# PROJETO DE SISTEMAS DE CONTROLE COM NI LABVIEW

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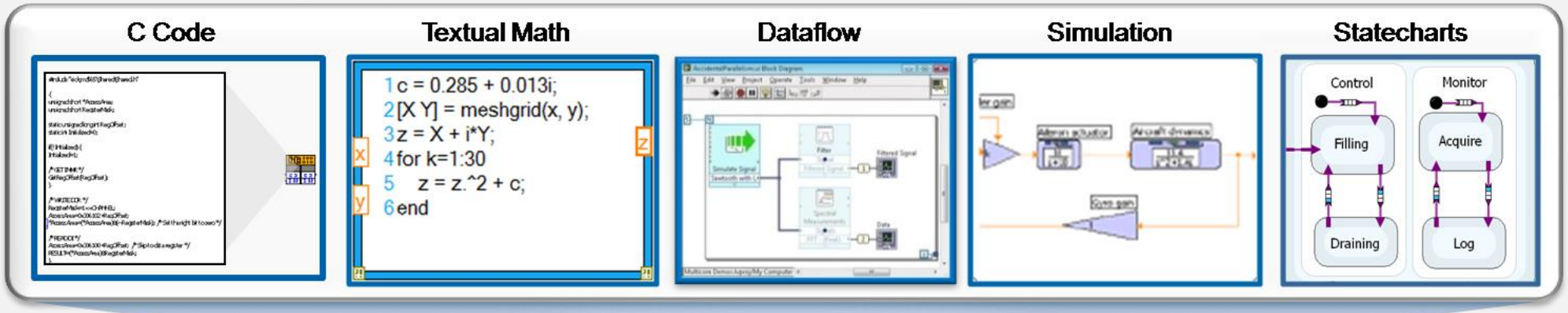
# AGENDA

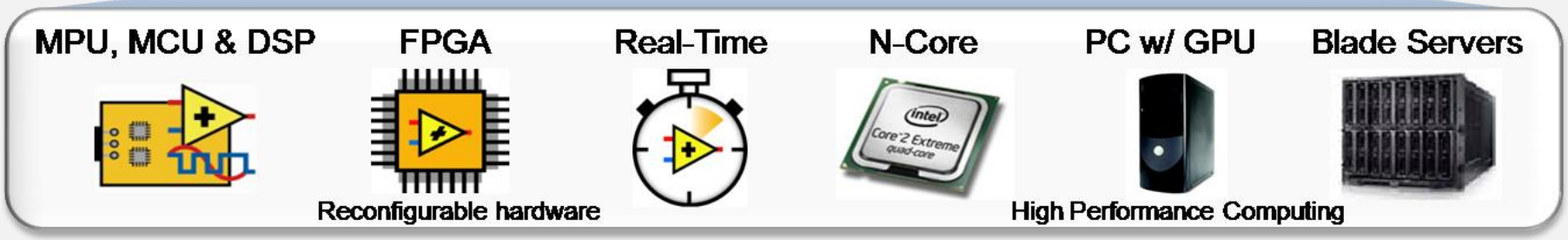
- Introduction to LabVIEW
- Control Design and Simulation Module
- Mathscript node
- Model Interface Toolkit
- Summary
- Case Studies




