Using LabVIEW and Matlab for Acquisition, Computation and Simulation

Raphaël TILLET

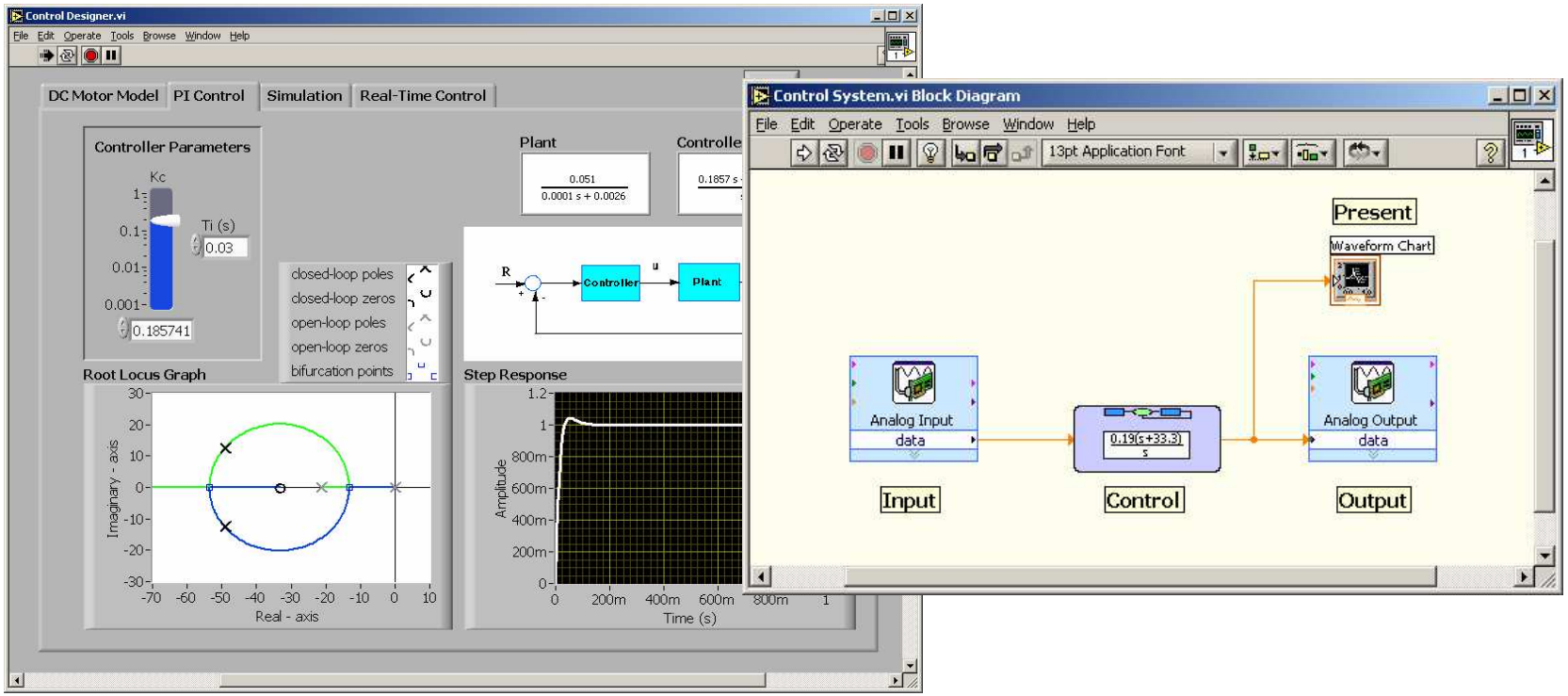
Raphaël.Tillet@ni.com

Agenda

- LabVIEW Overview
- Using Matlab Script inside LabVIEW
- Using LabVIEW VI inside Matlab
- Importing Simulink Model in LabVIEW / LabVIEW RT
- LabVIEW PDA Module
- Conclusion

