Using LabVIEW and Matlab for Acquisition, Computation and Simulation

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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

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Importing Simulink Model in LabVIEW / LabVIEW RT

Simulation Interface Toolkit
The MathWorks Simulink

• Modeling, simulation and analysis of dynamical systems
  – Linear and nonlinear systems
  – Continuous 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
Demo: LabVIEW-based UI for Simulink
Migrating to Hardware Simulation

Offline Simulation

Host PC

Real-Time Target

Hardware Verification

Interface to Controller or Plant

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LabVIEW Real-Time

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

- Compact Vision System
- Compact FieldPoint
- FieldPoint
- PXI
- PCI Plug-In Board
- Desktop PC

LabVIEW Real-Time
Importing Simulink® Models into LabVIEW
Step 2: Solver Parameters

[Diagram showing a simulation model with solver parameters settings]

- Solver: Fixed-step
- Output options: Mode: SingleTasking
- Simulation time: Start: 0.0, Stop: 60
- Solver options: Type: ode4 (Runge-Kutta)
- Fixed step size: 0.1
Step 3: Real-Time Workshop

- Simulation Parameters: auto_suspension
  - Solver, Workspace I/O, Diagnostics, Advanced, Real-Time Workshop
    - Category: Target configuration
    - System target file: niidl.tlc
    - Template makefile: niidl_default.tml
    - Make command: make_real
    - Generate code only
    - Build

- System Target File Browser: fl
  - System target file
    - asap2.tlc: ASAM-ASAP2 Data Definition Target
    - dtc.tlc: DCS(48W) Real-Time Target
    - gtt.tlc: Generic Real-Time Target
    - gtt_malloc.tlc: Generic Real-Time Target with dynamic memory allocation
    - gtt_malloc.tlc: Visual C/C++ Project Makefile only for the "gtt" target
    - niidl.tlc: LabVIEW DLL target
    - oek_leo.tlc: (Beta) L3/G (Lyco-Embedded OSEK) Real-Time Target
    - rsm.tlc: Rapid Simulation Target
    - rttmGenC.tlc: $-Function Target
    - tornado.tlc: Tornado (ViWorks) Real-Time Target

Selection: C:\natLabR12\rtw\cniidl\niidl.tlc
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
- CompactRIO
  - RT Controller
  - Input / Output
- Ethernet Communication
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
  – 5½ digit precision
  – Functions include: current, voltage, resistance
Questions?