NATIONAL INSTRUMENTS

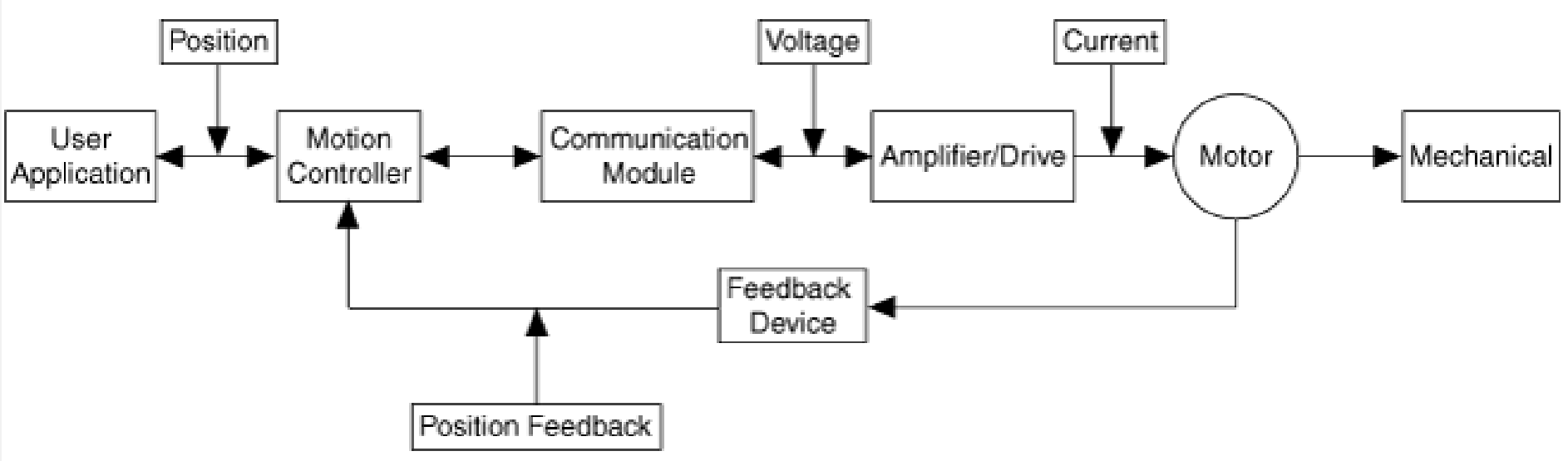
# LabVIEW™

Graphical System Design Platform



# CONTROL SYSTEMS IN BLOCK DIAGRAM FORM

- Systems are typically represented as a combination of  transfer function blocks
- Each block has dynamics described by a model
- Can make simplifications for each block i.e.:
  - Can neglect higher frequency dynamics for sensors and signal conditioning
  - Can linearize nonlinear blocks



# REAL-TIME MODELING ENVIRONMENTS

- The MathWorks, Inc. Simulink
- LabVIEW
- LabVIEW Control Design and Simulation Module
- Esterel SCADE Suite
- Tesis DYNAWare models
- NI MATRIXx SystemBuild
- C/C++/FORTRAN/Ada
- MapleSim models from Maplesoft
- SimulationX from ITI
- GT-POWER engine models from Gamma Technologies Inc.
- AVL BOOST
- AVL CRUISE
- Dynacar from Tecnalia
- CarSim from Mechanical Simulation*
- VI Car Real-Time from VI Grade*
- AMESim from LMS
- Dymola models from Dassault**

# LABVIEW CONTROL DESIGN & SIMULATION MODULE

**Implement Both Model-Based and Measurement-Based Design**

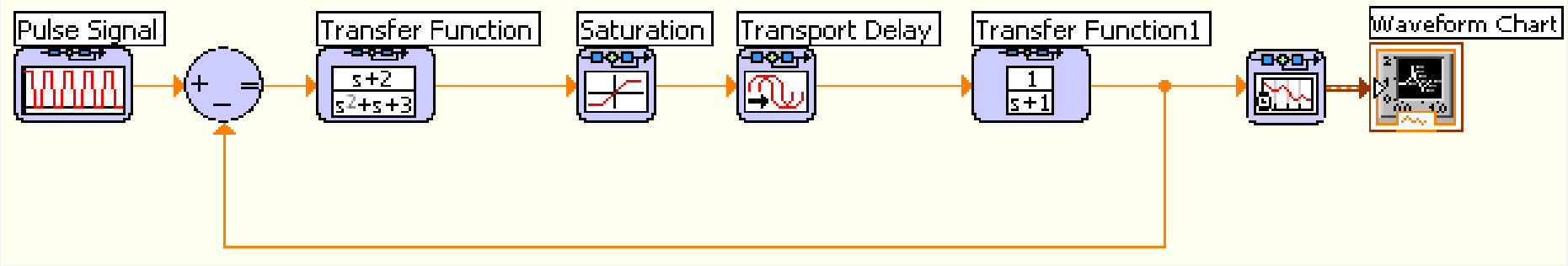
Integrate measurements with design for system identification, model calibration, or model validation. Then deploy your algorithm to NI real-time embedded hardware for rapid control prototyping and hardware-in-the-loop (HIL) applications.

**Choose Your Syntax: .m File, Signal Flow, or a Combination**

Using LabVIEW Control Design and Simulation with LabVIEW MathScript RT, you can perform textual mathematics and algorithm design in LabVIEW with the .m file syntax. You can also simulate and implement controllers using graphical signal flow.

