NATIONAL INSTRUMENTS™

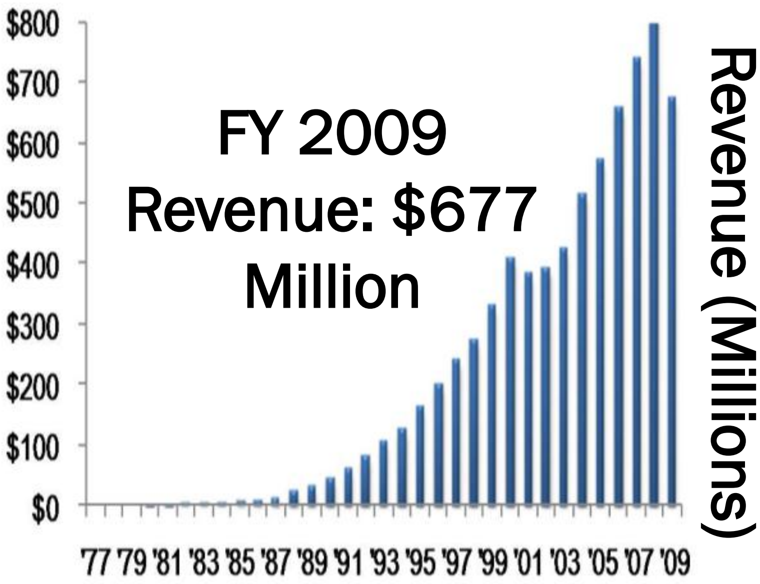
Outline

- Introduction to National Instruments
- Control Applications in LabVIEW
- Our Verification Tools Today
- Our Verification Tools Tomorrow

INTRO TO NATIONAL INSTRUMENTS

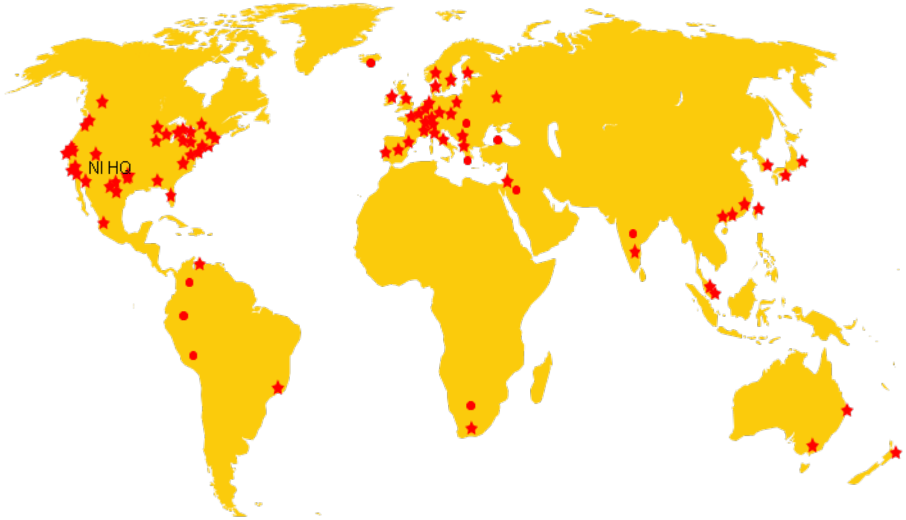
Corporate Background

- Leaders in Computer-based Measurement and Automation
- Long-term Track Record of Growth and Profitability
- $677 M Revenue FY 2009; $202 M Revenue in Q4 2009
- More than 5,000 employees; operations in 40+ countries
- R&D Investment: 16% of Annual Income
- *Fortune*'s 100 Best Companies to Work For: 12 Consecutive Years



National Instruments in Academia

- 110 Countries
- Adopted in 6,000+ universities worldwide
- Used in all engineering and science disciplines



