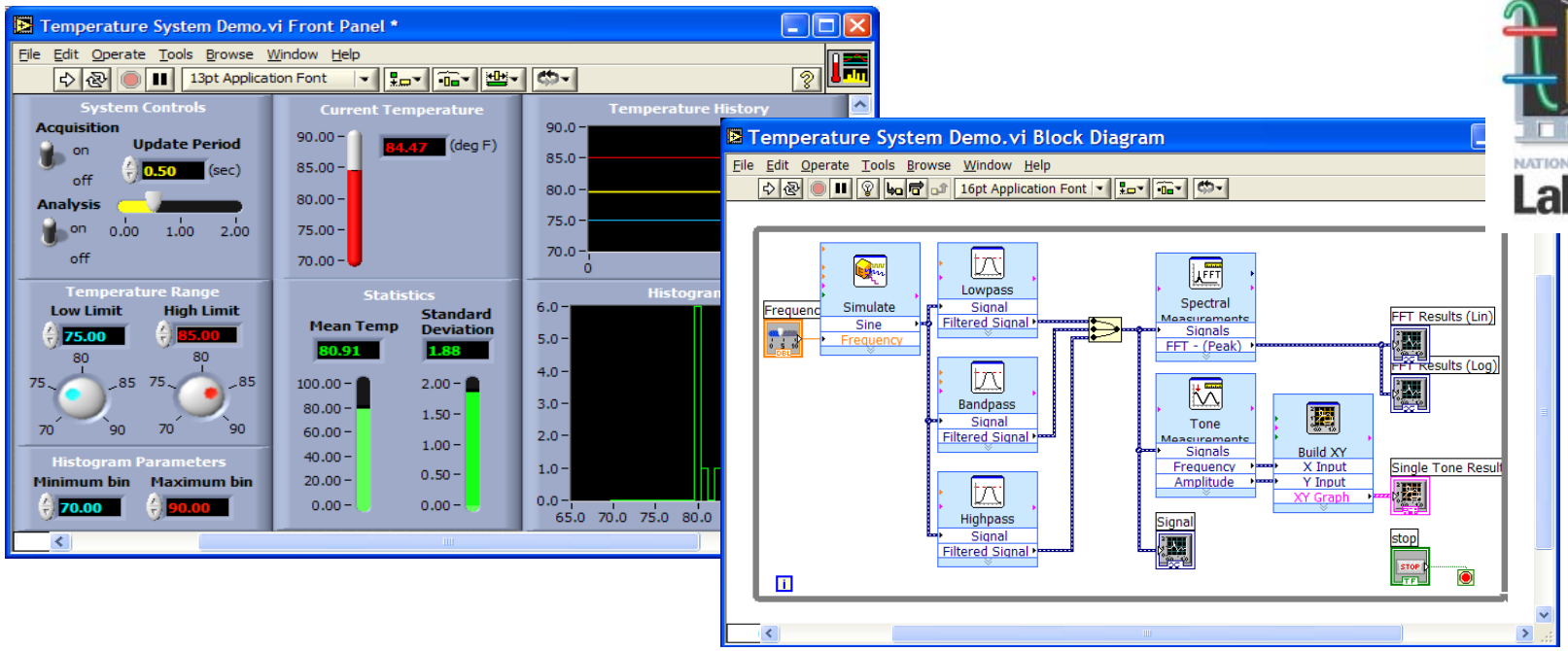
Software Used Most for DAQ and Instrument Control

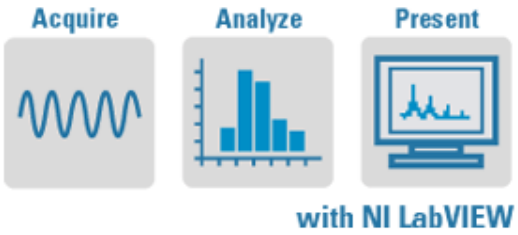


Survey: 2005 Global Product Awareness Tracking Study. Thinking of data acquisition and instrument control software, which of the following software packages do you use the most? Responses receiving less than 4% of mentions are not reported in the chart above. Other and none are not reported in the chart above. Total respondents=1006, Margin of error +/- 2.59%.

LabVIEW

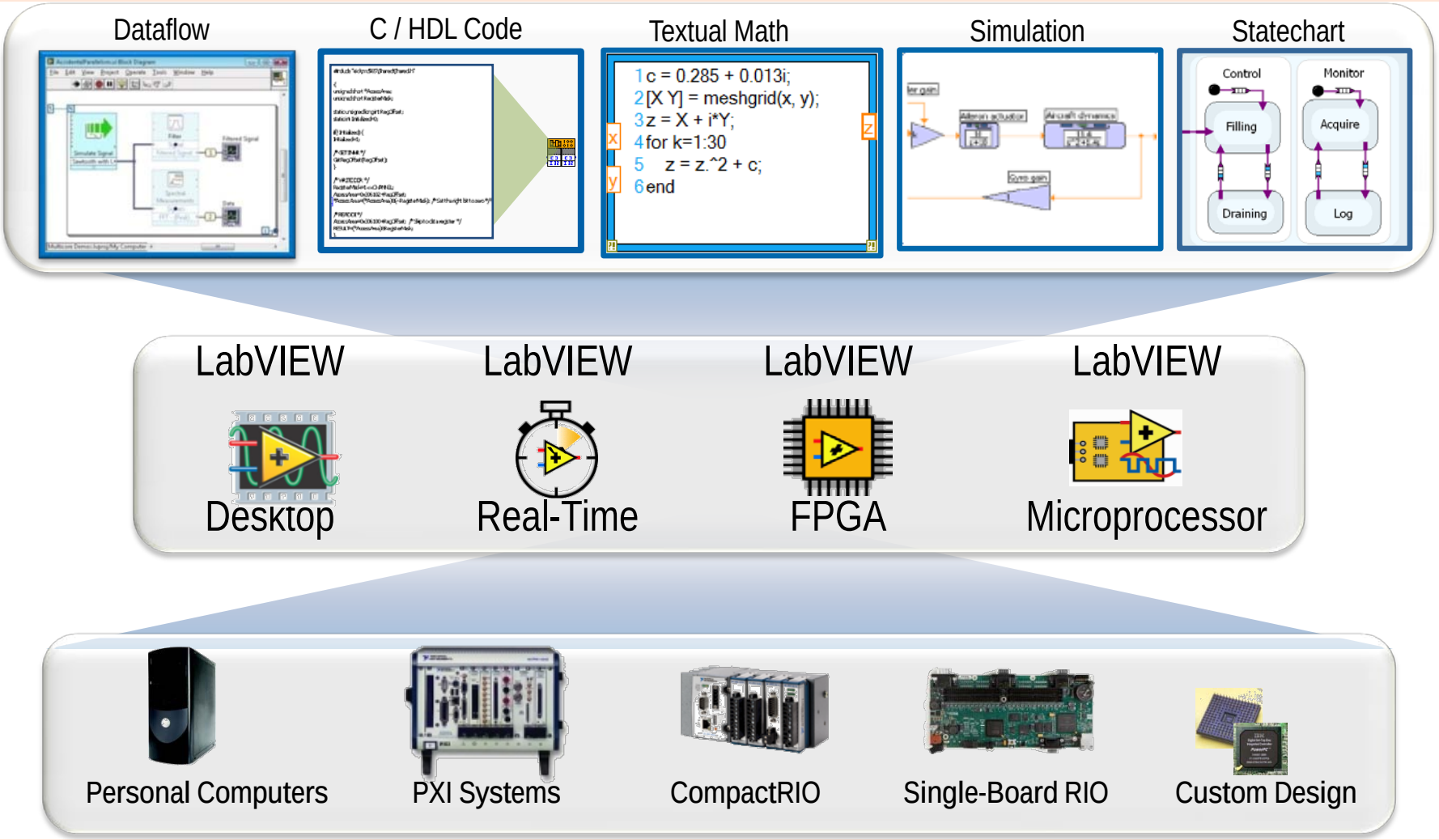
Graphical System Design





- Compiled graphical development environment
- Development time reduction of four to ten times
- Tools to acquire, analyze, and present your data
- Built-in Engineering Libraries
- Easily Connects to Hardware I/O