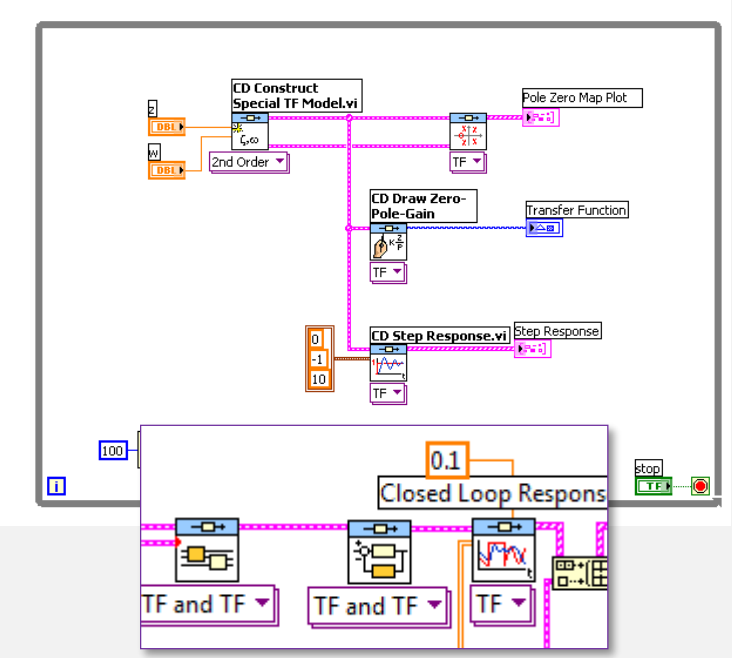
**Design, Prototype, and Deploy Within a Single Software Environment**

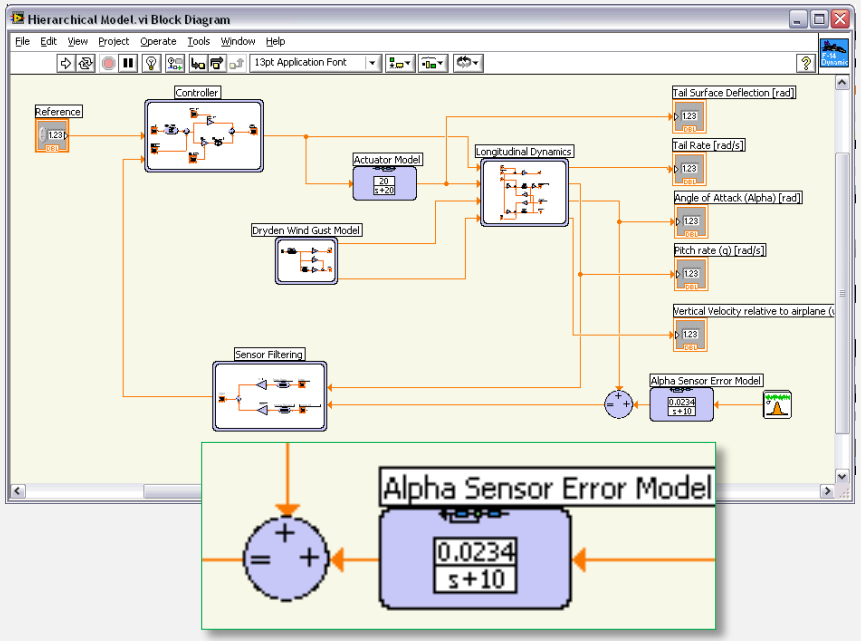
LabVIEW Control Design and Simulation integrates with the LabVIEW platform to offer programming capabilities such as built-in parallelism, multicore, and multirate technologies, as well as tools for deploying to real-time hardware.