LabVIEW Overview

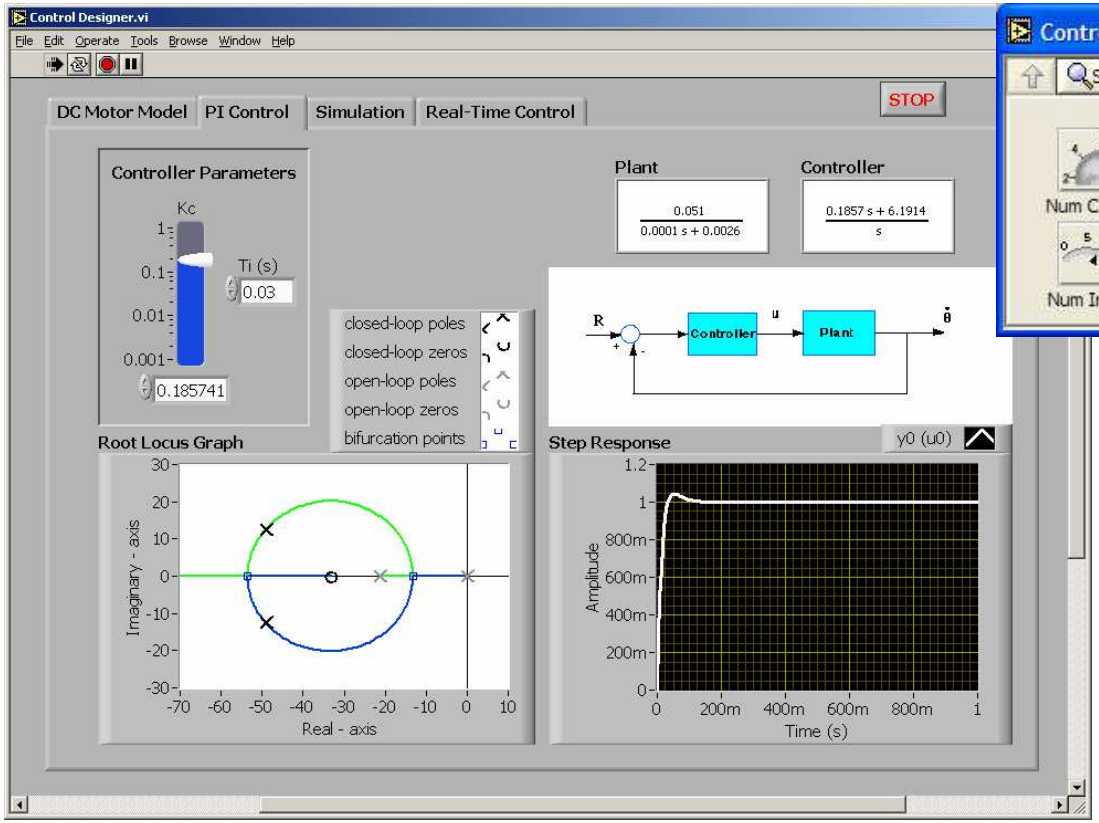
LabVIEW Graphical Software

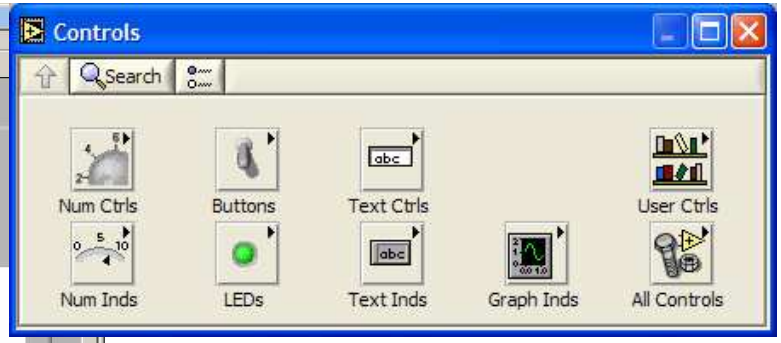


- Compiled graphical development environment
- Four to ten times development reduction time
- Tools to acquire, analyze, and present your data

NI LabVIEW Environment—The Front Panel

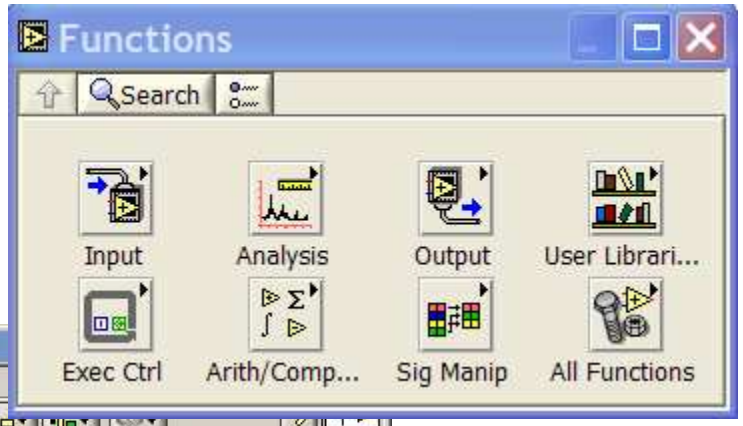
- Professional graphical user interfaces
- Pre-built, configurable user interface objects
- Designed specifically for measurement and control applications

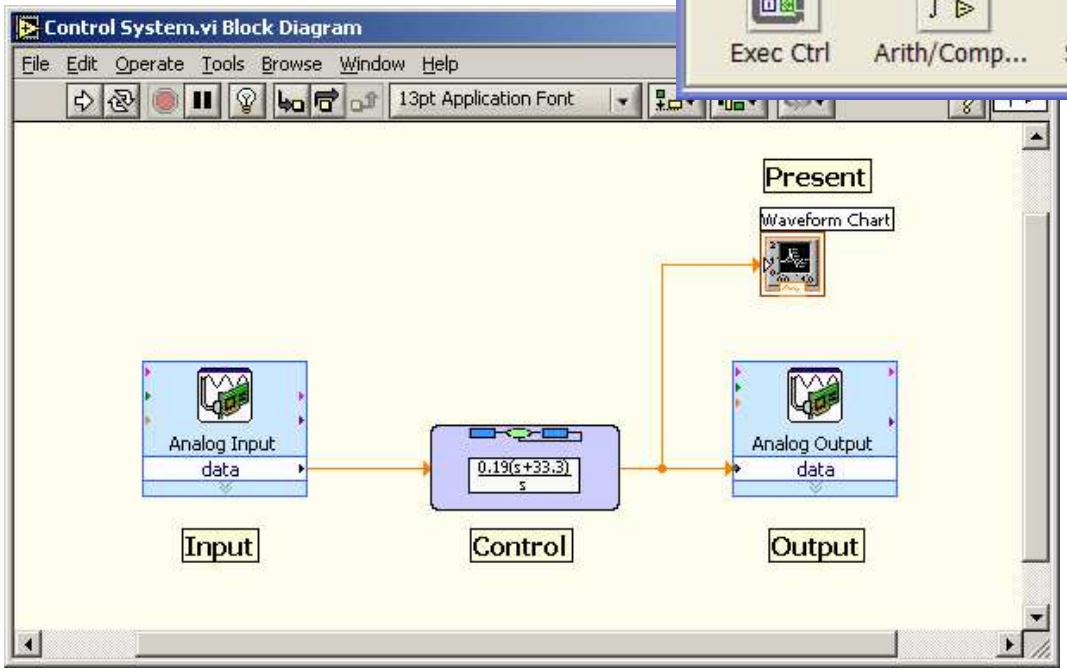




NI LabVIEW Environment—The Block Diagram

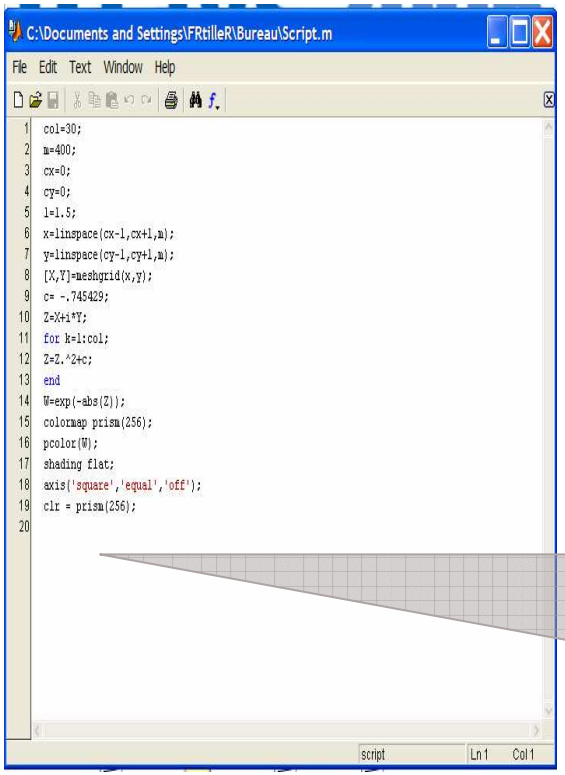
- Intuitive flowchart-like code
- Express VIs, templates, design patterns, and frameworks
- Hundreds of pre-built measurement subVIs
- Self-documenting