Diversity of Industries

Telecom

Automotive

Semiconductors

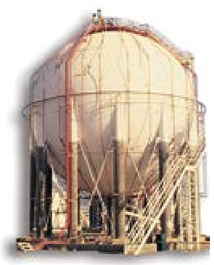
Electronics

Computers

ATE

Military/Aerospace

Advanced Research



Petrochemical

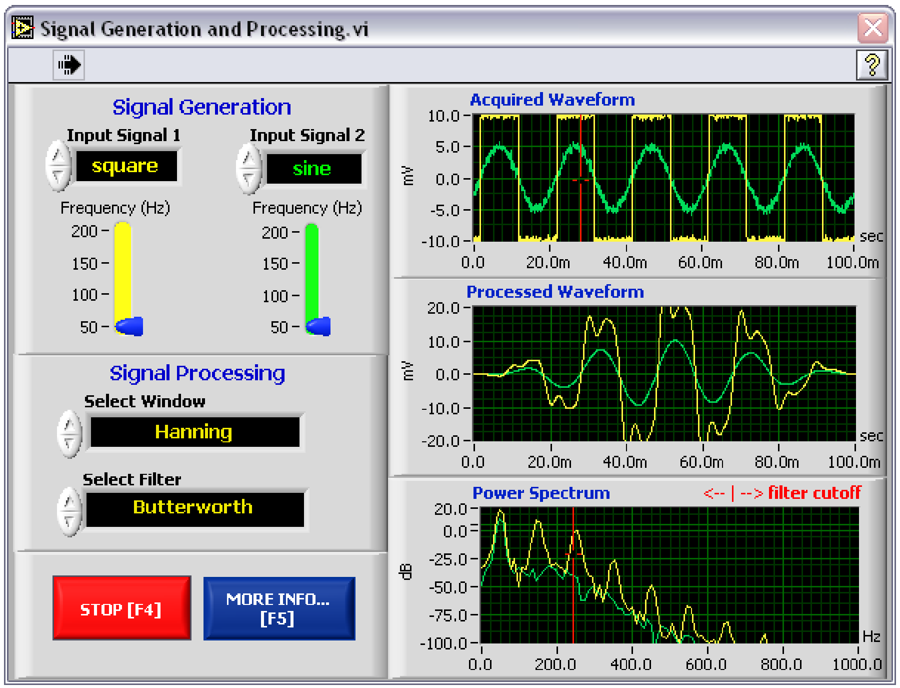
Food Processing

Textiles

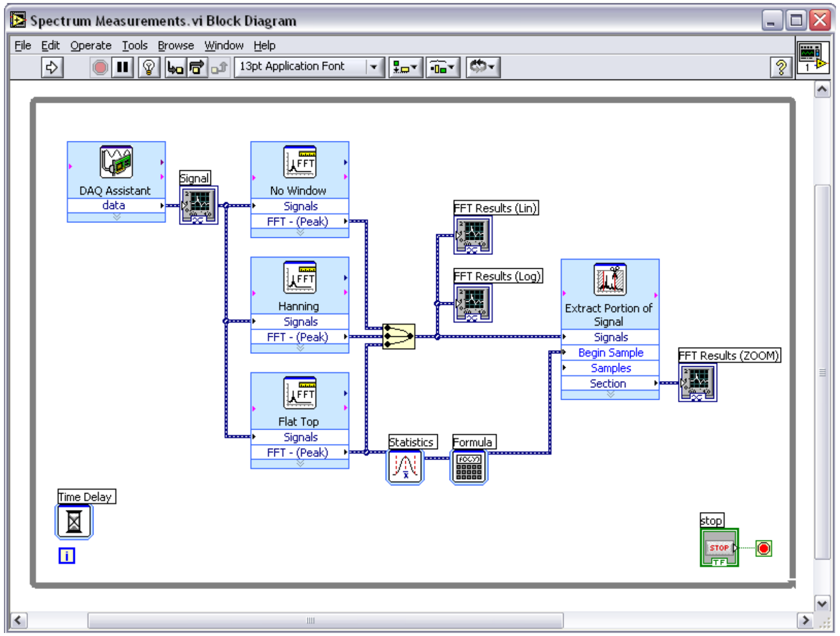
CONTROL APPLICATIONS IN LABVIEW

What is LabVIEW?

