New Platforms and Technologies for Teaching and Research
Agenda

• NI ELVIS
• NI myDAQ
• NI USRP

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NI ELVIS Platform
Multidisciplinary Teaching & Engineering Platform
Challenges in today’s lab

1. Making basic engineering concepts interesting for students
2. Relating theory to practice
3. Wasting time with out-of-date technology
4. Keeping up-to-date with industry tools
5. Limited time and budget to revise courses
NI ELVIS II series

- Hands-On, learning solution
- Integrated, cost effective platform
- Expands into multiple courses through interchangeable plug-in boards

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Challenges for students

• Predicting circuit behavior
• Understanding effects of components on system
• Breadboard wiring mistakes
• Easily taking measurements
• Comparing calculated data to live measurements
Student challenges in the lab

1. Theory

\[ V(t) = Ae^{st} = Ae^{(\sigma + j\omega)t} \]

2. Design & Simulation

3. Prototype & Compare

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What is NI ELVIS?

- Partner Plug-In Boards
- USB Plug-and-play interface
- Complete integration with NI Multisim
- 12 built-in instruments powered by LabVIEW
- Full suite of curriculum
NI ELVISmx Virtual Instruments

- Digital Multimeter
- Oscilloscope
- Function Generator
- Variable Power Supply
The NI Multisim Environment

- Simulation Capture
- Real measurements
- 3D Breadboard
Hardware Specifications

Impedance Analyzer
- 1 Hz to 35 kHz Range
- NPN, PNP, Diode

Other Analyzers:
- Bode Analyzer
- 2-wire Current-Voltage Analyzer
- 3-Wire Current-Voltage Analyzer

Integrated DAQ
- AI sampling rate 1.25 MS/s single channel, 1 MS/s Multichannel
- 16 bit resolution
- AO 2.8 MS/s update rate
- 24 DIO lines, 15 PFI, 2 CTR (32 bits)

Prototyping Board
- Updated connections
- Detachable
- User-defined Banana Plugs, BNC, D-Sub connectors

Variable Power Supply
- 10 bit resolution
- 0 to +12V, 0 to -12V
- 500 mA current range
NI ELVIS Platform for Hands-On Learning

- 12 Integrated Instruments
- Programmable with LabVIEW
- USB-Plug & Play
- Small form factor
- Expandable with plug-in modules

Circuits
Digital Electronics
Controls
Communication
Embedded
Biomedical
# NI ELVIS | Multidisciplinary Teaching Platform

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<th>Circuits</th>
<th>Measurements</th>
<th>Control</th>
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<th>Communications</th>
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<td>Electrical, Biomedical, Mechatronics</td>
<td>Electrical, Biomedical, Mechatronics Physics, Chemistry</td>
<td>Electrical, Mechanical, Systems</td>
<td>Electrical, Computer Physics</td>
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[Image of National Instruments, Vernier, Quanser, Freescale, and Emona logos]
# New NI ELVIS Partner Board Additions

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<tr>
<th>Biomedical</th>
<th>Signal Processing</th>
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[Image of QNET Myoelectric Trainer]

[Image of SIGEx Signals & Systems Trainer]
NI myDAQ
Agenda

• What is myDAQ and who is it for?

• Planned Marketing Activities
What's In The Box?

- NI myDAQ device
- Integrated installation DVD
  - NI ELVISmx & NI DAQmx
  - LabVIEW Evaluation (30 day)
  - Multisim Evaluation (30 day)
- USB Cable
- DMM Probes
- Audio cable (3.5mm)
- Screw terminal connector and NI screwdriver
- Getting Started Card
- TI Samples Program Card
- Reusable Storage Tray
NI myDAQ Features

**Plug & Play Instruments**
DMM * Oscilloscope * Func Gen
Bode * DSA * ARB * Digital I/O

**Computer Interface**
- LabVIEW using NI DAQmx
- Multisim Using ELVISmx

- Integrated DMM
  V, I, Ω, Diode

- USB Bus Powered
- 8 In/Out
- 15 V and 5V Power Supply
- 1 Counter
- Analog In/Out
  2 ch, 200ks/s/ch, 16-bit
- 3.5mm Audio In/Out

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National Instruments Confidential
NI ELVISmx Instruments for myDAQ

Supported Instruments

- DMM
- Oscilloscope
- Function Generator
- Bode Analyzer
- Dynamic Signal Analyzer
- Arbitrary Waveform Generator
- Digital Reader
- Digital Writer
Demo
Endless Possibilities…

Extend learning with custom modules

- Custom signal conditioning
- Custom control plants
- Experiment kits
- Student design

Custom PCBs & Signal Conditioning

Low Cost Mini-System Experiments
For more information...

- Courseware
- Download Resource Kits
- Webcast
- ni.com/nielvis
- ni.com/mydaq
- Case Studies & White Papers
NI Universal Software Radio Peripheral (USRP)
NI USRP Radio Prototyping Platform

Software Defined Radio for Everyone

- Flexible
- Easy-to-use
- Affordable
- For Education and Research

Digital Communications Lab Manual
Authored by Dr. Robert Heath
NI-USRP and LabVIEW Platform

A computer-hosted RF transceiver for development of software-defined radio

Hardware and software are easy to install, connect, and learn

1 Gigabit Ethernet link streams live data for processing on a host PC running LabVIEW
Stanford University - Networked Systems Group

Needs:
- Exposure to real-world signals
- Recruit students to RF/Communications early
- Prepare students for research

Solution:
- SDR Platform
- Lower learning curve
- Maintainable
- Affordable

“The course evaluations for our class was fantastic. Students rated the class 4.94/5.0, likely one of the highest ratings among all classes in the School of Engineering at Stanford.”

Dr. Sachin Katti, ECE

Stanford, CA
NI USRP

Tunable RF Transceiver
Front Ends

- Frequency Range
  - 50 MHz – 2.2 GHz (NI-2920)
  - 2.4 GHz – 2.5 GHz & 4.9 GHz - 5.5 GHz (NI-2921)

Signal Processing
and Synthesis

- NI LabVIEW to develop and explore algorithms
- NI Modulation Toolkit and LabVIEW add-ons to simulate or process live signals

Applications

- FM Radio
- TV
- GPS
- GSM
- ZigBee
- Safety Radio
- OFDM
- Passive Radar
- Dynamic Spectrum Access

1 Gigabit Ethernet to PC

- Plug-and-play capability
- Up to 25 MS/s baseband IQ streaming
Demo

NI USRP-2190 Transmitter

NI USRP-2190 Receiver

LabVIEW
Communications Design in LabVIEW

LabVIEW Modulation Toolkit

- Analog and Digital modulation formats
  - AM, FM, PM
  - ASK, FSK, MSK, GMSK, PAM, PSK, QAM
  - Custom
- Visualization
  - 2D and 3D Eye, Trellis, Constellation
- Modulation Analysis
  - BER, MER, EVM, burst timing, frequency deviation, $\rho$ (rho)
- Impairments
  - Additive White Gaussian Noise (AWGN)
  - DC offset, Quadrature skew, IQ gain imbalance, phase noise
- Equalization, Channel Coding, Channel Models
Digital Communications Bundle

Bundle Contents
- Two NI USRP-2920 + Toolkits
- MIMO Cable
- Digital Comm Lab Manual

Target Courses
- Communication Systems
- Digital Communications

Key Benefits
- Affordable
- Accessible
- NI Supported
- TX & RX Real RF Signals
- Scales to Research
Questions