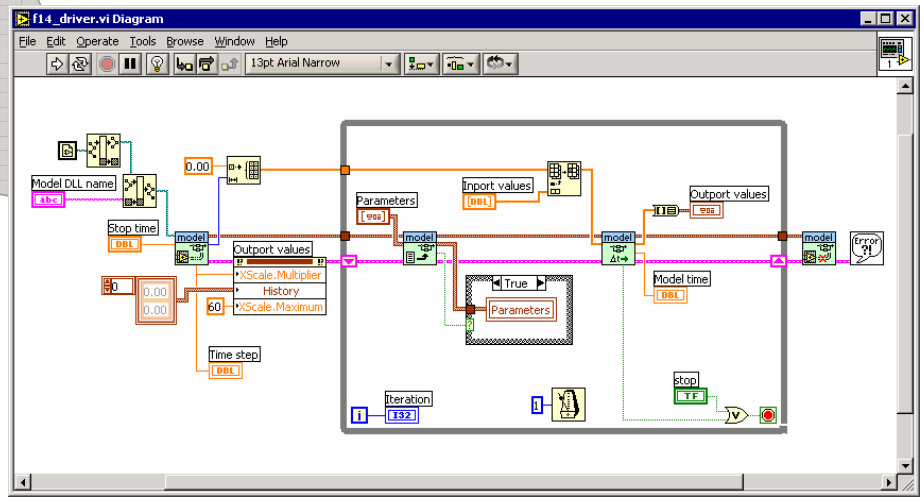




Using Matlab Script inside LabVIEW

Matlab Script inside LabVIEW





Matlab Script inside LabVIEW

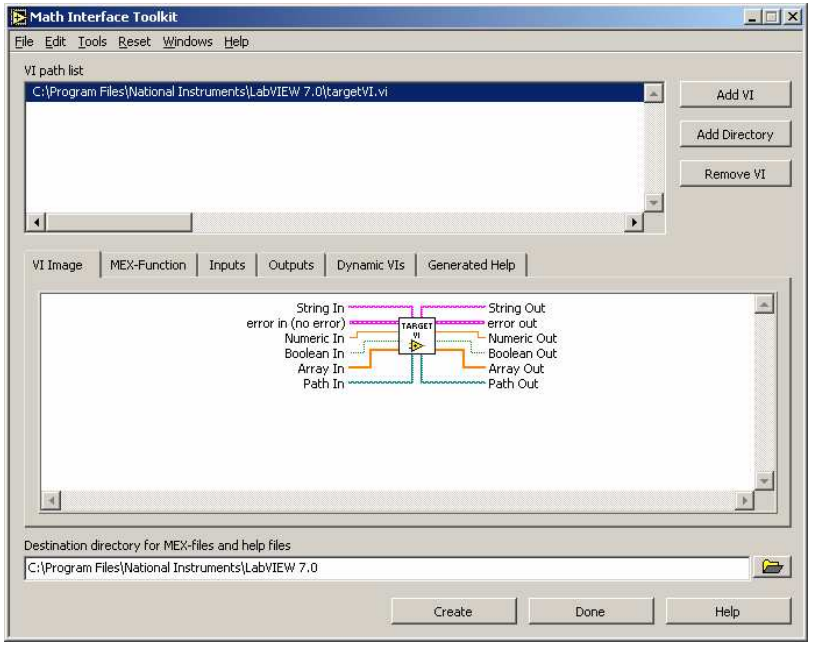
- Need a Matlab License on the Computer
- Microsoft ActiveX technology is used to make the communication
- Can import any existing (work reuse) script inside LabVIEW

Using LabVIEW VI inside Matlab: Math Interface Toolkit

LabVIEW Math Interface Toolkit

An intuitive LabVIEW wizard for converting any LabVIEW VI into a MEX-function, callable natively from MATLAB

- Packages a LabVIEW VI (and inclusive sub-VIs) into a MEX-function
- Customizable function and parameter prototypes and parameter arrangement
- Automatic help generation



LabVIEW Math Interface Toolkit

- MEX-Function is built in a DLL format and can be delivered for free.

- The LabVIEW Run-Time needs to be install to use the DLL.

- Any National Instruments Hardware (DAQ, GPIB, Serial, IMAQ, Motion or CAN) can be used inside Matlab.

Demo: Embedding LabVIEW into MATLAB

The MathWorks MATLAB

⇦

LabVIEW Development Software
LabVIEW Math Interface Toolkit

⇔

Signal Connection

Importing Simulink Model in LabVIEW / LabVIEW RT

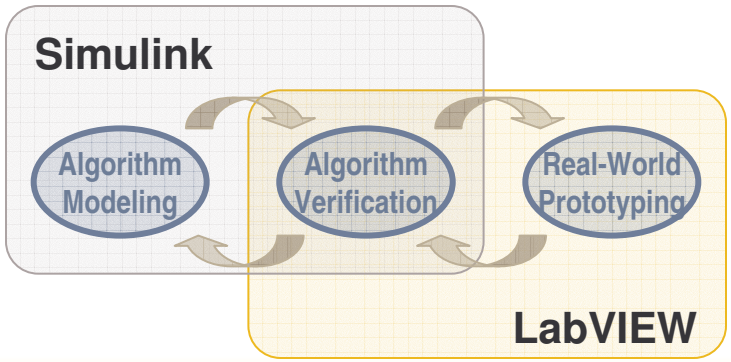
Simulation Interface Toolkit

The MathWorks Simulink

- Modeling, simulation and analysis of dynamical systems
  - Linear and nonlinear systems
  - Continous time, sampled time or hybrid
- Models represented with block diagrams
- Common in aerospace, automotive, and academic