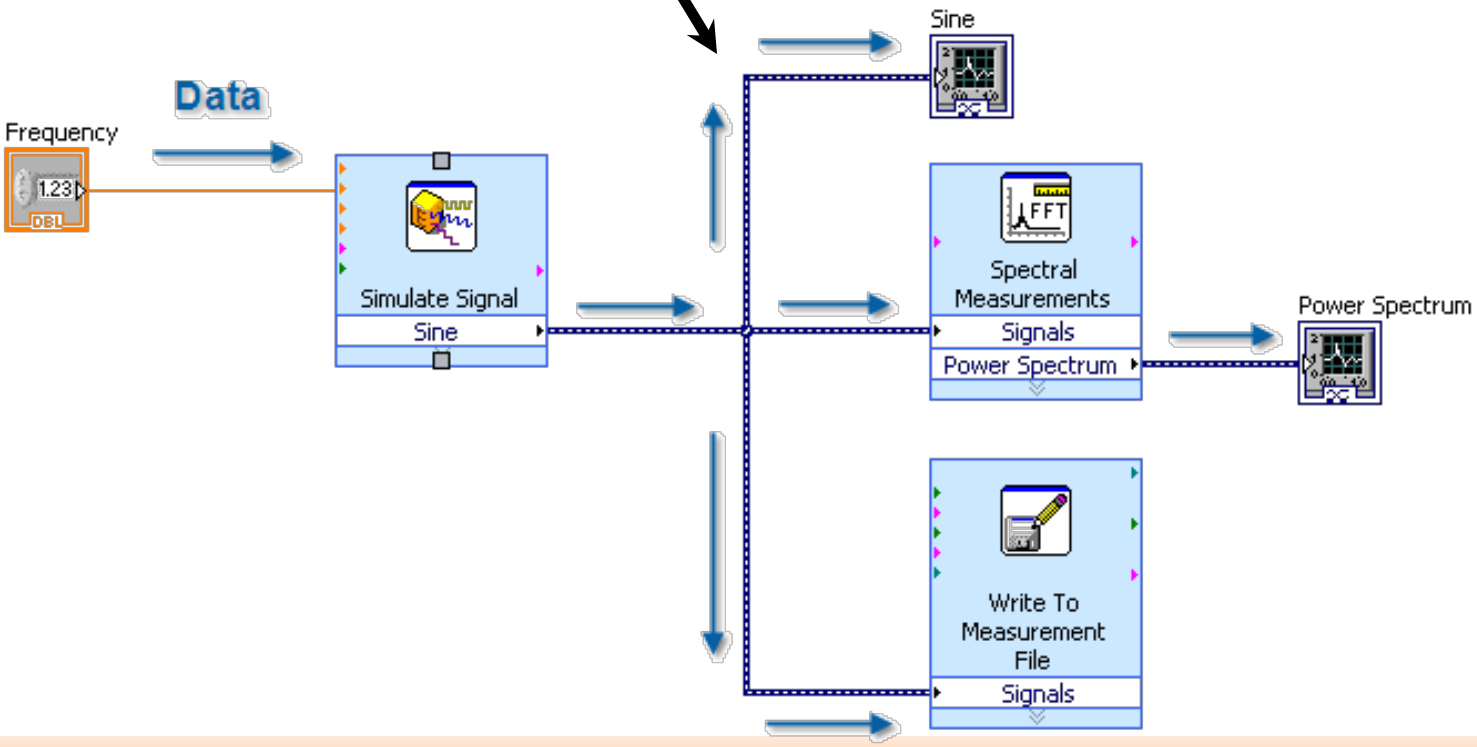
Models of Computation



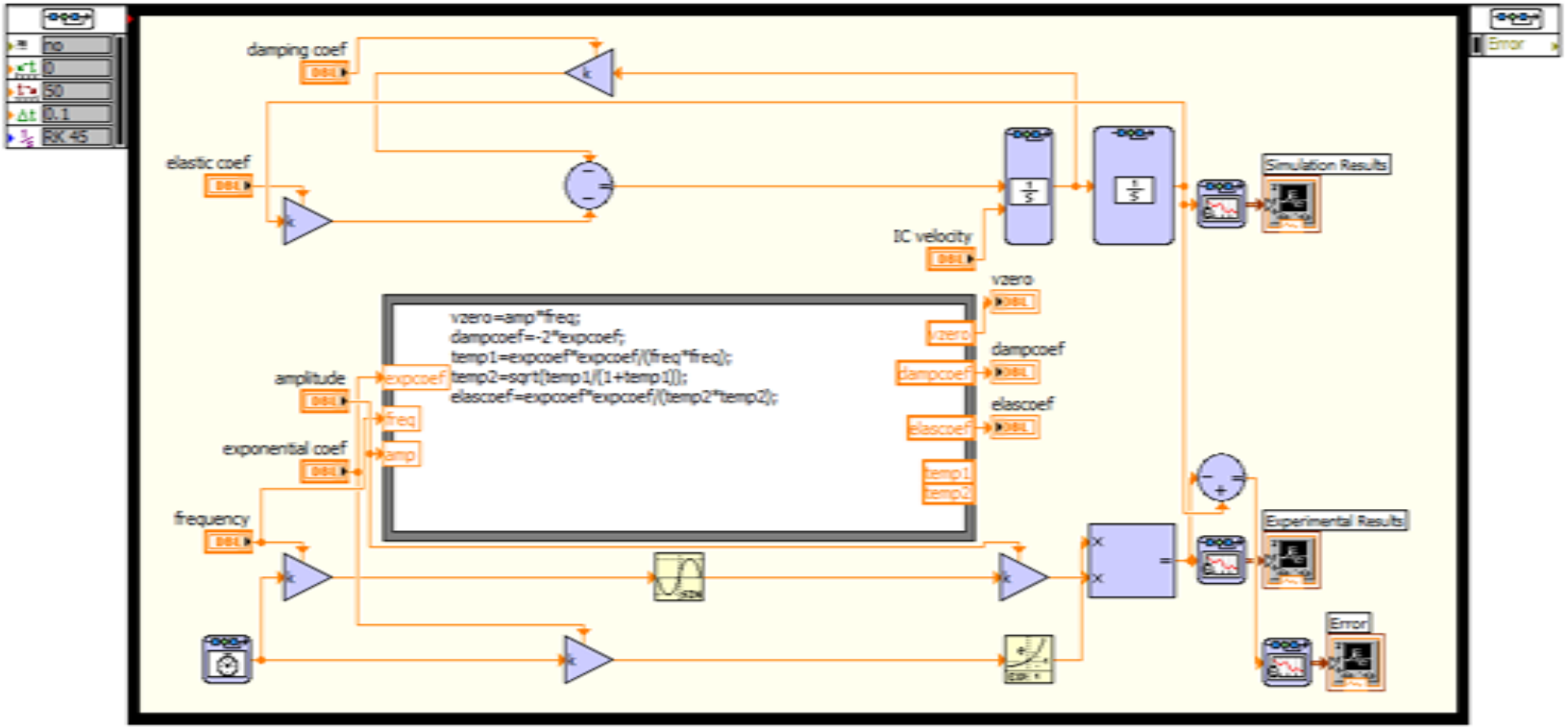
NI LabVIEW—Graphical Programming

1 Start of Data Flow

2 VIs execute once all inputs are available



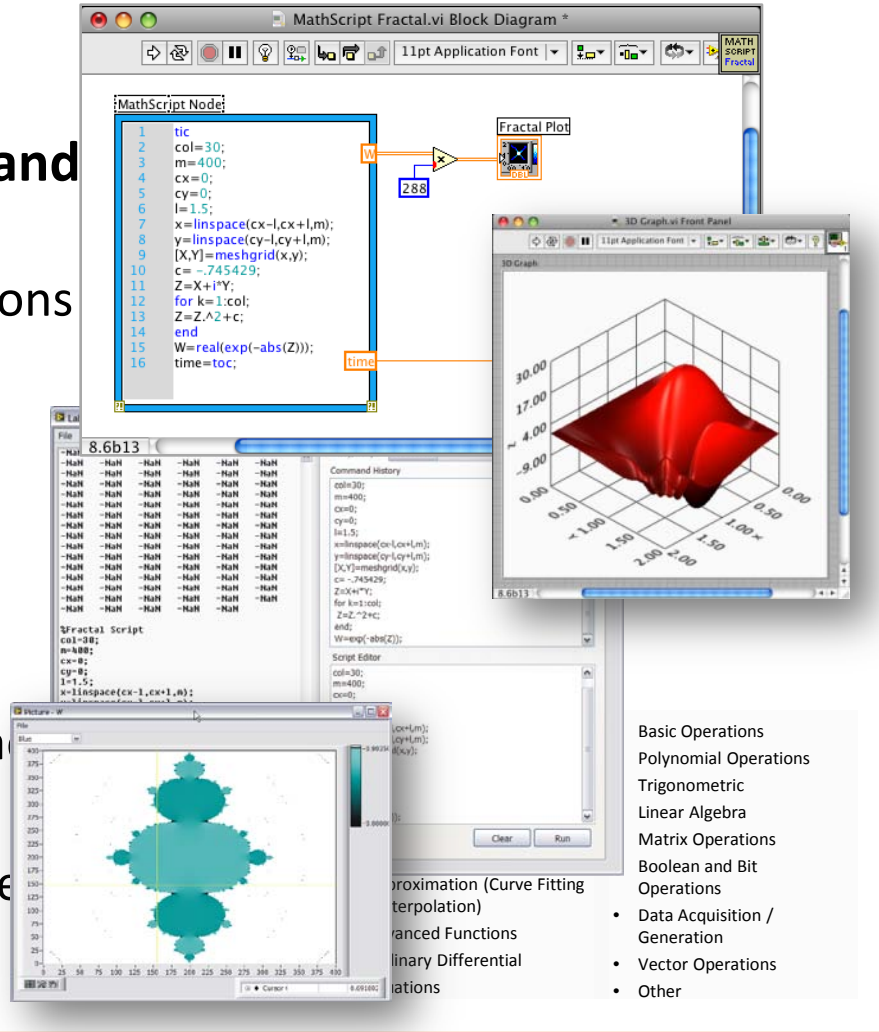
LabVIEW
Combined Graphical/Textual Programming



LabVIEW MathScript

Text-based signal processing, analysis, and math within LabVIEW

- Take advantage of 800 built-in functions
- Create user-defined functions
- Reuse many of your custom .m files



A native LabVIEW solution

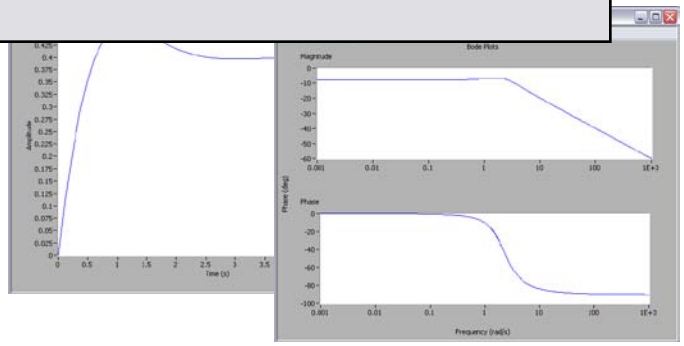
- Interactive and programmatic interfa
- Enables hybrid programming
- Does not require third-party software

Example

Little or No Learning Curve for Customers Familiar with The MathWorks Inc. MATLAB® Language Syntax

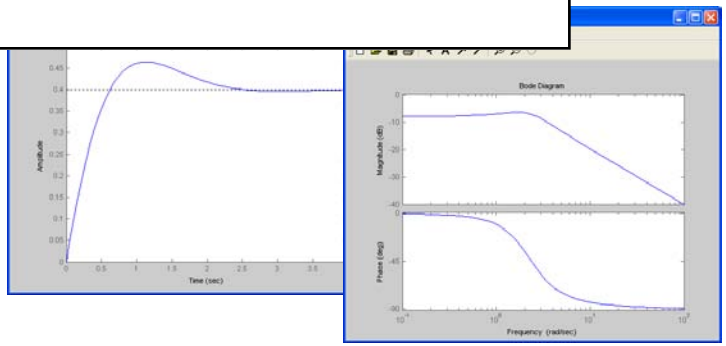
LabVIEW MathScript Syntax

```
>>num = [1 2];

>>den = [1 3 5];

>>sys = tf(num,den);

>>step(sys)

>>bode(sys)

>>pole(sys)
ans =

          -1.5 + 1.6583i
          -1.5 - 1.6583i
```

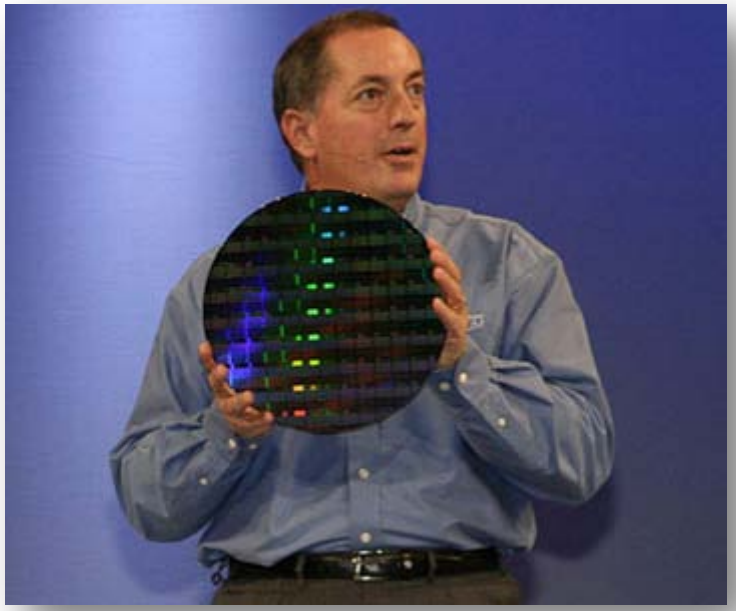


MATLAB ® syntax

```
>> num = [1 2];
>> den = [1 3 5];
>> sys = tf(num,den);
>> step(sys)
>> bode(sys)
>> pole(sys)

ans =

  -1.5000 + 1.6583i
  -1.5000 - 1.6583i
```



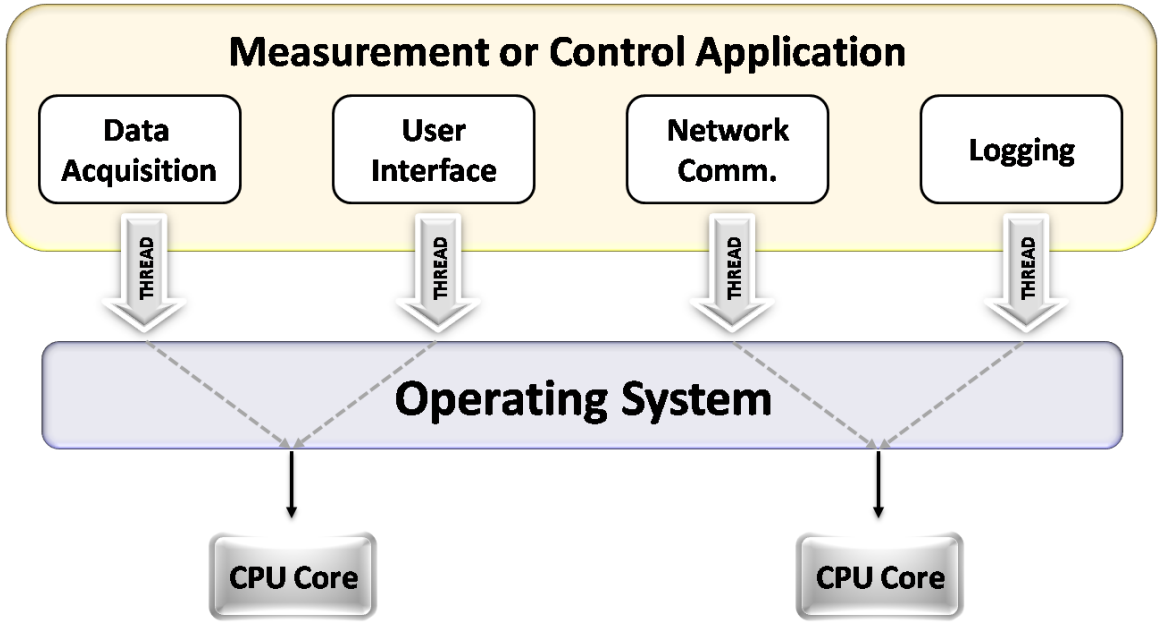
The Multicore Design Challenge



"Intel pledges 80 cores in five years."