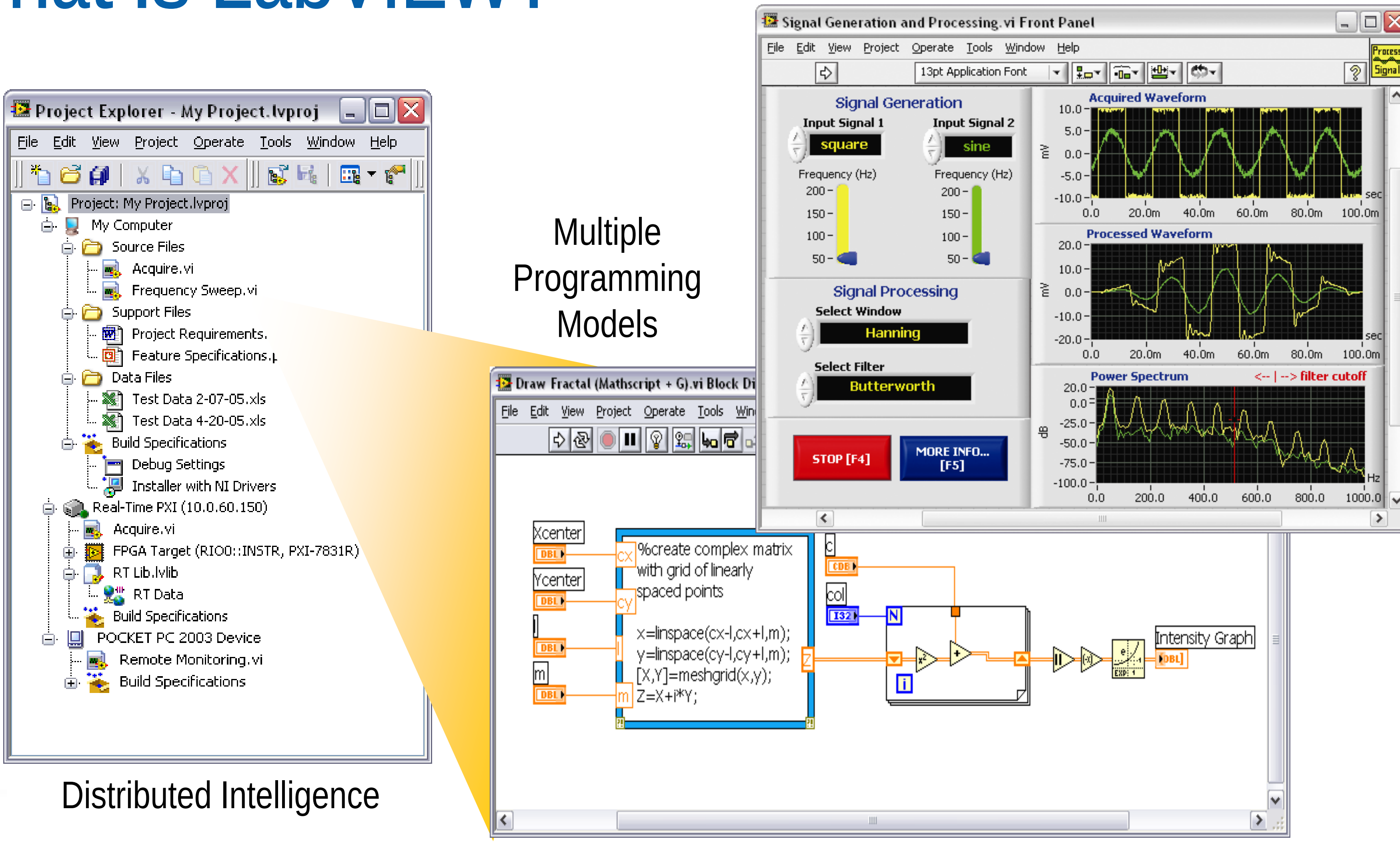
Front Panel



Block Diagram



What is LabVIEW?