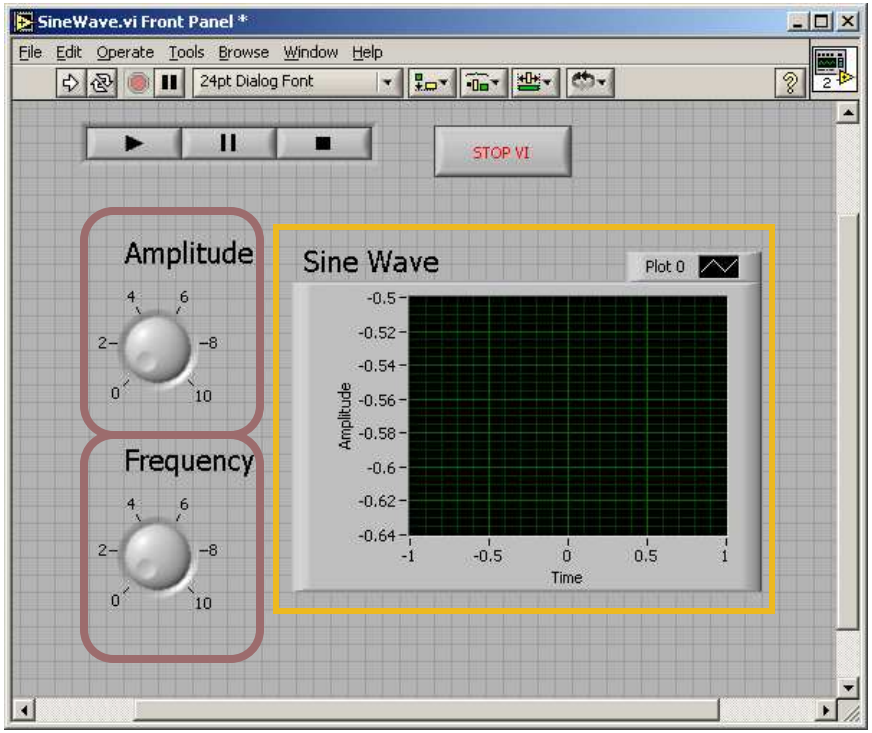
Importing Simulink Models into LabVIEW

- Reuse existing control or plant models developed in The MathWorks Simulink
- Use the LabVIEW Simulation Interface Toolkit to
  - Build powerful user interfaces for Simulink models
  - Import Simulink models into LabVIEW