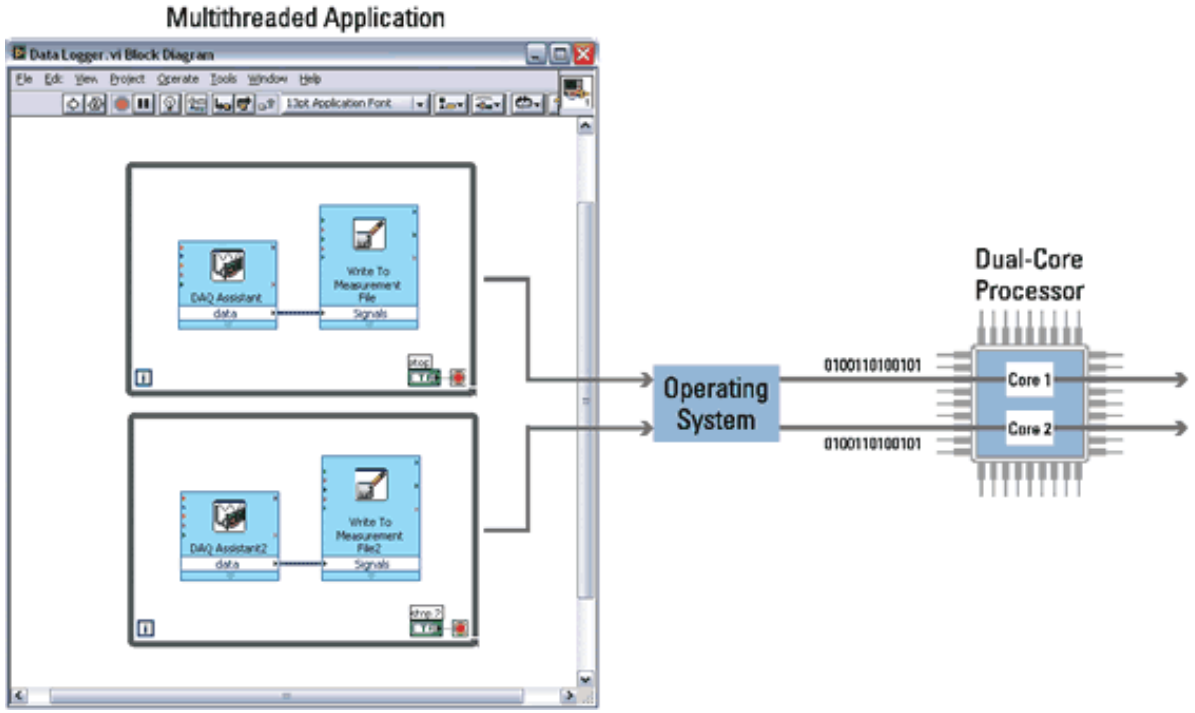
Headline following Intel Developers Forum
September 2006

Programming Multicore CPUs in LabVIEW



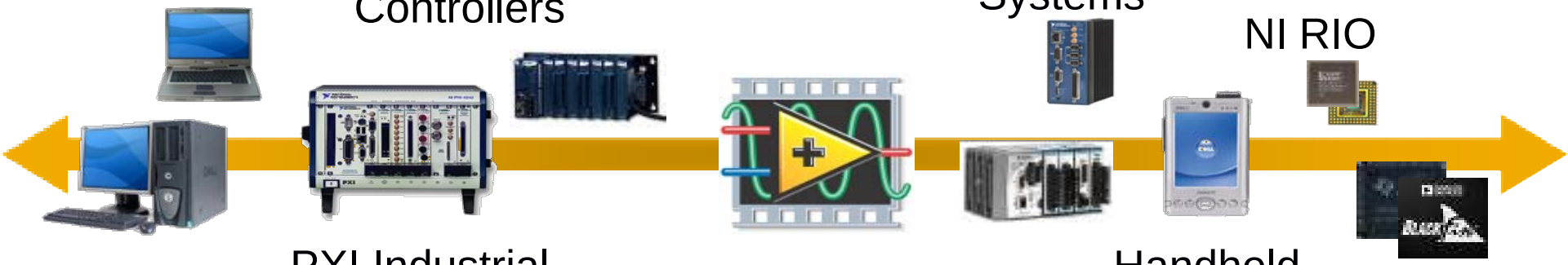
Applications **must** make use of threads to benefit from multicore processors.

Automatic Multithreading in LabVIEW



Graphical Code → Threads → Cores

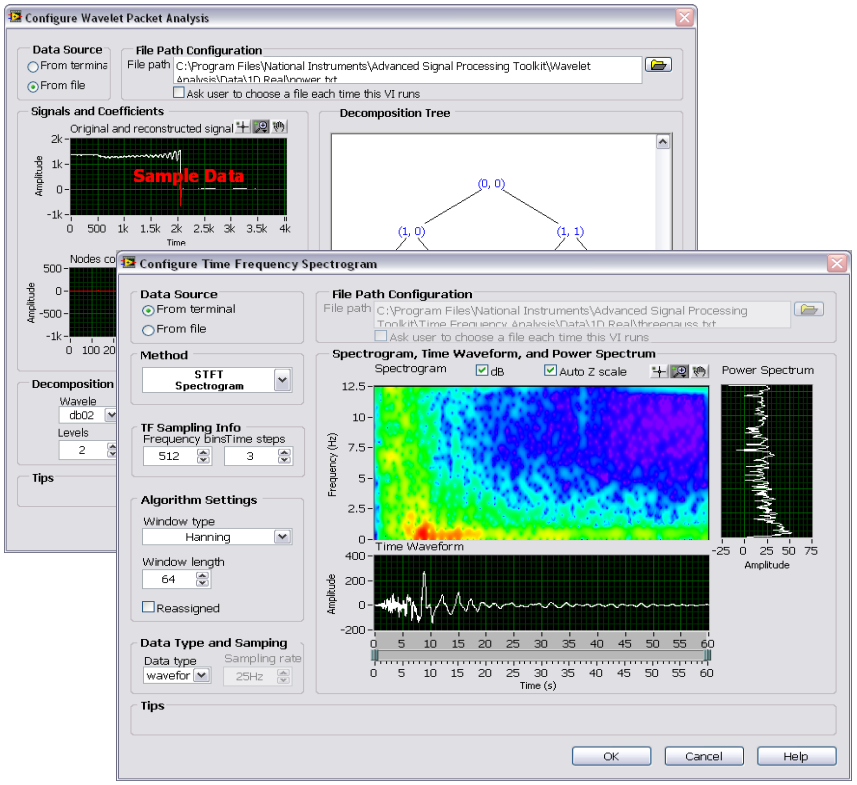
LabVIEW Everywhere



Platforms

- Desktop
  - Windows, Macintosh, Linux
- Industrial
  - Real-Time OS
  - PACs (IPCs, PXI, Cfp, CRIO, etc)
  - Industrial displays / touchpanels
- Mobile
  - Windows Mobile, Windows CE
- Embedded
  - FPGAs, Microprocessors, DSPs

LabVIEW Advanced Signal Processing Toolkit

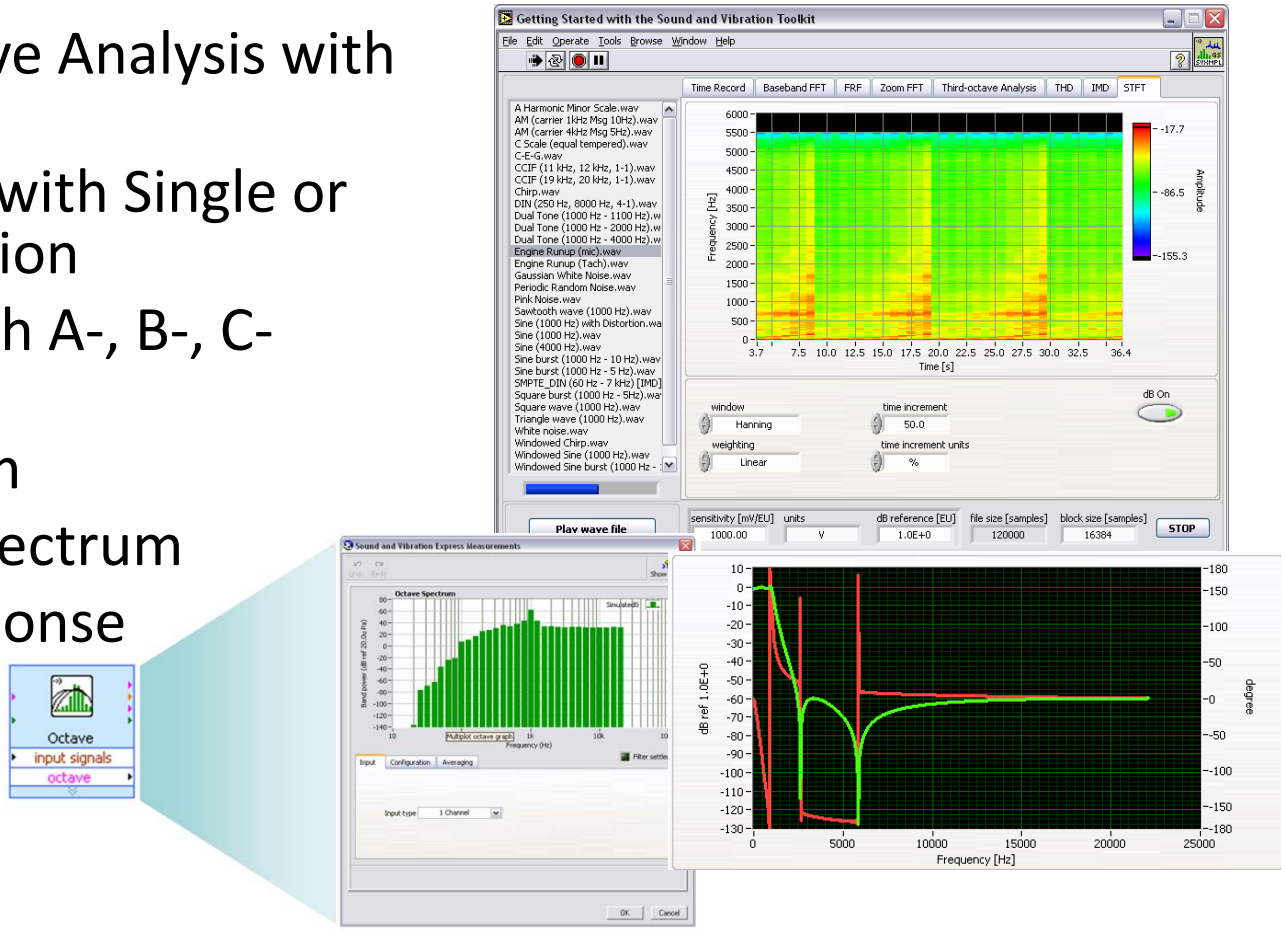


- Time-Frequency Analysis
- Time-Series Analysis
- Wavelet and filter bank design
- Applications
  - Automotive
  - Biomedical
  - Seismology
  - Radar/Sonar