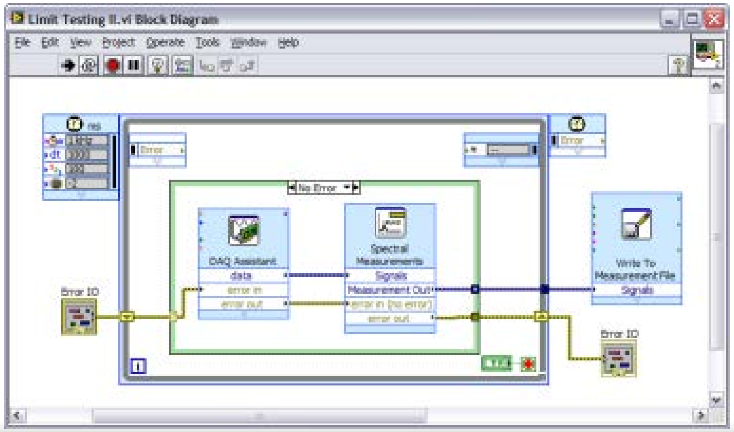


Multiple Programming Models

Distributed Intelligence

LabVIEW is a Programming Language

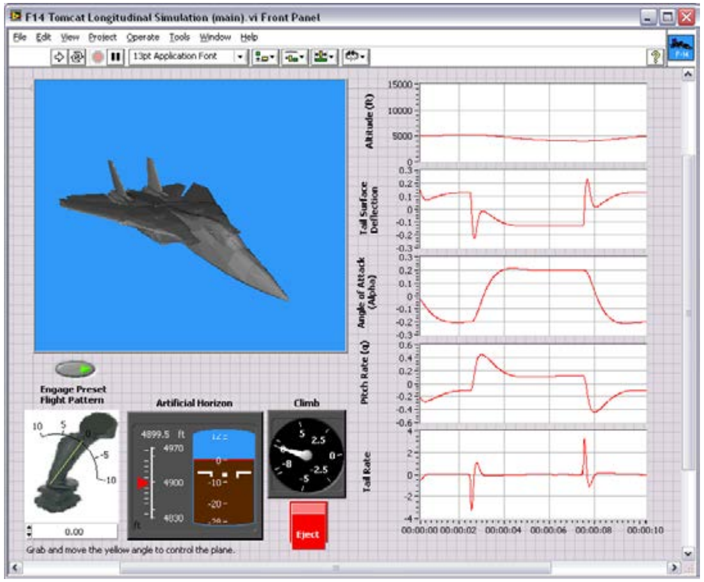
- Graphical Programming (often called 'G')
  - Data types
  - Structures (i.e. loops, case, event handling)
  - Standard functions (i.e. File I/O)
- Reuse external code
- Compiles to machine code
- Automatic multithreading