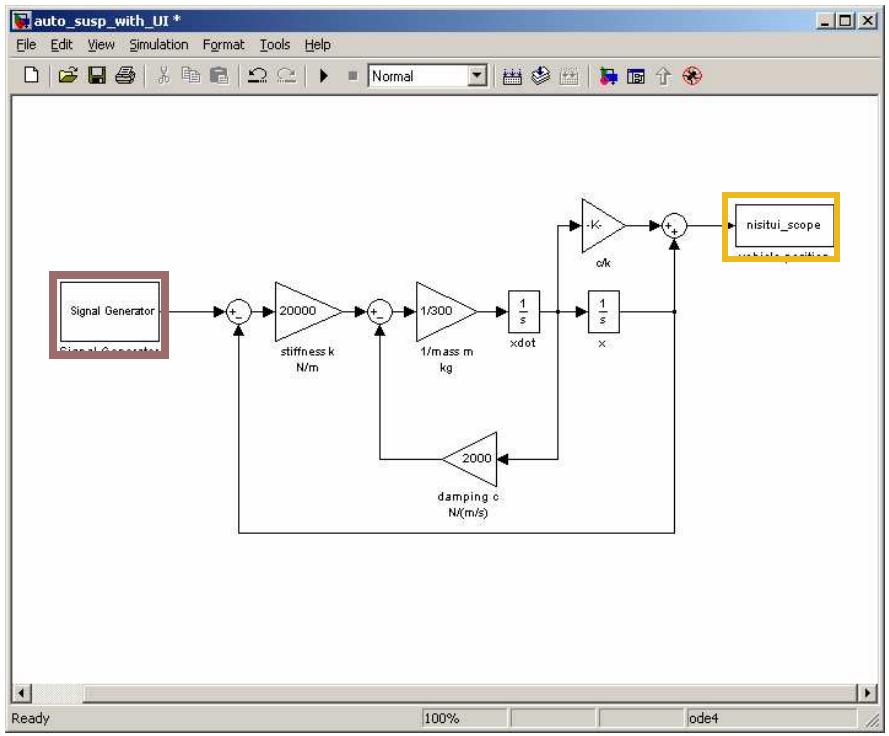


Building Powerful User Interfaces

- Run LabVIEW VI to verify Simulink Model

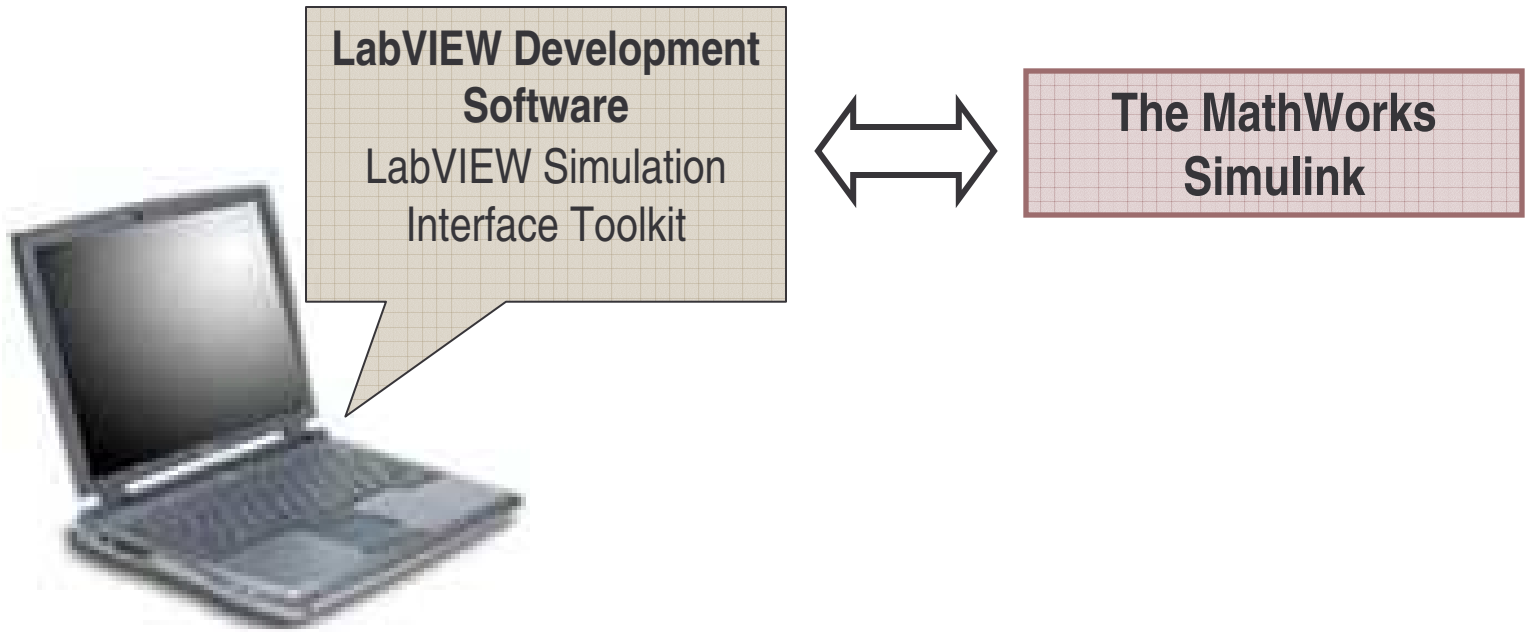


LabVIEW Front Panel



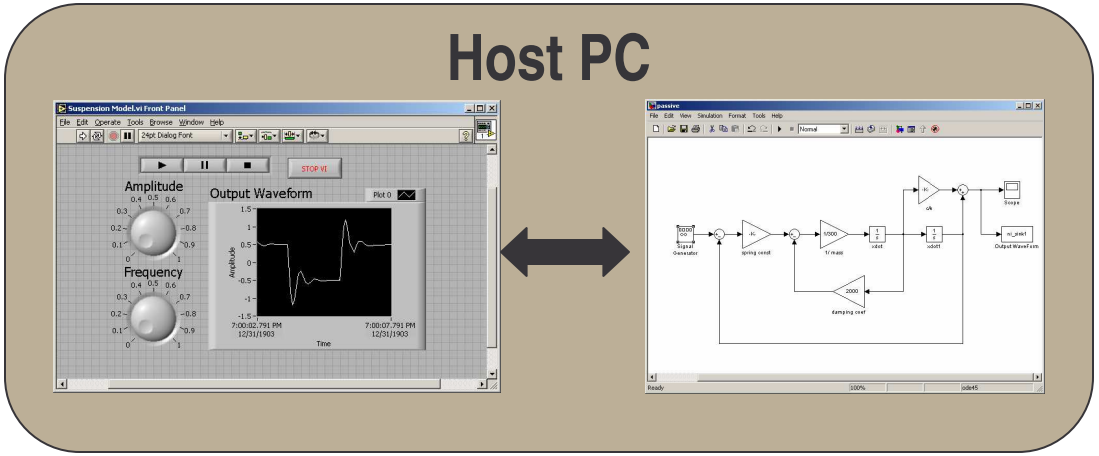
Simulink model

Demo: LabVIEW-based UI for Simulink