# LABVIEW CONTROL DESIGN & SIMULATION MODULE

- Tools for Control Design and Analysis
- Tools for System Simulation



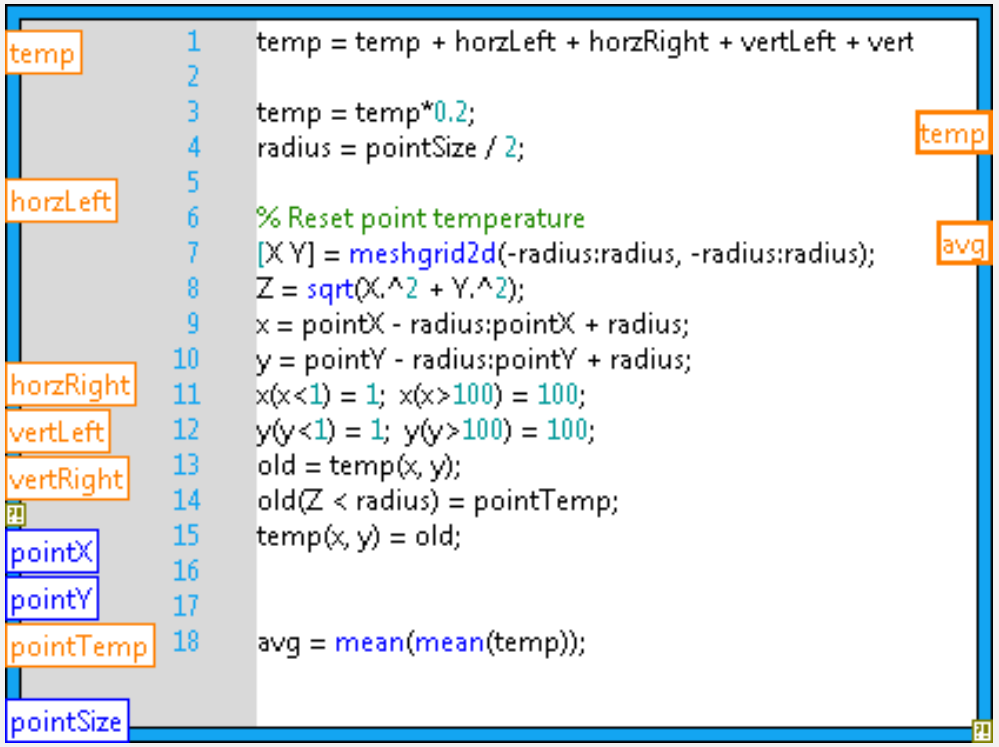
# LABVIEW CONTROL DESIGN & SIMULATION MODULE

- Tools for Control Design and Analysis
  - Model construction, reduction, interconnection and conversion
  - Time domain analysis (Rise time, Overshoot, Peak time, Settling time, Steady state…)
  - Frequency domain analysis (Pole-Zero, Bode Magnitude and Phase, Nyquist, Nichols)
  - State-Space, State-Feedback, Stochastic systems, Predictive control, etc..

- Tools for System Simulation
  - Block implementation in a simulated solver (Runge-Kutta, BDF, Adams-Moulton, Rosenbrok, Radau, SDIRK, etc…)
  - Discrete, linear and non-linear systems
  - Gains scheduling, linearization
  - Import DLL models