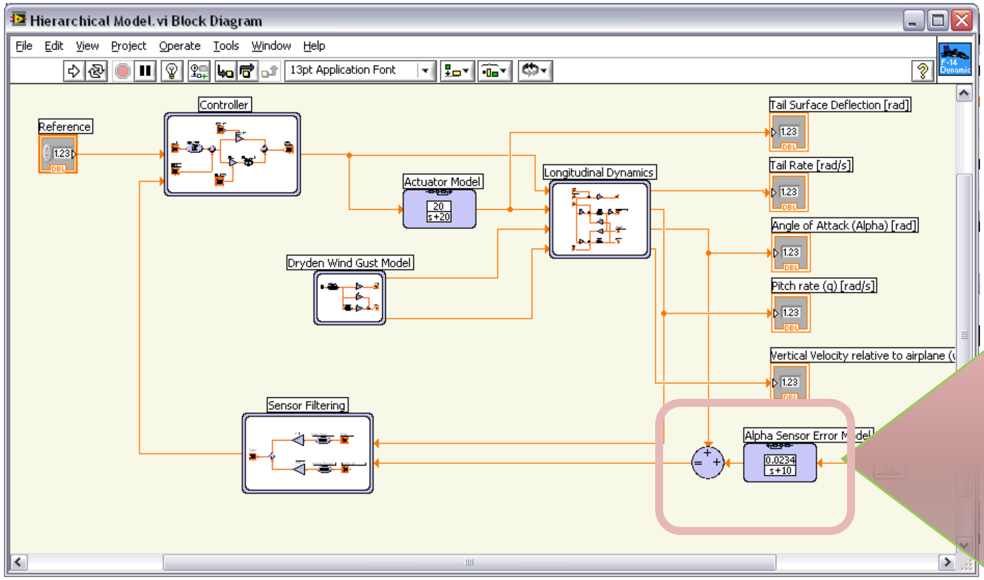


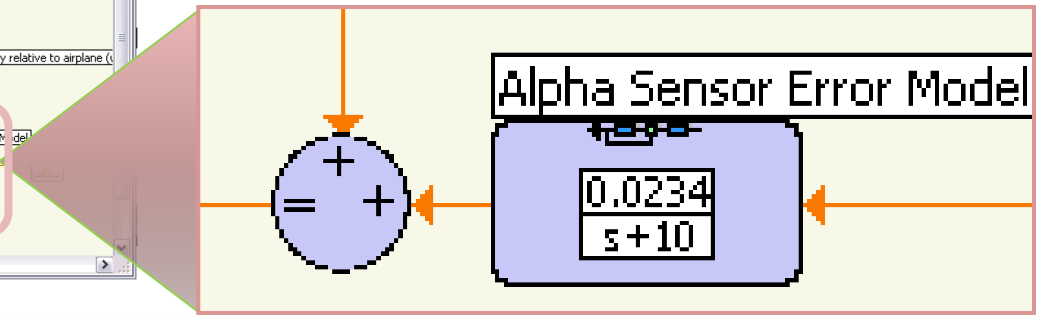
NATIONAL INSTRUMENTS

Dynamic System Simulation & Control

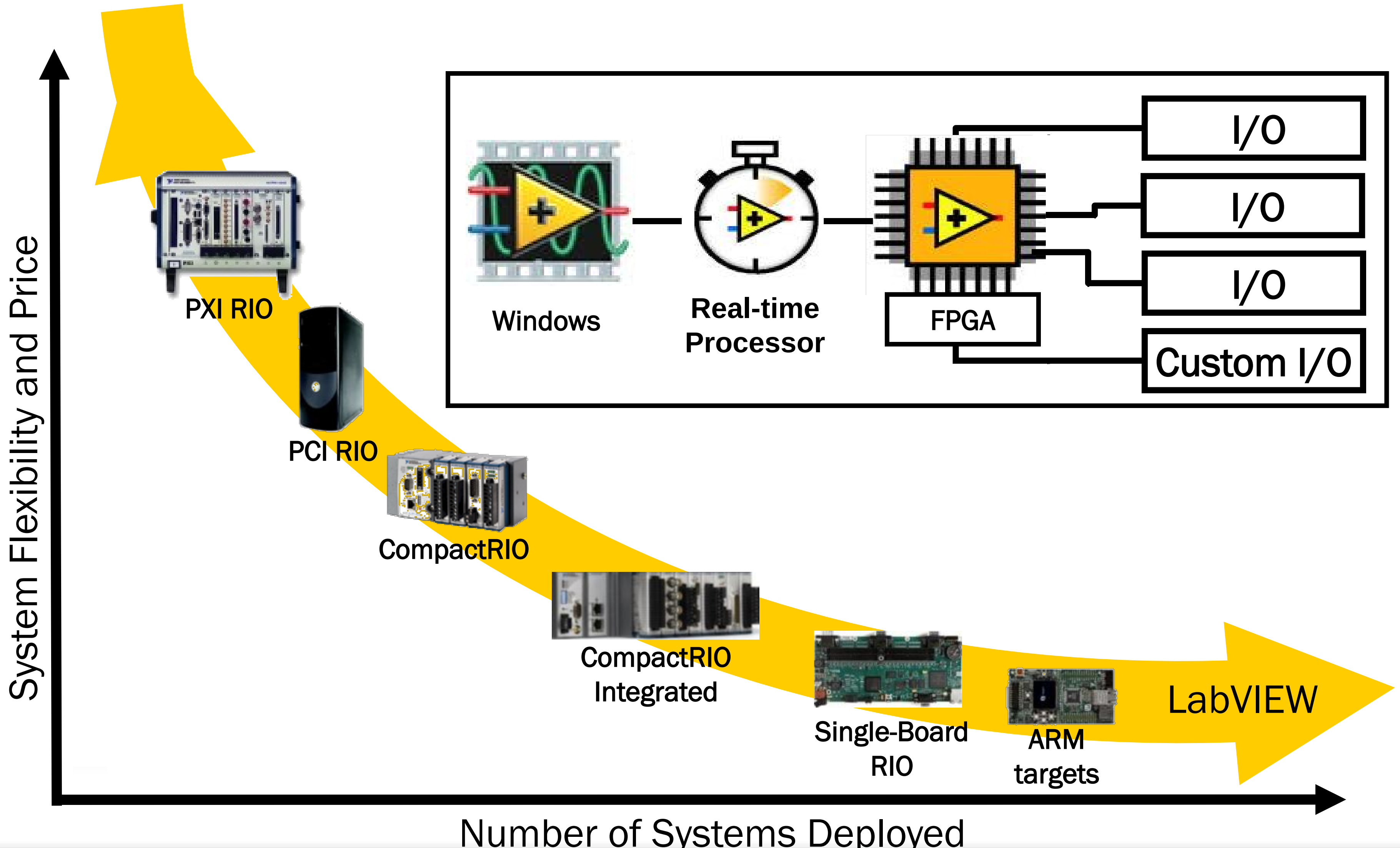
- Both signal flow and .m file development
- Single environment for:
  - Simulation of dynamic systems
  - Real-time implementation for rapid control prototyping or hardware-in-the-loop simulation