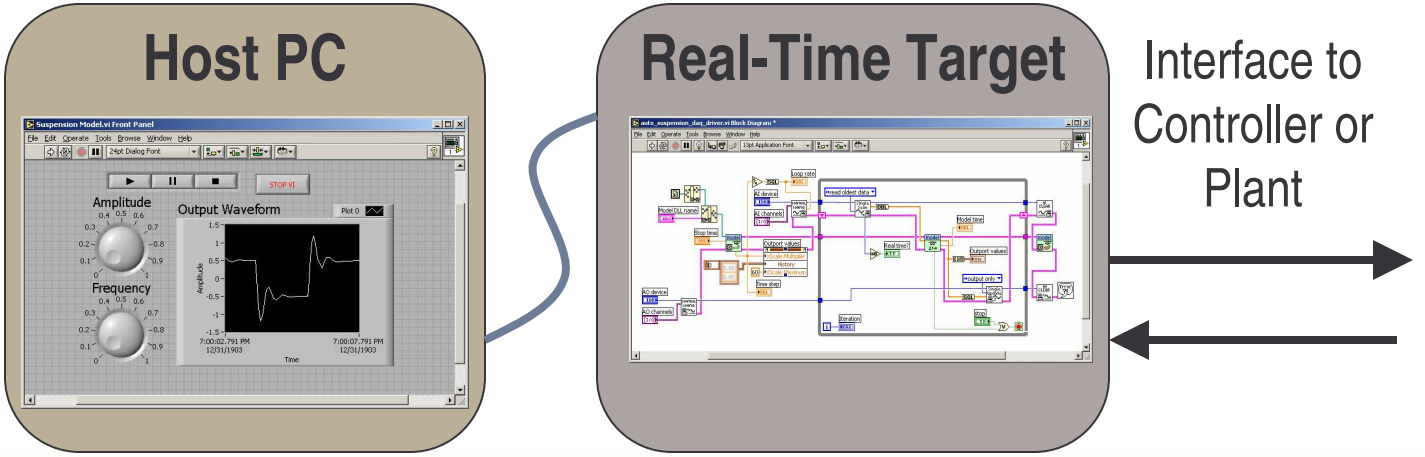


Migrating to Hardware Simulation

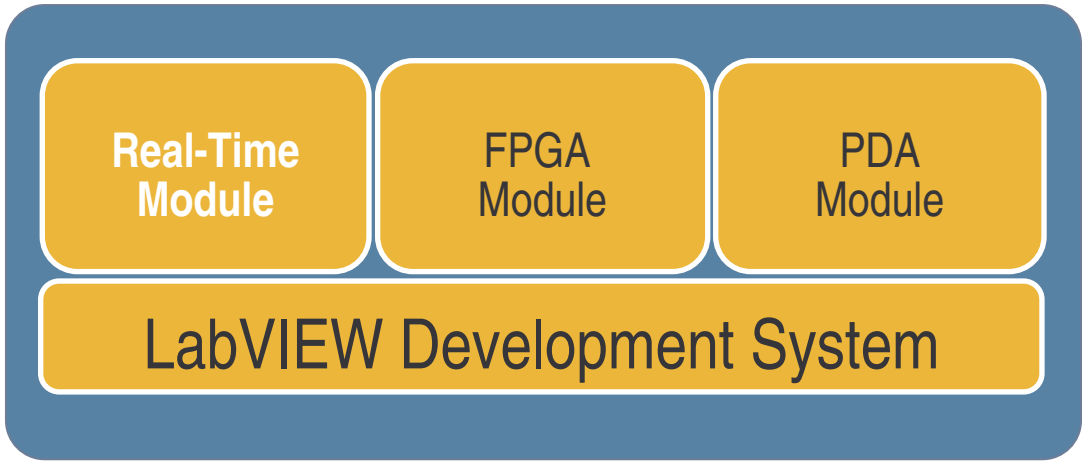
Offline Simulation

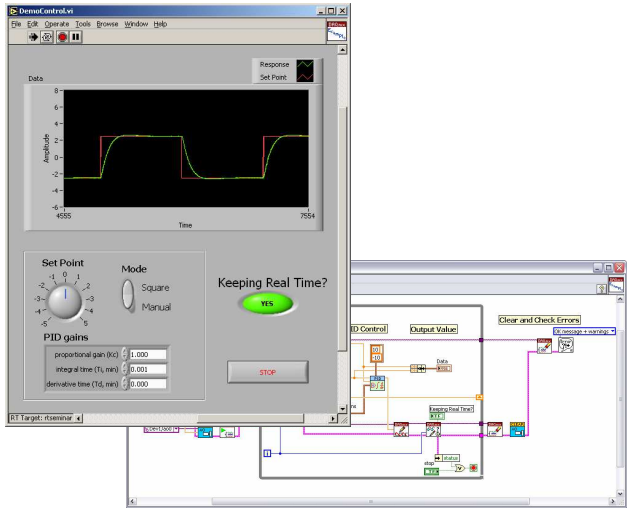


Hardware Verification



LabVIEW Real-Time





- LabVIEW VI executes on Real Time target
- VI timings are strictly respected (Determinism)