LabVIEW Sound and Vibration Toolkit

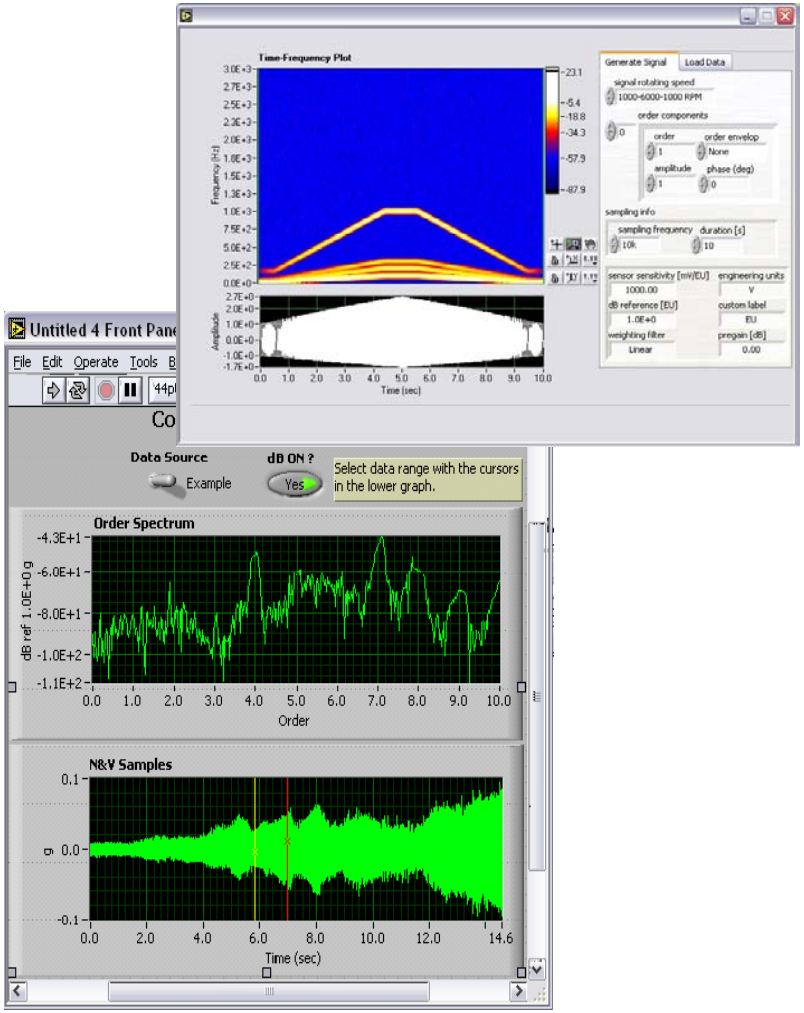
10 Express VIs

- Fractional Octave Analysis with Weighting
- Vibration Level with Single or Double Integration
- Sound Level with A-, B-, C-Weighting
- Power Spectrum
- Zoom Power Spectrum
- Frequency Response
- Peak Search
- Power in Band
- Limit Testing



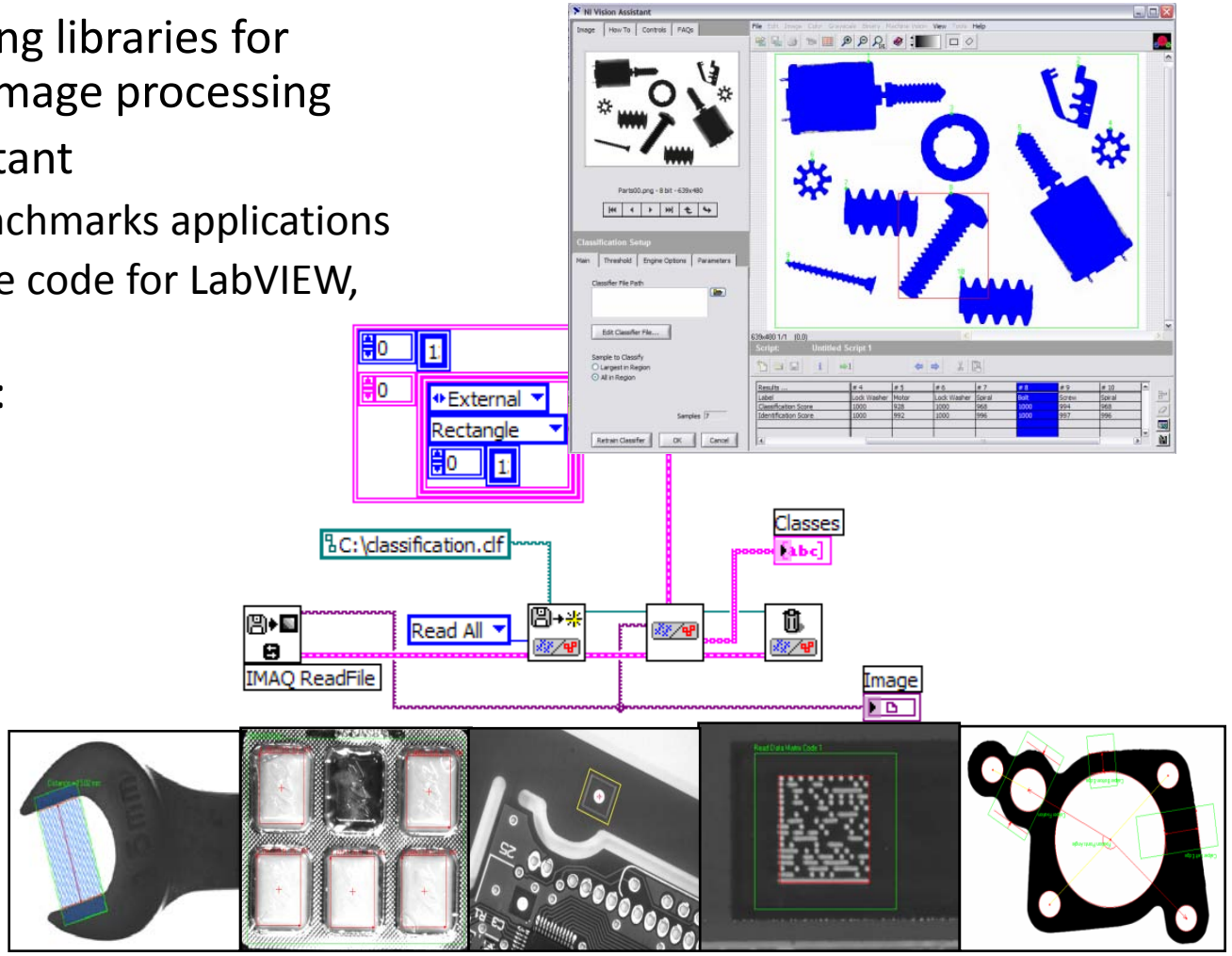
LabVIEW Order Analysis Toolkit

- Gabor order tracking algorithm analyzes signals from rotating machinery
- Resampling order analysis for online condition monitoring
- Flexible order energy selection in the joint time-frequency domain
- Plot order versus time or RPM
- Order extraction tools separate order-specific signal components
- Digital and analog tachometer signal processing



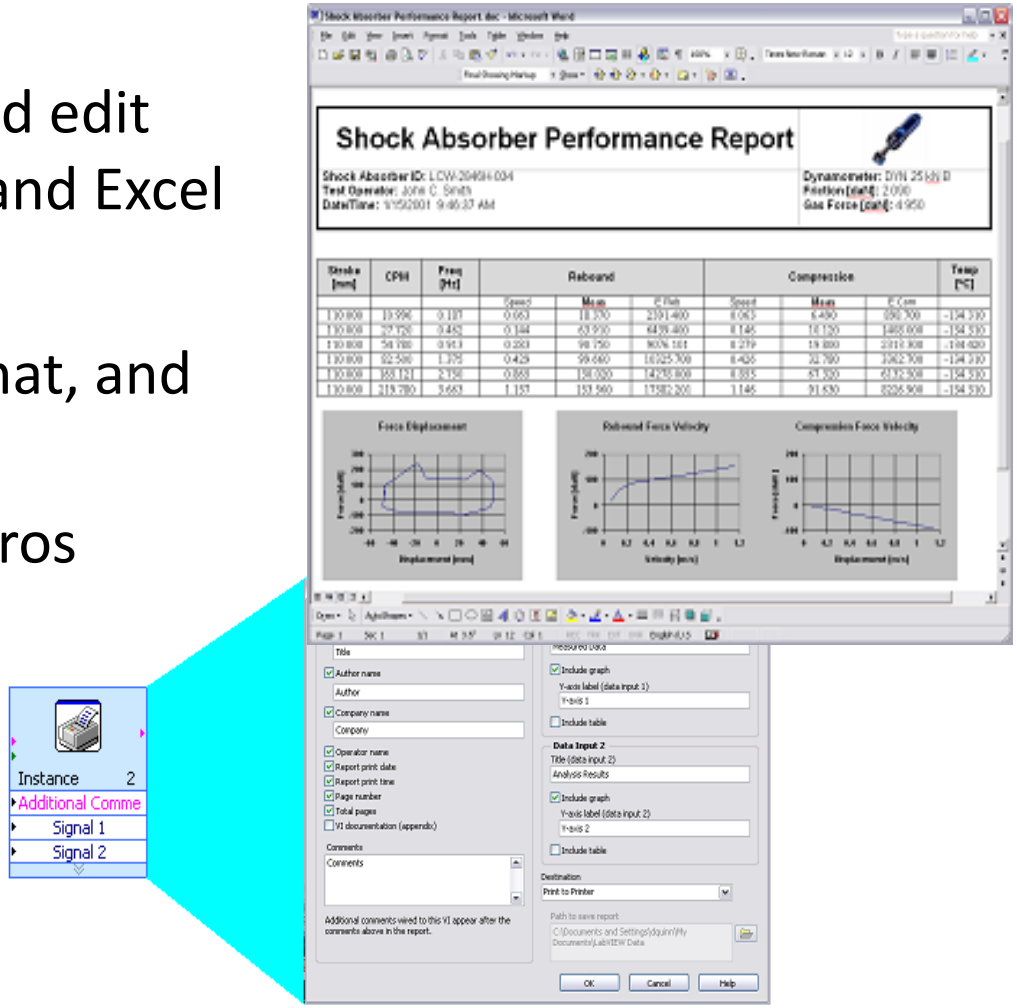
NI Vision Development Module

- LabVIEW programming libraries for machine vision and image processing
- Includes Vision Assistant
  - Prototypes and benchmarks applications
  - Generates complete code for LabVIEW, Visual Basic, and C
- Hundreds of tools to:
  - Enhance images
  - Check for presence
  - Locate features
  - Identify parts
  - Measure objects



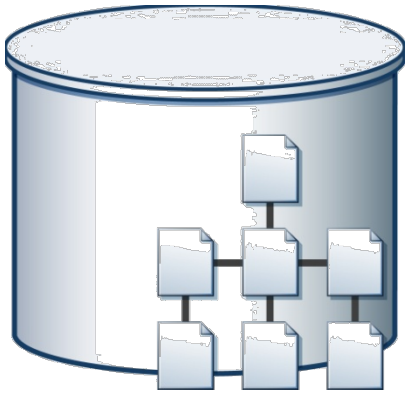
Report Generation Toolkit for Microsoft Office

- Programmatically create and edit reports in Microsoft Word and Excel
- Populate report templates
- Manage report layout, format, and appearance
- E-mail reports and run macros
- Express VI included