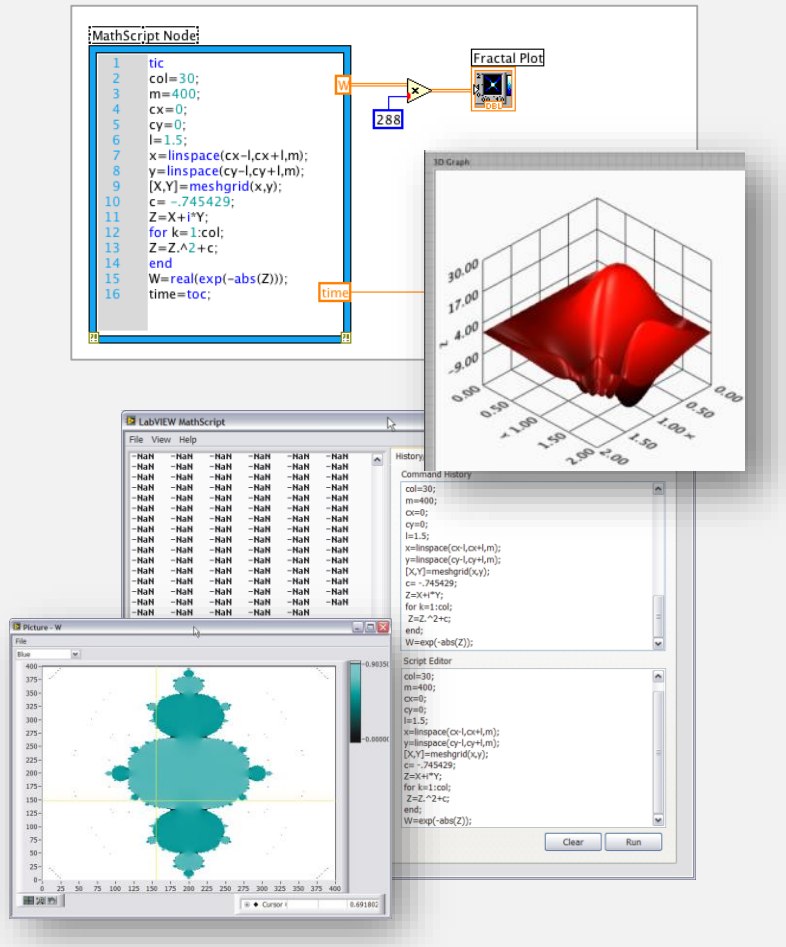
# LABVIEW MATHSCRIPT NODE

- MathScript Functions can be found in LabVIEW Help



# LABVIEW MATHSCRIPT RT MODULE

- Execution in Real-Time OS and Hardware
- Text-based controls, signal processing, and math
  - 900 built-in functions & you can create user-defined functions
  - Reuse .m file scripts you developed with The MathWorks, Inc. MATLAB® software and GNU Octave
- Native LabVIEW solution
  - Does not require any 3rd-party software
  - Works with LabVIEW Real-Time & all NI hardware targets

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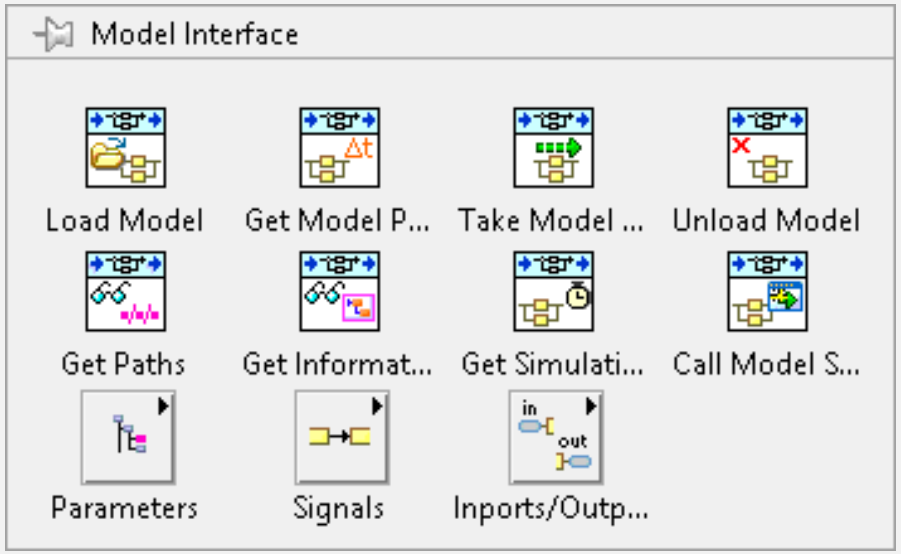
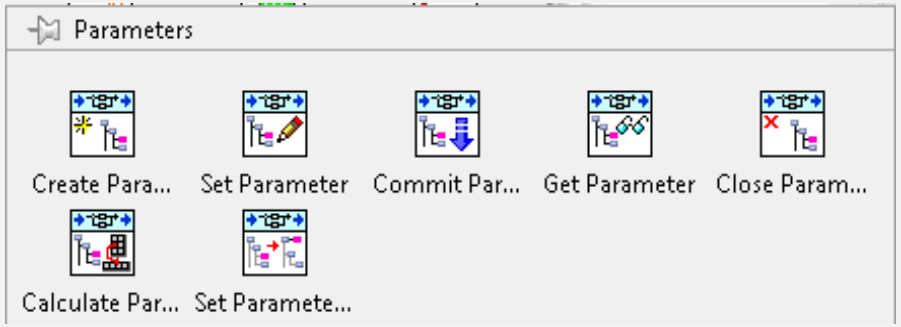
# LABVIEW MODEL INTERFACE TOOLKIT

- **Import models from a variety of modeling environments into LabVIEW**
  - Built on the NI VeriStand model framework
  - More robust APIs with improved usability and documentation
  - Allows you to run multiple models simultaneously
  - Includes shipping examples that can be used as templates