Real Time Target

LabVIEW Real-Time

Compact Vision System

Compact FieldPoint

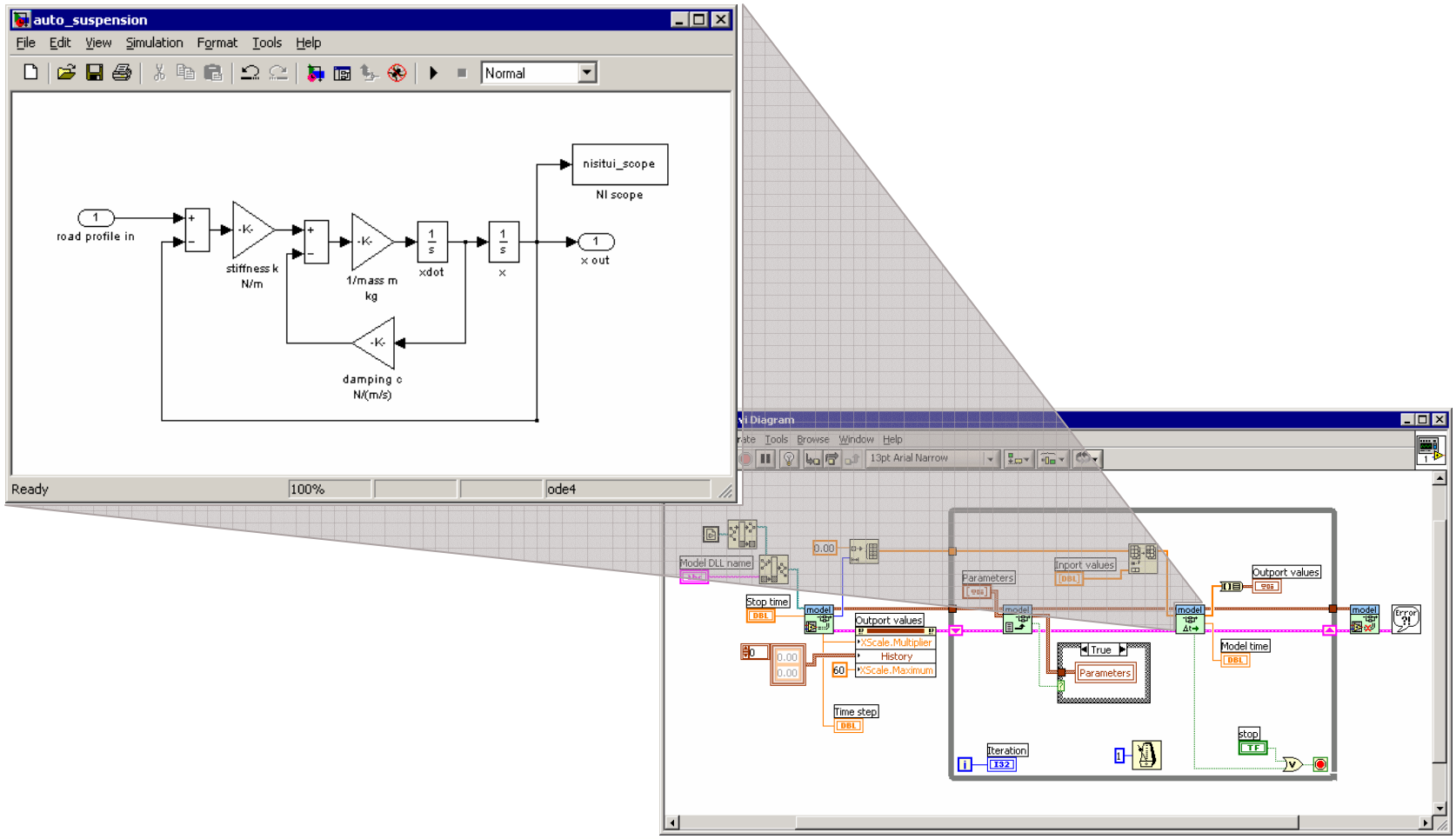
FieldPoint

PXI

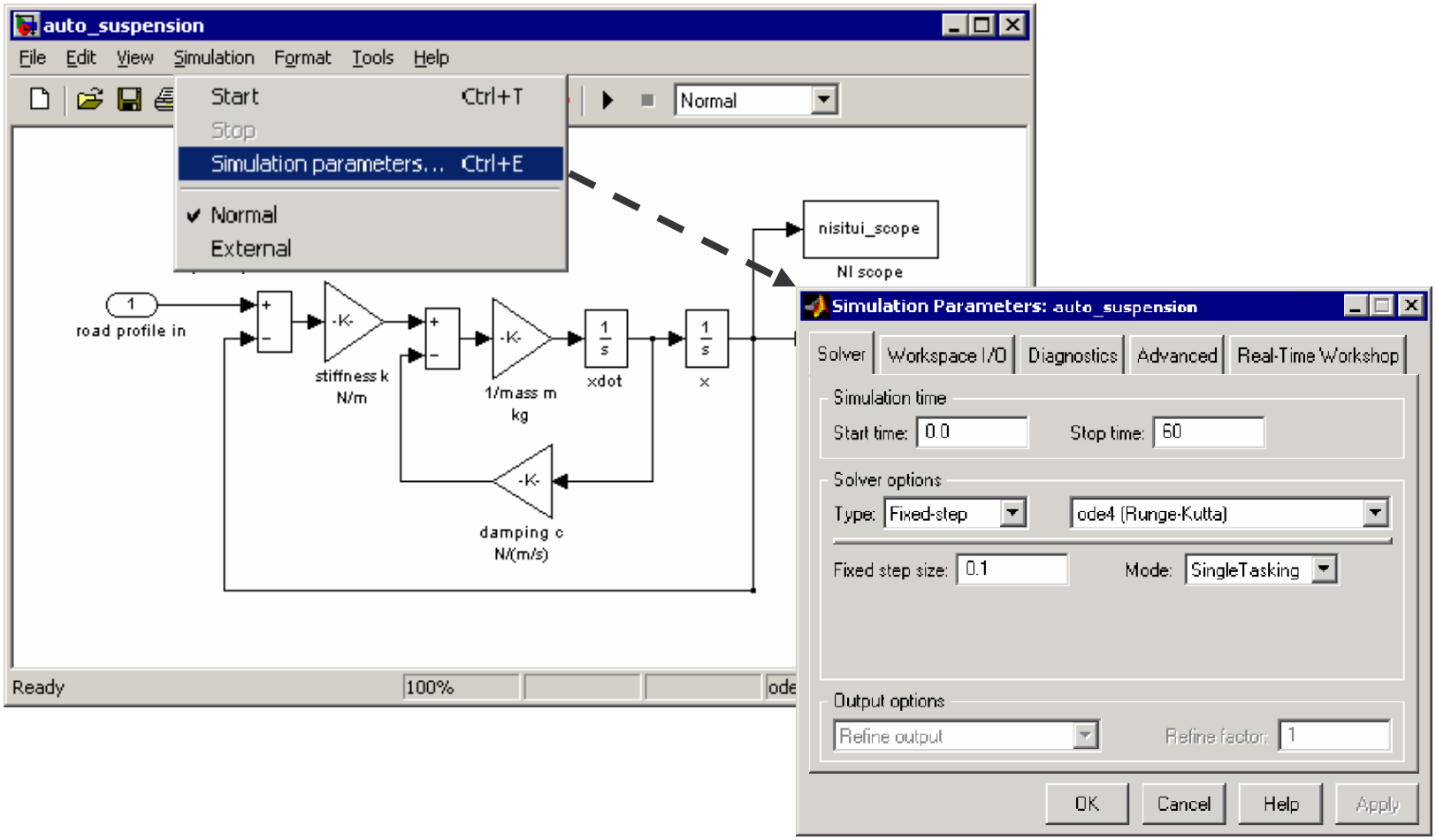
PCI Plug-In Board

Desktop PC

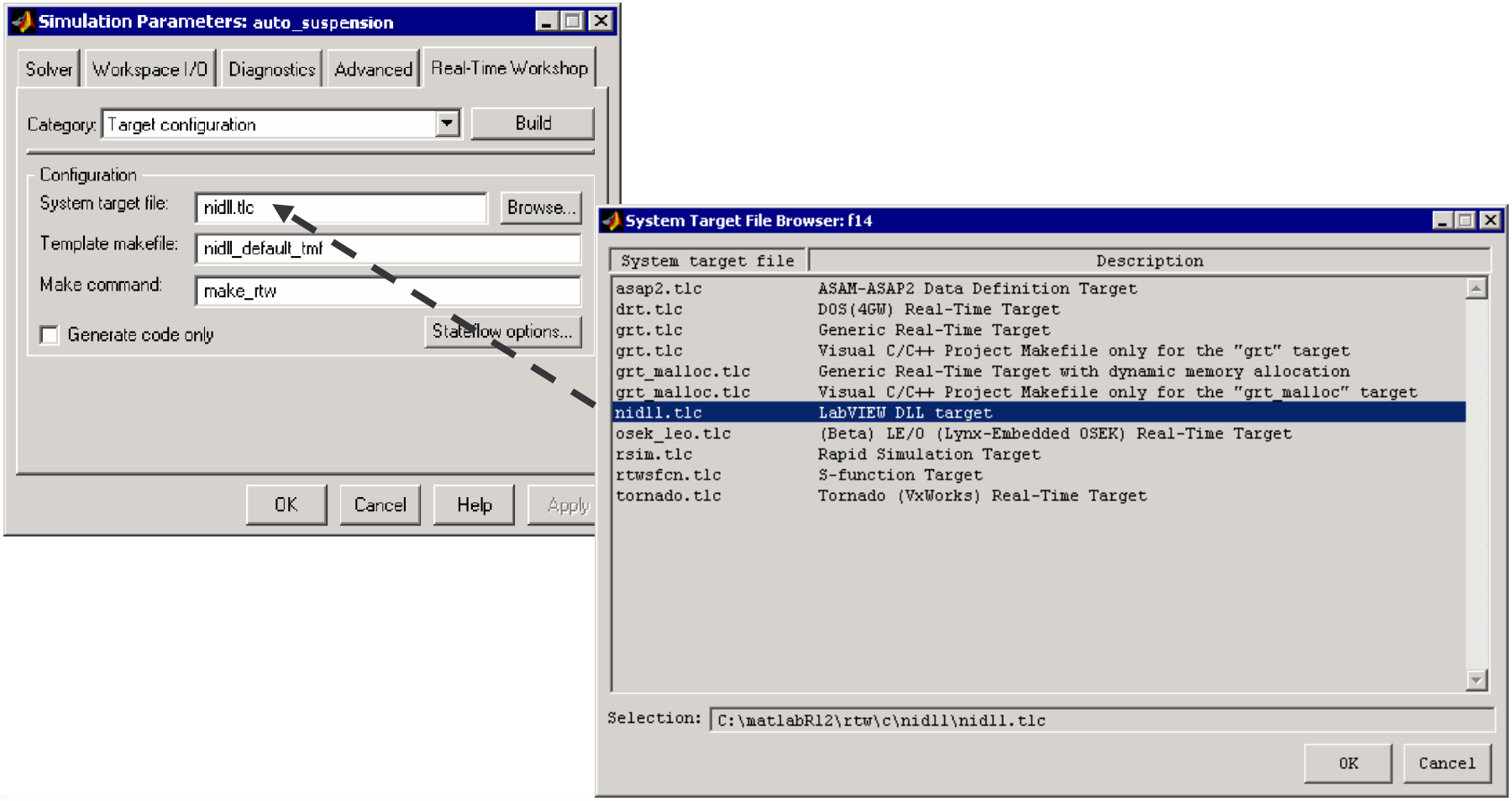
Importing Simulink® Models into LabVIEW



Step 2: Solver Parameters



Step 3: Real-Time Workshop



Automated Build Procedure

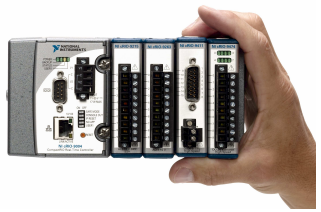
1) Real-Time Workshop® generates C code from model
2) MS VC++ compiles code into *model*.dll
3) LabVIEW generates *model*_driver.vi and *model*_daq_driver.vi examples
4) Utility downloads DLL to LabVIEW Real-Time target

Demo: Importing Simulink into LabVIEW

LabVIEW Development Software
LabVIEW Simulation Interface Toolkit

Ethernet Communication

CompactRIO
RT Controller
Input / Output



LabVIEW PDA Module

Expansion of Portable Measurements

- PDAs goes mainstream
  - Processors up to 400Mhz
  - Wireless Communications (Bluetooth, Wifi)
  - PCMCIA adapters
  - Mass Storage with CompactFlash
  - Low power consumption
  - Programs reside in ROM for fast load
  - Color touch screen
- LabVIEW PDA module release to expand the reach of virtual instrumentation

What is the LabVIEW PDA Module?

Add-On Module to LabVIEW which extends the graphical development environment to PDA targets

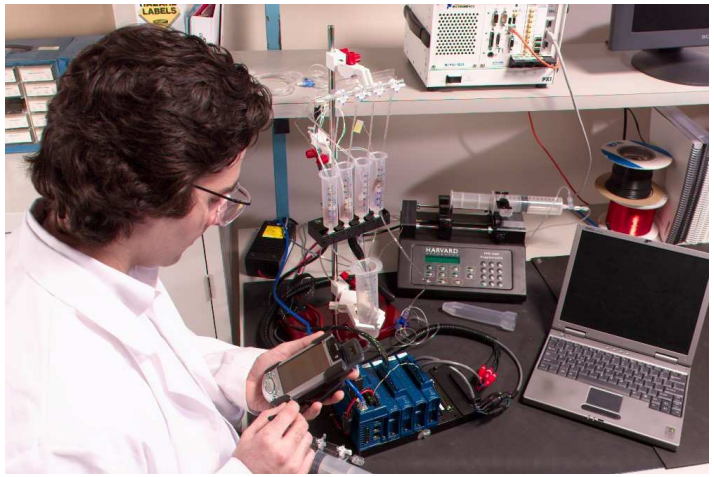
- A way to leverage PDAs as portable, inexpensive, and efficient computer systems
- Leverages LabVIEW's easy to use environment for rapid development and deployment

Programming the PDA with LabVIEW

- Programming Environment (included in package)
  - LabVIEW 7.1
  - Hot Sync or ActiveSync (PDA Desktop)
  - LabVIEW PDA Module
  - Codewarrior or Visual Embedded Studio
  - Emulator
- Additional Programming Resources
  - Palm SDK from Palm
  - Visual Studio C++ and Visual Basic from MS
  - Customize the Emulator with various ROMs and Skins