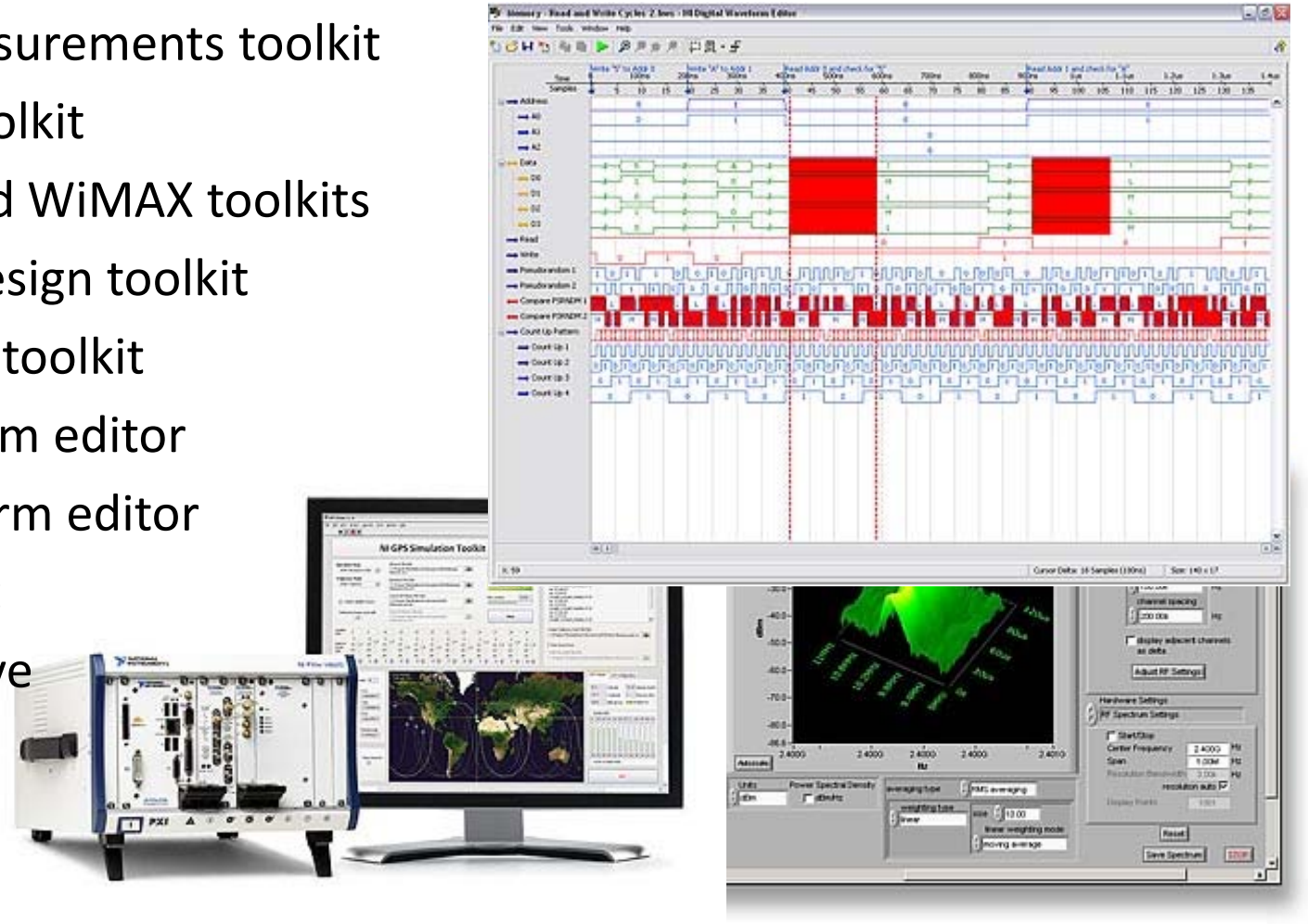
Database Connectivity Toolkit

- Insert, select data from OLE DB, ODBC databases
  - Microsoft Access, SQL Server, Oracle, etc.
- Create, drop tables
- Save records in XML format
- Execute SQL queries
  - Immediate, parameterized
- Execute stored procedures
- Accept, reject multiple operations (transactions)



Other LabVIEW tools

- Spectrum Measurements toolkit
- Modulation Toolkit
- GPS, WLAN and WiMAX toolkits
- Digital Filter Design toolkit
- Adaptive Filter toolkit
- Digital waveform editor
- Analog waveform editor
- Internet toolkit
- Switch executive
- OPC servers
- …



PC-Based Real-Time and Embedded

What is Real-Time?

- Real-time **does not** always mean real fast
- Real-time means **absolute reliability**
- Real-time systems have timing constraints that must be met to avoid failure
- Determinism is the ability to complete a task within a fixed amount of time

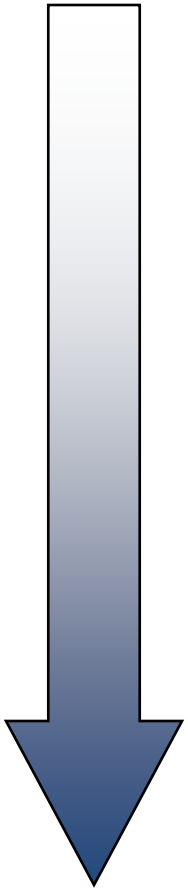
Operating System Characteristics

General Purpose OS

- High-priority tasks can be preempted by lower-priority tasks
- Extraneous background programs
  - Screen savers, disk utilities, virus software, etc.
- Peripheral Interrupts
  - Mouse, keyboard, etc.

Real-Time OS

- Scheduler ensures high-priority tasks execute first
- Direct control over all tasks
- Stand-alone (no mouse, keyboard, etc.)



Loop Rate	Software Jitter
10-100 Hz	Unbounded
Up to 50 kHz	Bounded

LabVIEW Real-Time Hardware Targets

LabVIEW Real-Time

Industrial Controllers

PXI

Desktop or Industrial PC

Compact Vision System

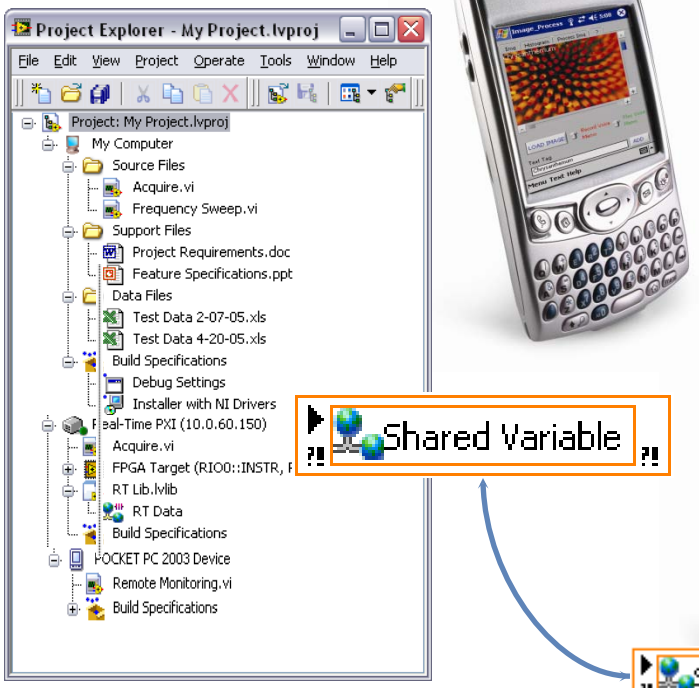
CompactRIO

LabVIEW Touch Panel Module

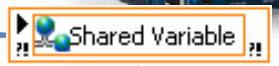
- Add-on to LabVIEW for building HMI applications
  - Ability to deploy to Windows CE and XP embedded HMI hardware
  - Target NI and 3rd party touch panels
- Familiar LabVIEW development environment
  - Rich user interface
  - Advanced control and analysis
  - Ability to use programming structures

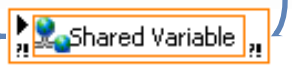
LabVIEW Mobile Module

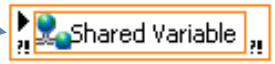
Take LabVIEW With You



- Handheld Data Acquisition and Instrument Control
- Communicate using 802.11, Bluetooth, SMS Text Messaging, IrDA and serial protocols
- Easily connect to distributed applications using shared variables