- **Usability**
  - Useful for basic connection of simulation models to NI hardware
  - Can be used to upgrade existing LabVIEW based HIL applications
  - Compatible with myRIO and ARM based CompactRIO



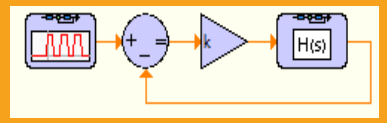
SUMMARY

## Deploy to Hardware Through LabVIEW

MathScript RT Module

```
1  A = [0 1; -2 -4];
2  eigs = eig(A);
3  detA = det(A);
```

Control Design & Simulation Module




Model Interface Toolkit

## The MathWorks Inc. software development environment

Your .m code — MATLAB®

Your .mdl code — Simulink®

Your dll — Simulink Coder™

LabVIEW Real-Time

NI VeriStand

CompactRIO, Single-Board RIO, myRIO, PXI, or Desktop PC

# CASE STUDIES

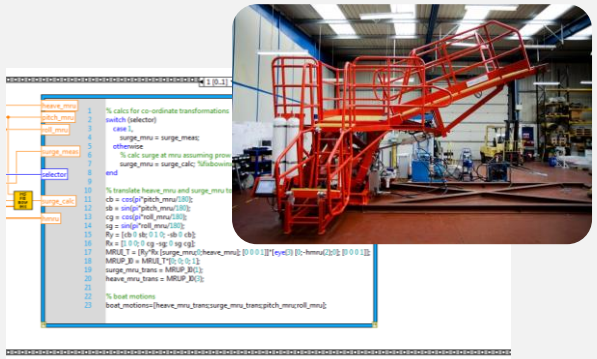
- Portable 3D Vision-Guided Medical Robot for Autonomous Venipuncture
  - Vasculogic, USA
  - NI SoftMotion, CompactRIO, LabVIEW CD&Sim, LabVIEW Robotics Module, NI Vision
  - http://sine.ni.com/cs/app/doc/p/id/cs-16255

- Replacing Diesel with Hybrid Power in Buses
  - Vantage Power Ltd., UK
  - LabVIEW CD&Sim for control prototyping and simulation, CompactRIO
  - http://sine.ni.com/cs/app/doc/p/id/cs-16242

# CASE STUDIES

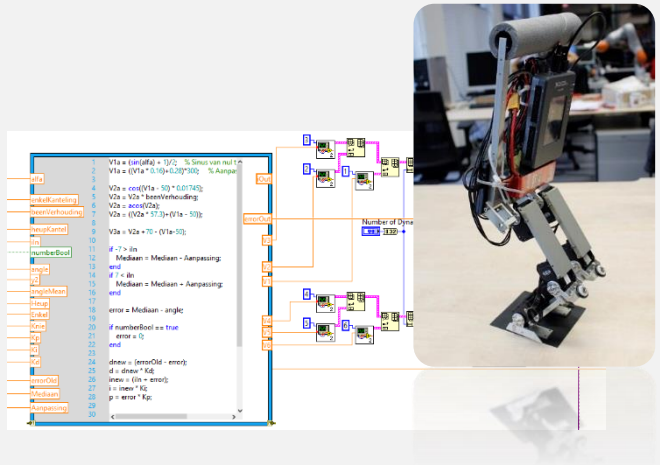
- Industrial Inspection Drone Using the NI RIO Platform
  - VTOL Technologies, UK
  - myRIO, LabVIEW Control Design and Simulation Module, LabVIEW MathScript
  - http://sine.ni.com/cs/app/doc/p/id/cs-16701

- Offshore Turbine Access System
  - Houlder Ltd. & ISC Ltd. UK
  - CompactRIO, LabVIEW MathScript
  - http://sine.ni.com/cs/app/doc/p/id/cs-14813



# CASE STUDIES

- Stand-Alone Bipedal Humanoid Robot
  - TU Delft, NL
  - myRIO, LabVIEW MathScript
  - http://sine.ni.com/cs/app/doc/p/id/cs-16912



- Controlling 70-Ton Gripper Arms for Offshore Wind Turbine Construction
  - Houlder Ltd. & ISC Ltd. UK
  - CompactRIO, LabVIEW MathScript, LabVIEW Touch Panel
  - http://sine.ni.com/cs/app/doc/p/id/cs-15650