  - Third Party Add-ins

Application Examples

- User Interface
  - User interface for Head-less systems (LabVIEW Real-time targets)
  - Mobile user interface (wireless communication)
- Portable Data Acquisition
  - Apps in small/hard-to-reach spaces
  - Apps where UUT is too big to be moved
- Example Applications
  - Air Quality Monitoring
  - Automotive Repair Diagnostics
  - Manufacturing Plant System Maintenance
  - Portable Temperature Monitoring



How do you acquire data to a PDA

- Share data with other applications on the PDA
- Access built-in PDA hardware components and comm. devices
  - Microphone, speaker, IrDA and serial comm. ports
- Add expansion devices to PDAs

Supported Platforms

- Pocket PC 2003
  - Generally faster processors
  - Support for PCMCIA cards (DAQmx Base and DMM support)
- PalmOS 3.5 and above
  - Generally lower priced
  - Wide variety of devices

You have the ability to choose the device to meet your requirements!

Industrial PDA devices

- Diagnostic Instruments
  - Industrial specs
  - Integrated PCMCIA (DAQ and DMM supported)
  - www.ruggedhandheld.com

- DAP Technologies
  - Industrial specs
  - Integrated PCMCIA (DAQ and DMM supported)
  - www.daptech.com

Emulators & Simulators

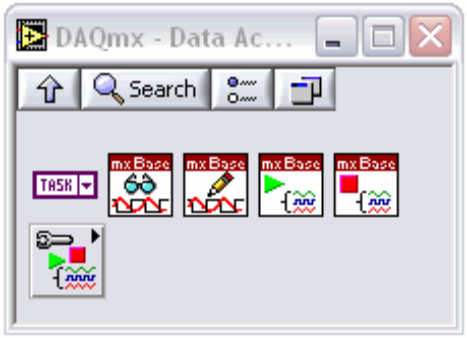
Develop and test without actual device

Ability to use PC's resources

- Serial ports
- Network adapter

Using Data Acquisition

- DAQmx Base architecture
  - Pocket PC with expansion sleeve only
  - Similar to PC DAQmx
  - Replaces “DAQ for PPC”
  - NI DAQCard 6024E, 6036E & 6062E
- Specifications
  - 200kS/s acquisition rate
  - Multichannel acquisitions
  - Triggering and Synchronization



Using Digital Multimeters (DMM)

- Build customized handheld DMMs
  - Pocket PC with expansion sleeve only
  - Simple API (3 functions)
  - NI 4050 DMM
- Specs
  - 51/2 digit precision
  - Functions include: current, voltage, resistance

Questions?