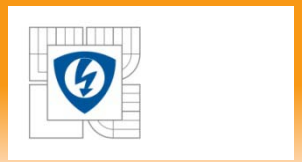


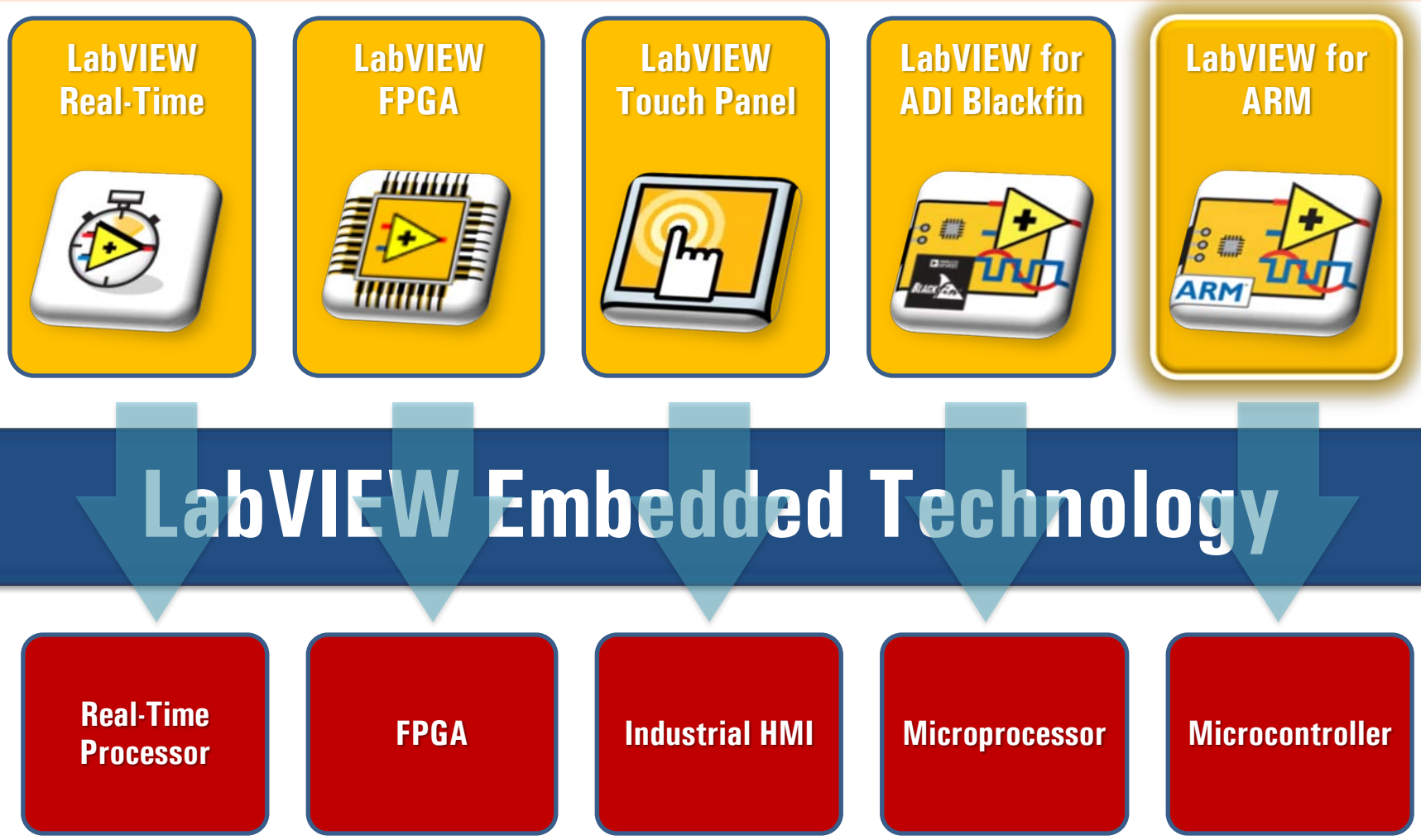


LabVIEW Mobile Module

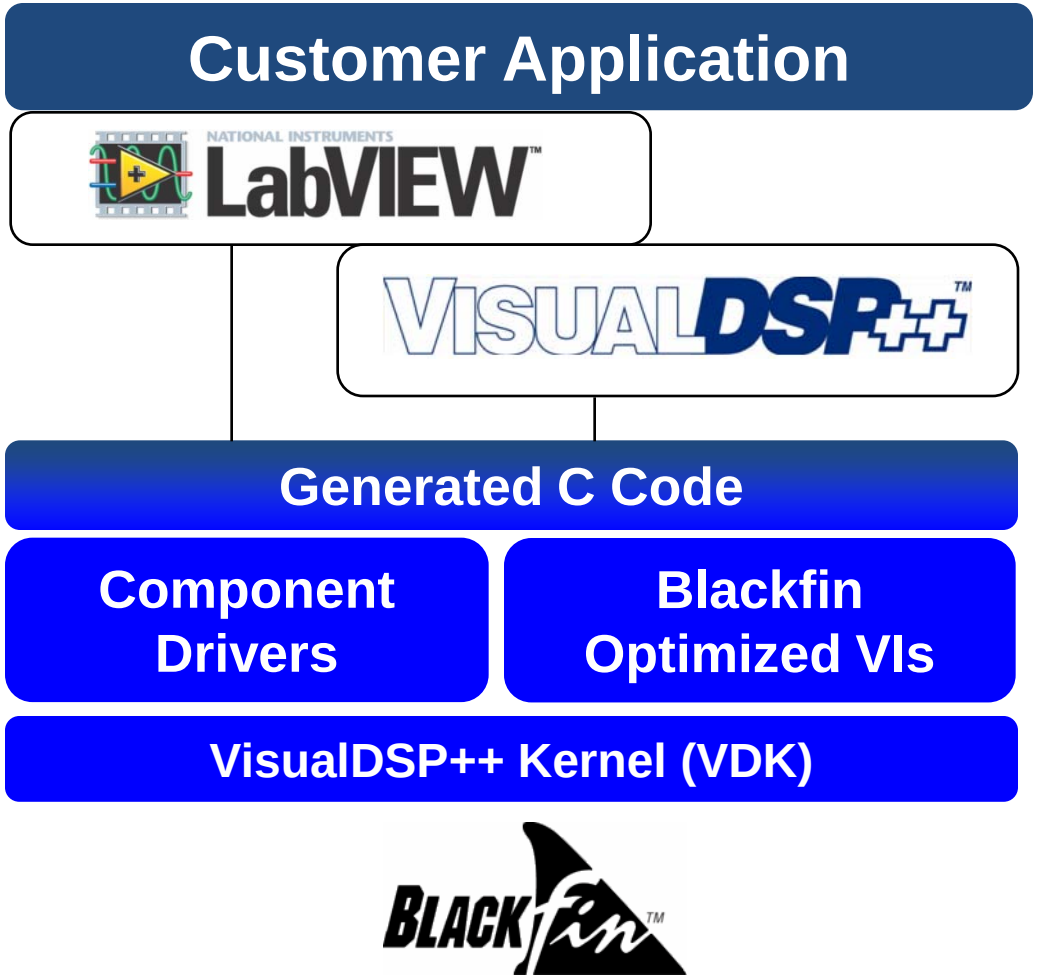
DAQ device support

- USB
  - USB-6008, 6009
    - MIO AI, AO, CTR, DIO
  - USB-6210, 6211, 6215, 6218
    - MIO AI, AO, CTR, DIO
  - USB-9215A, 9211A, 9233, 9234
    - Simultaneous AI, thermocouple, IEPE acceleration, accoustic
- Compact Flash
  - CF6004




LabVIEW Real-Time
LabVIEW FPGA
LabVIEW Touch Panel
LabVIEW for ADI Blackfin
LabVIEW for ARM
ARM
LabVIEW Embedded Technology
Real-Time Processor
FPGA
Industrial HMI
Microprocessor
Microcontroller

LabVIEW Embedded Module for ADI Blackfin

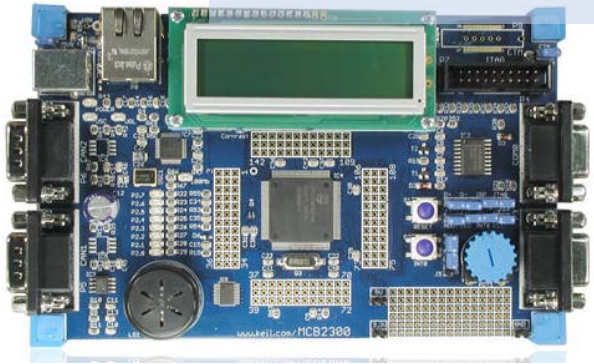


LabVIEW Embedded Module for ARM®

- Over 260 supported processors
- Integrated drivers for analog, digital, and communications
- Desktop Simulation support for software development

NATIONAL INSTRUMENTS LabVIEW™

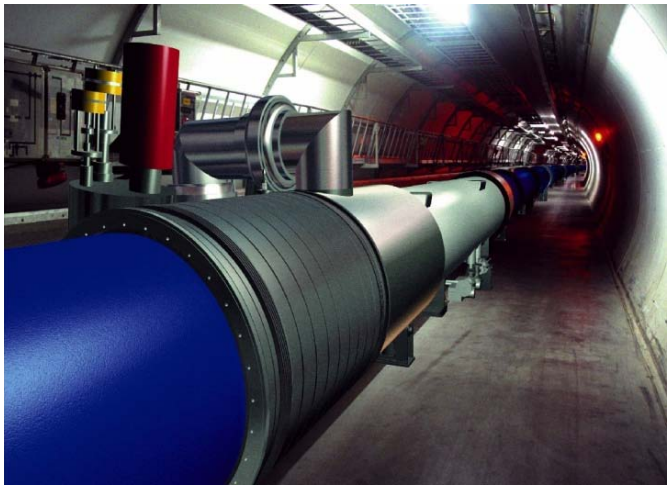
ARM®



CERN Uses NI LabVIEW Software and PXI Hardware to Control World's Largest Particle Accelerator

Application:
An FPGA-based motion control system capable of intercepting misguided or unstable particle beams.

Challenge:
Measuring and controlling, in real time, the position of bulk components to absorb energetic particles out of the nominal beam core with high reliability and accuracy at the world's most powerful particle accelerator, the Large Hadron Collider (LHC).

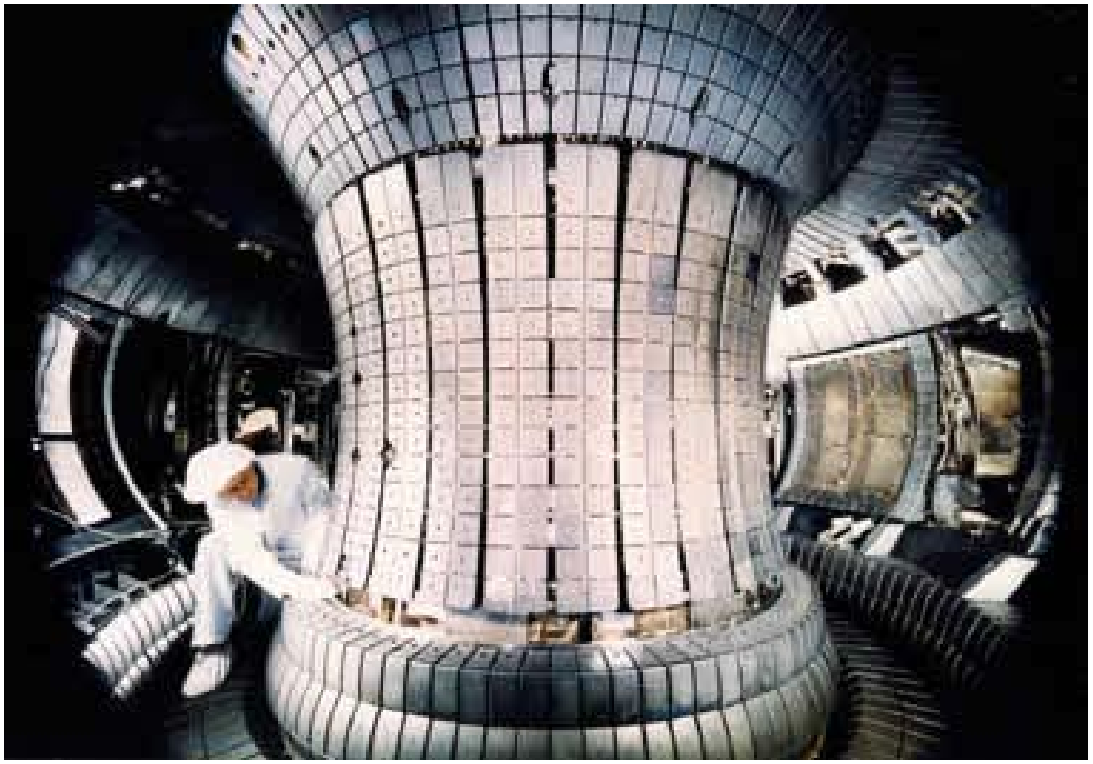


Products:
Data Acquisition, Real-Time Module, R Series, LabVIEW, SoftMotion Controllers, PXI/CompactPCI, FPGA Module

"We selected the LabVIEW and PXI solution for the deployment platform due to the small size, ruggedness, and cost savings over the traditional VME and programmable logic controller-based model. "

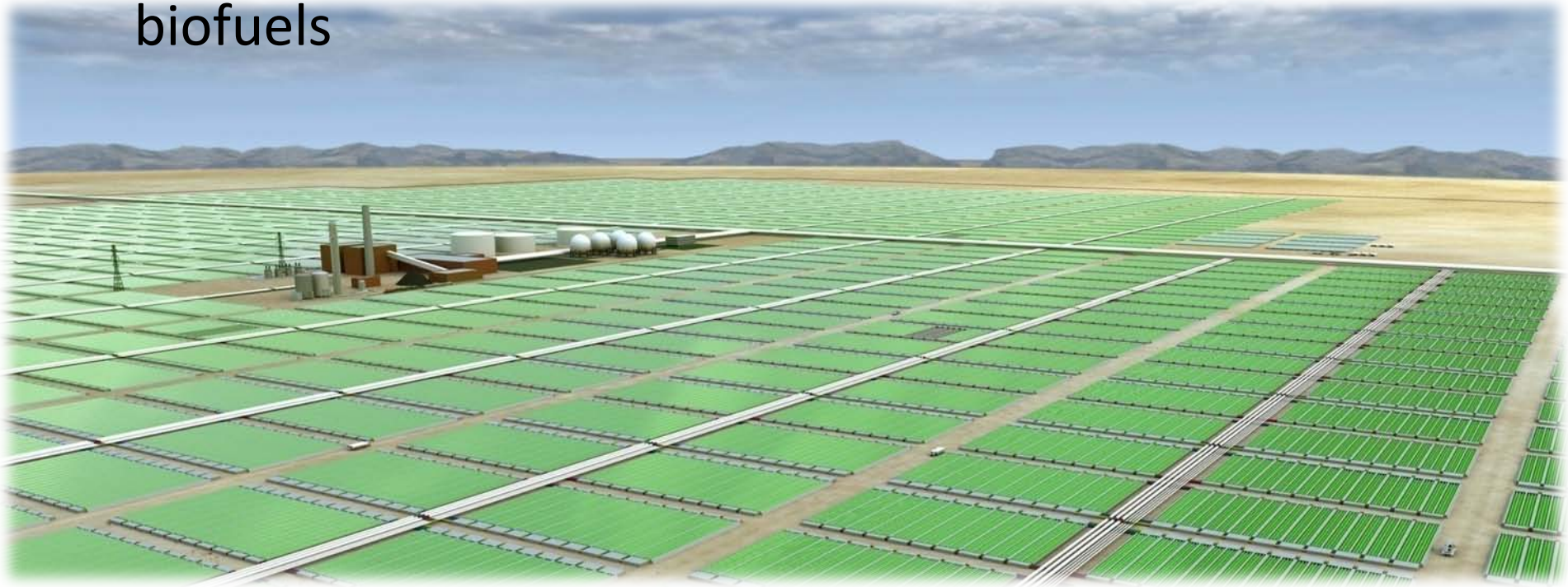
High-Speed Custom Control

Max-Planck-Institute Munich: Control of plasma in nuclear fusion tokamak with NI LabVIEW on 8 core system using data parallelism technique.

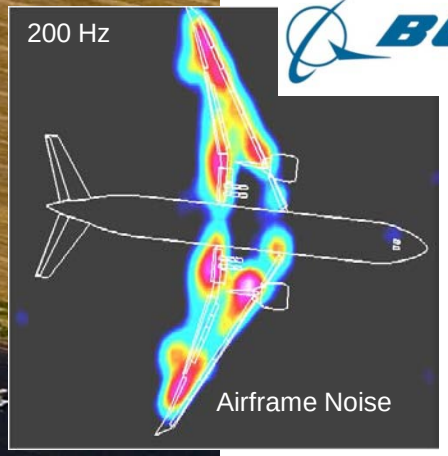


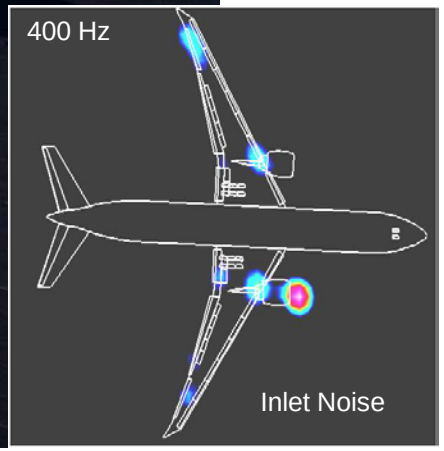
Biofuel Production from Algae

- Algae converts sunshine into chemical energy
- More efficient (water and land) than crop-based biofuels



787 aircraft noise analysis





BOEING

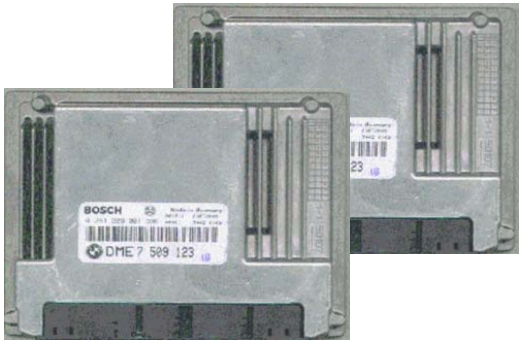
HiL Testsystem for BMW Hydrogen 7

Engine Control for BMW Hydrogen 7:

- 2x Master-Slave ECUs (V12-Engine)
- Gasoline Engine Production ECUs extended for H2-Operation
- Engine HiL operation requires other Car ECUs (Anti-Theft-Device, Gateway)

Complete Integration in BMW HiL Testprocess:

- Integration of BMW Model platform
- Connection to BMW Testautomation
- „Look & Feel“ similar to all other Powertrain-HiLs



Project specific HiL Requirements:

- Complete connection of all ECU Interfaces (4x adjustable Cam shafts, 6x Knock detectors, Fuel Injection, Lambda Probes, CAN- & BSD-Busses, H2-extensions…)
- Integrated electrical equivalent Loads
- Compact Size for Desktop Bench operation (to be carried to external test drive facilities)

What is CVI

C for Virtual Instrumentation

NATIONAL INSTRUMENTS™
LabWindows/CVI™

Complete ANSI C integrated development environment (IDE) for test, measurement, and automation applications

IDE
- Editor
- Debugger
- Compiler
- Linker
- Workspace
- Function panels

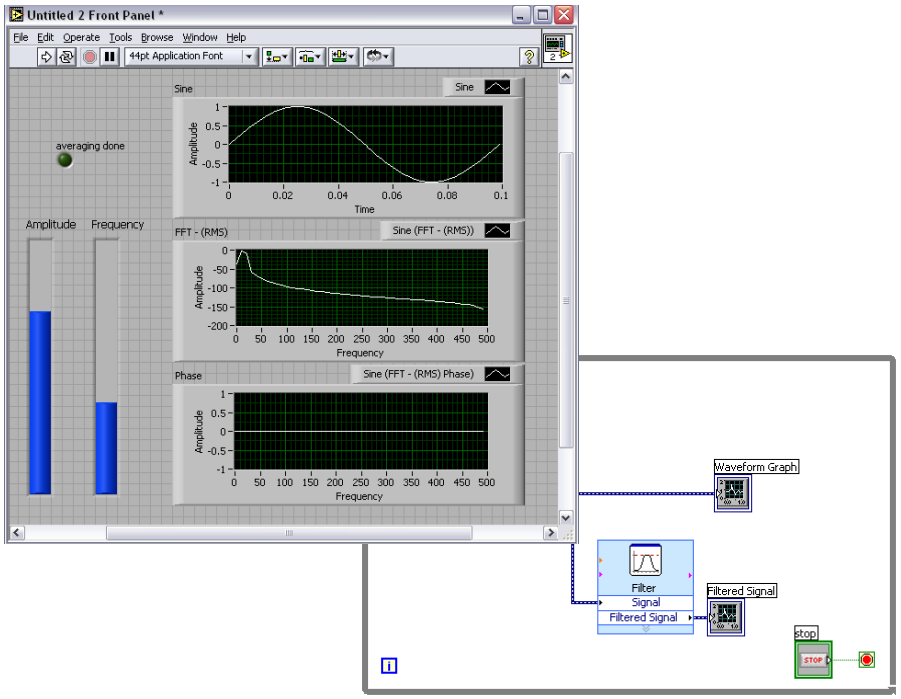
Engineering Specific Functionality
- Scientific user interface controls
- Analysis libraries
- Data acquisition libraries and wizards
- Instrument control libraries, wizards, and drivers

Specific Features and Benefits

- Faster/Easier Development and Debugging
  - Interactive function panels, drag and drop, intuitive configuration, CodeBuilder, remote debugging
- High Performance Execution
  - Efficient and fast executables, advanced multithreading capabilities, proven reliability
- Reusable/Standard Components
  - DLLs, COM, ActiveX, .NET server and component capabilities
- Designed for Engineers
  - Complete instrument support, advanced hardware support, powerful visualization capabilities, scientific analysis tools

Process and Analyze Data with ADE (LabVIEW)

- Over 600 built-in functions for signal processing, analysis and math:
- Signal synthesis
- Curve fitting and interpolation
- FFT-based frequency analysis
- Mathematics
- Probability and statistics
- Time- and frequency-domain analysis
- Digital signal processing
- Waveform alignment and resampling
- Measurement-oriented analysis libraries
- Application-specific toolkits
- Much more…



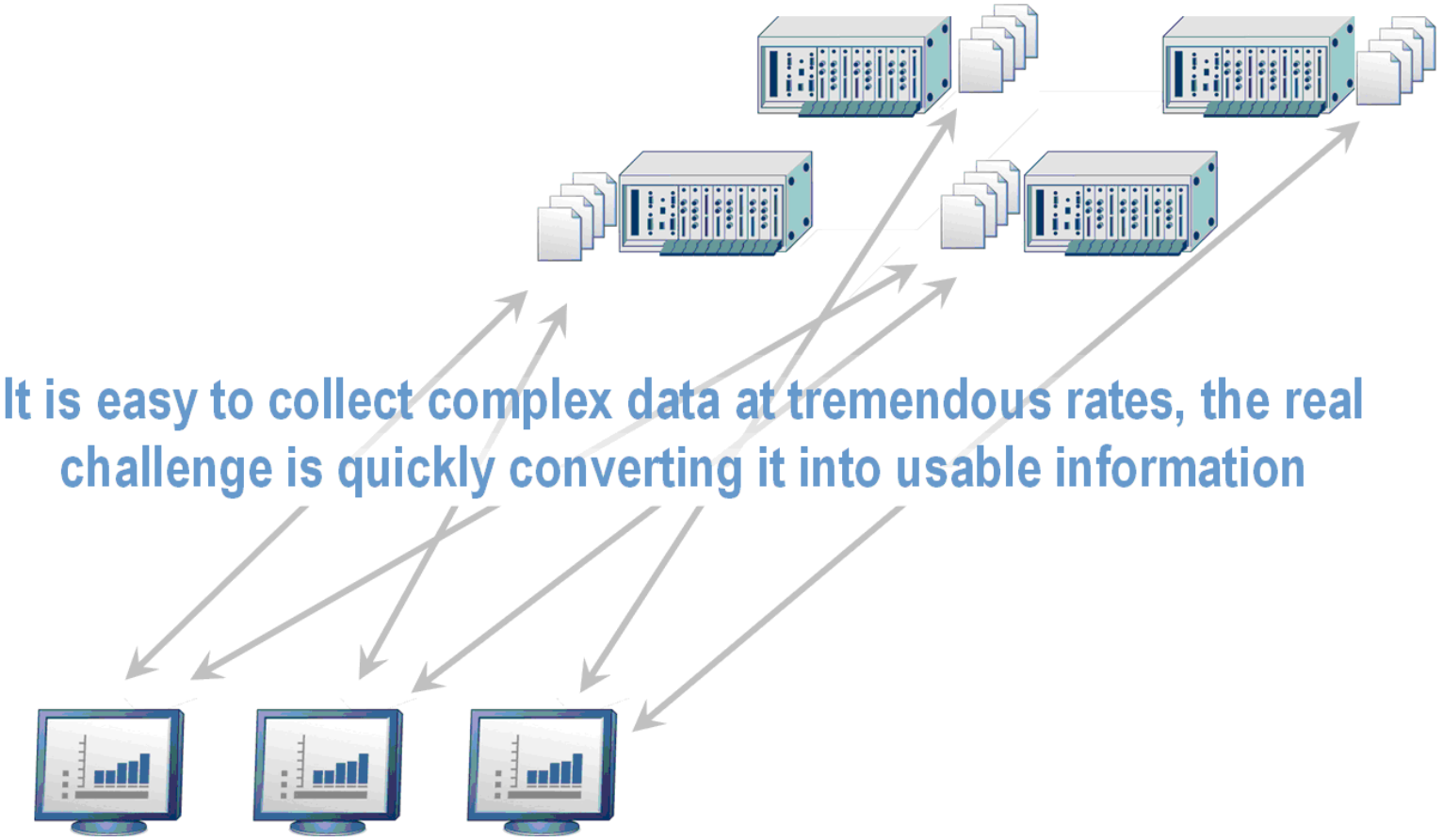
OR…

NI DIAdem

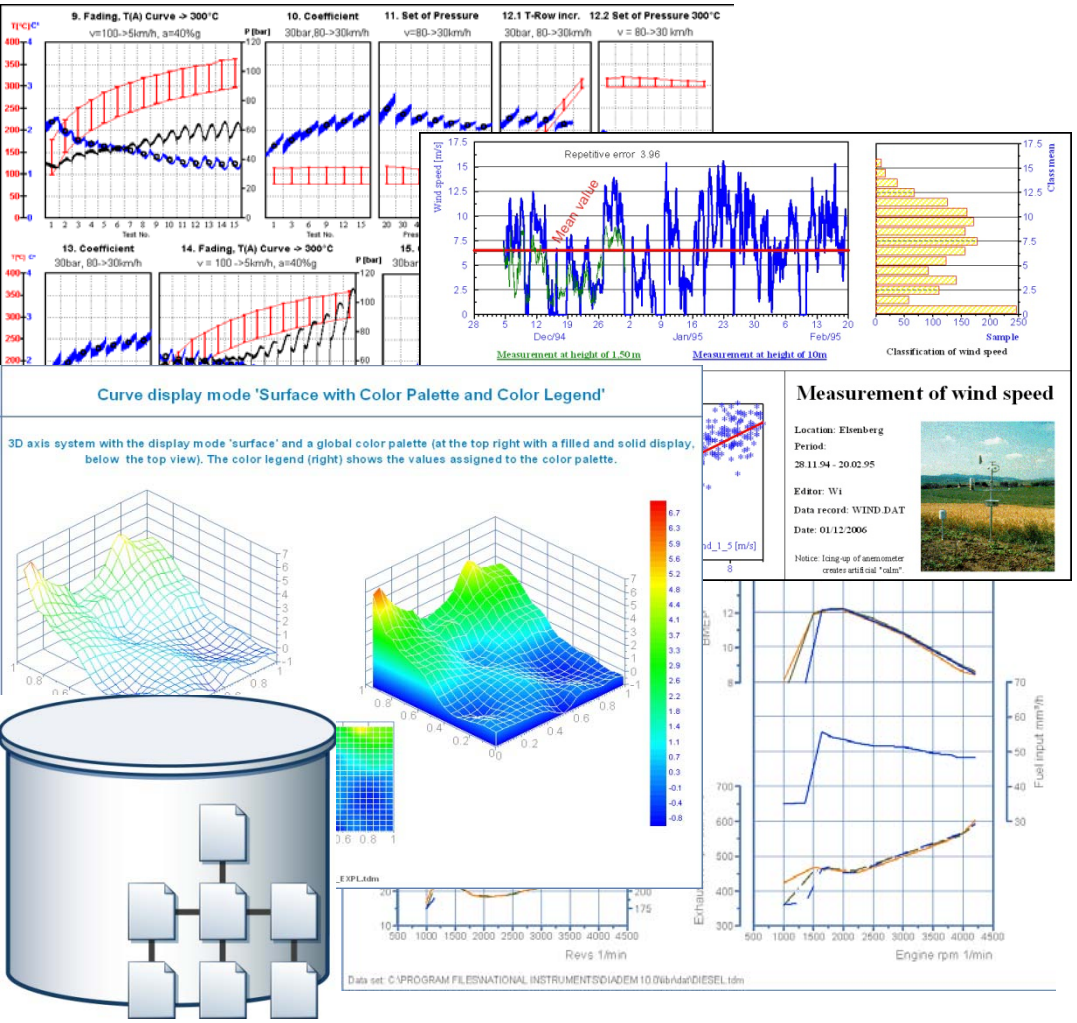
Data Management Software

Revolutionary software for organizing, finding and reporting technical data

The Data Problem

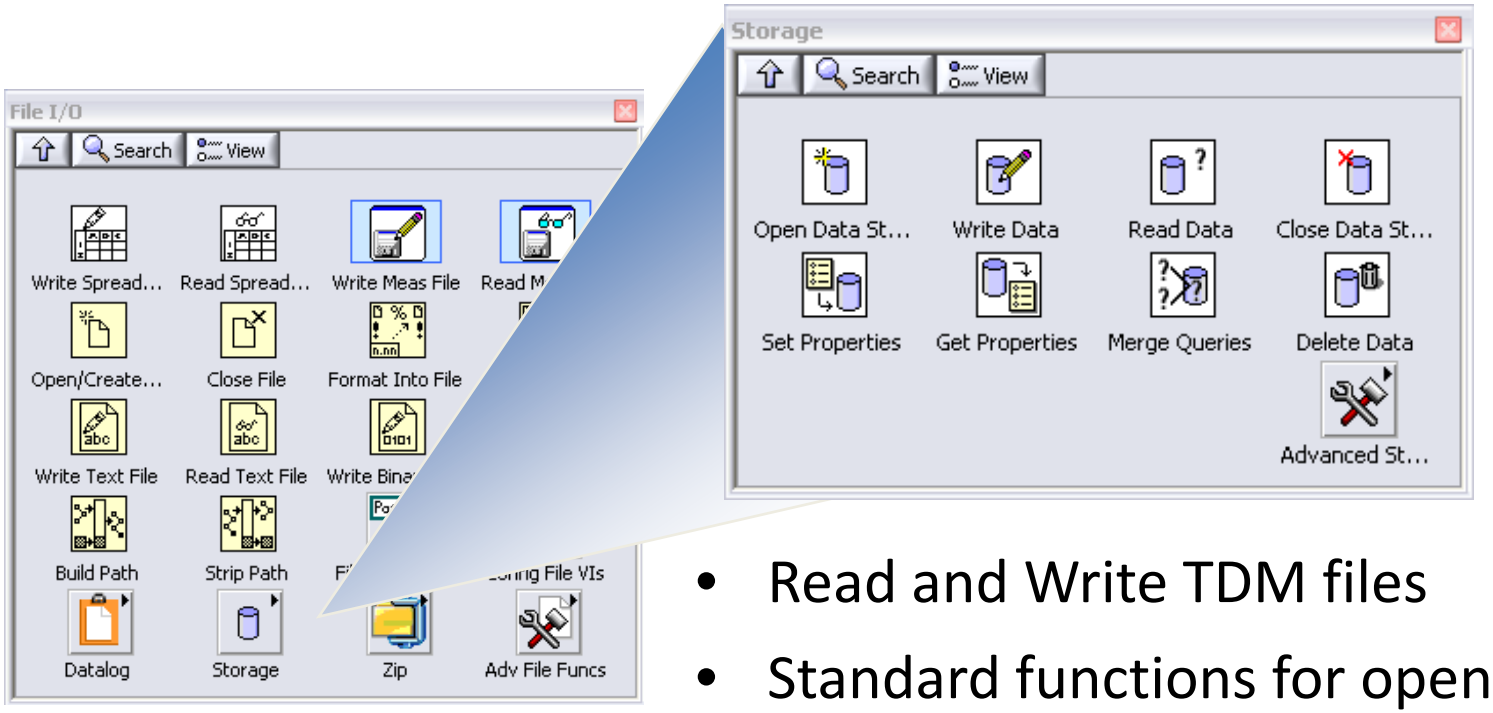


NI DIAdem – Organizing, Analyzing & Reporting



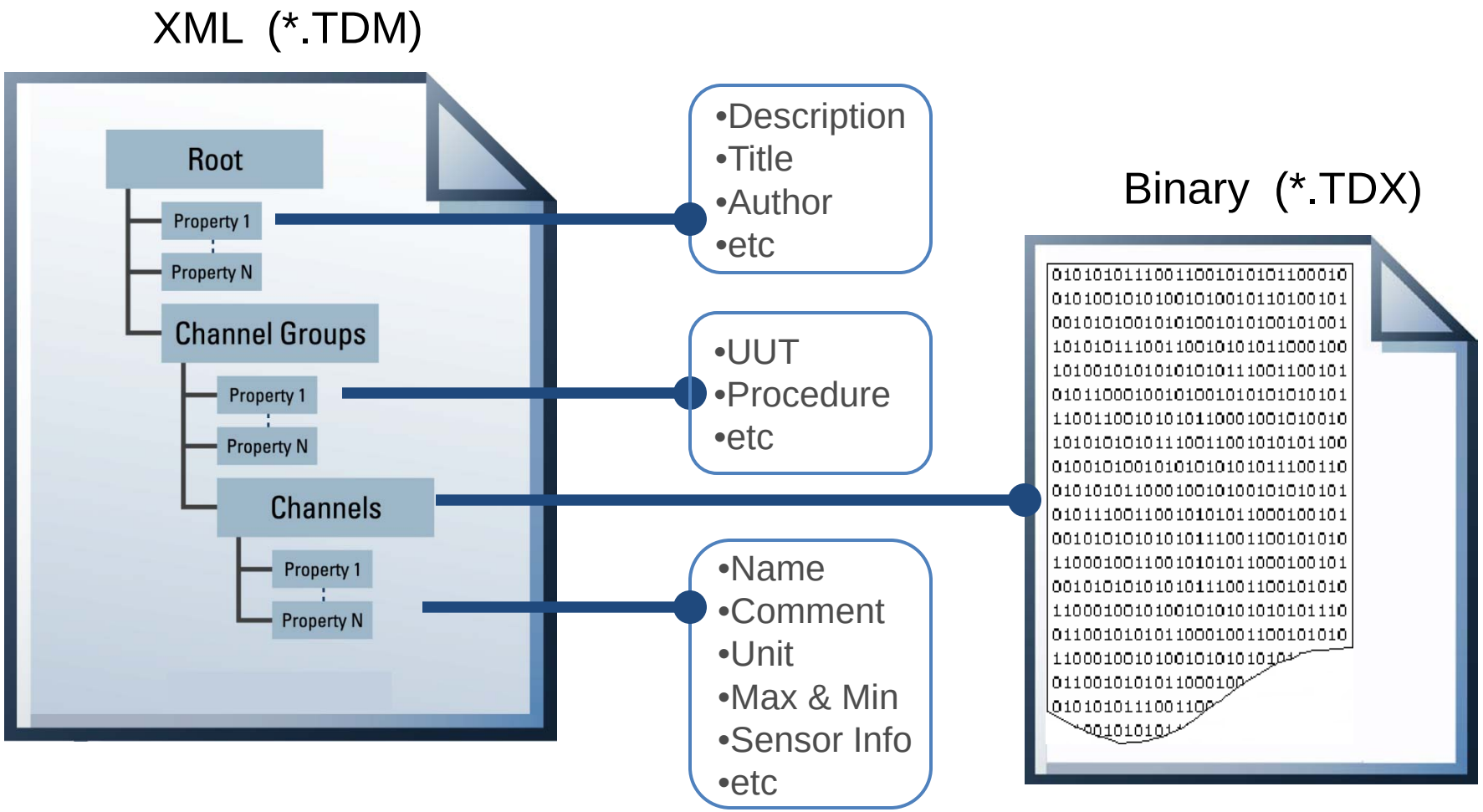
- Self-configuring data management tools
- Intuitive data searching
- Interactive analysis & reporting
- Time saving automation capabilities
- Extensive data import capabilities
- Tight integration with LabVIEW
- Connectivity to 3rd party math tools

The LabVIEW Storage VIs

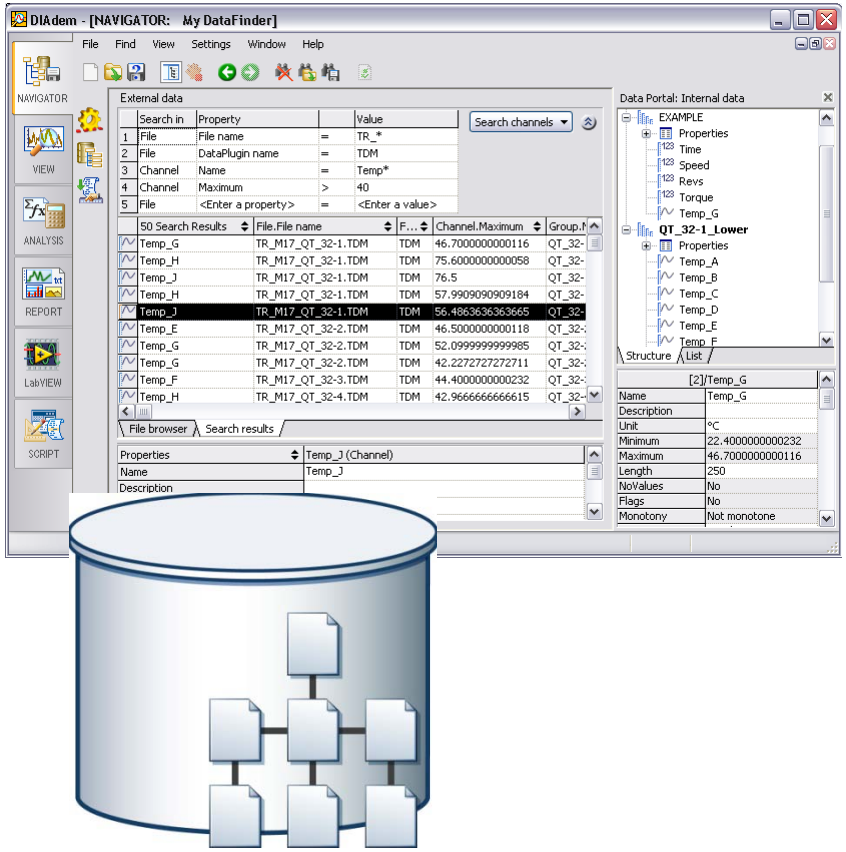


- Read and Write TDM files
- Standard functions for open, write, close
- Advanced functions for selective data loading
- Advanced functions for structuring data

TDM Files are Self Describing



The DIAdem DataFinder Technology



- Is one of the many features available in DIAdem, NI's application for off-line analysis and reporting
- Automatically creates a Data Index behind the scenes that contains all the attributes of each data file
- Enables you to locate data by performing searches on properties at the file, group and channel levels