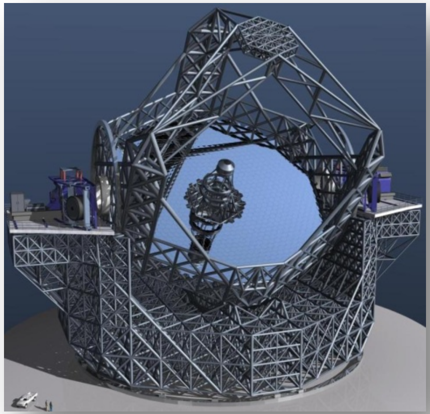




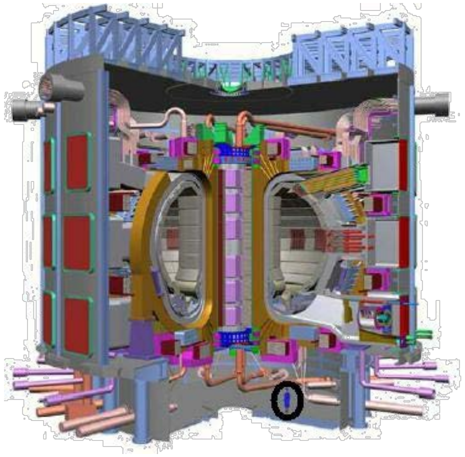
Deployment Curve



Tough Real-Time Challenges

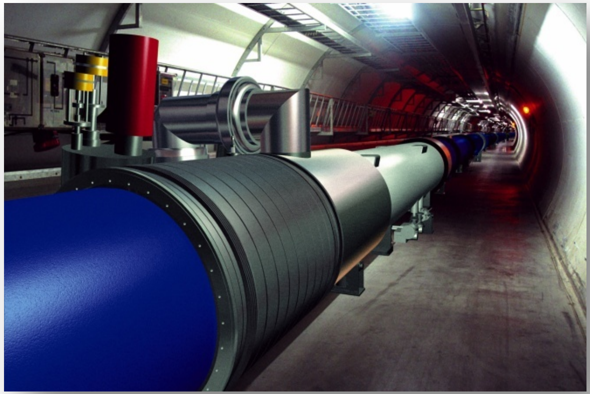


Large Telescope
Mirror Control

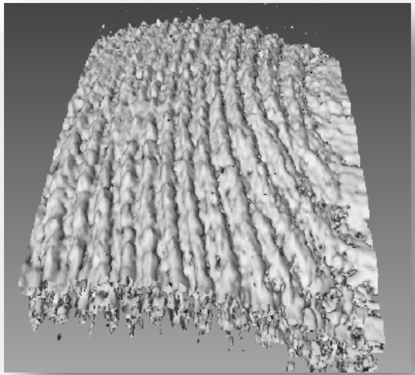


Tokomak
Plasma Control

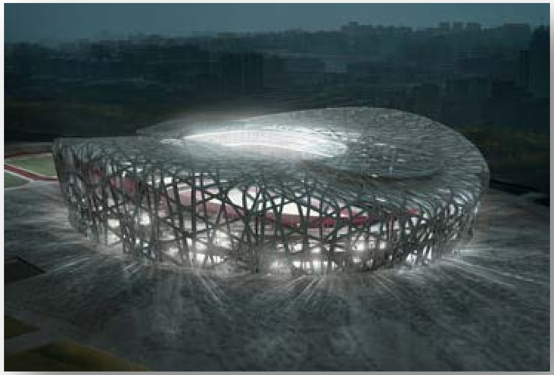
Wind Turbine Sound Source
Characterization



CERN Hadron Collider

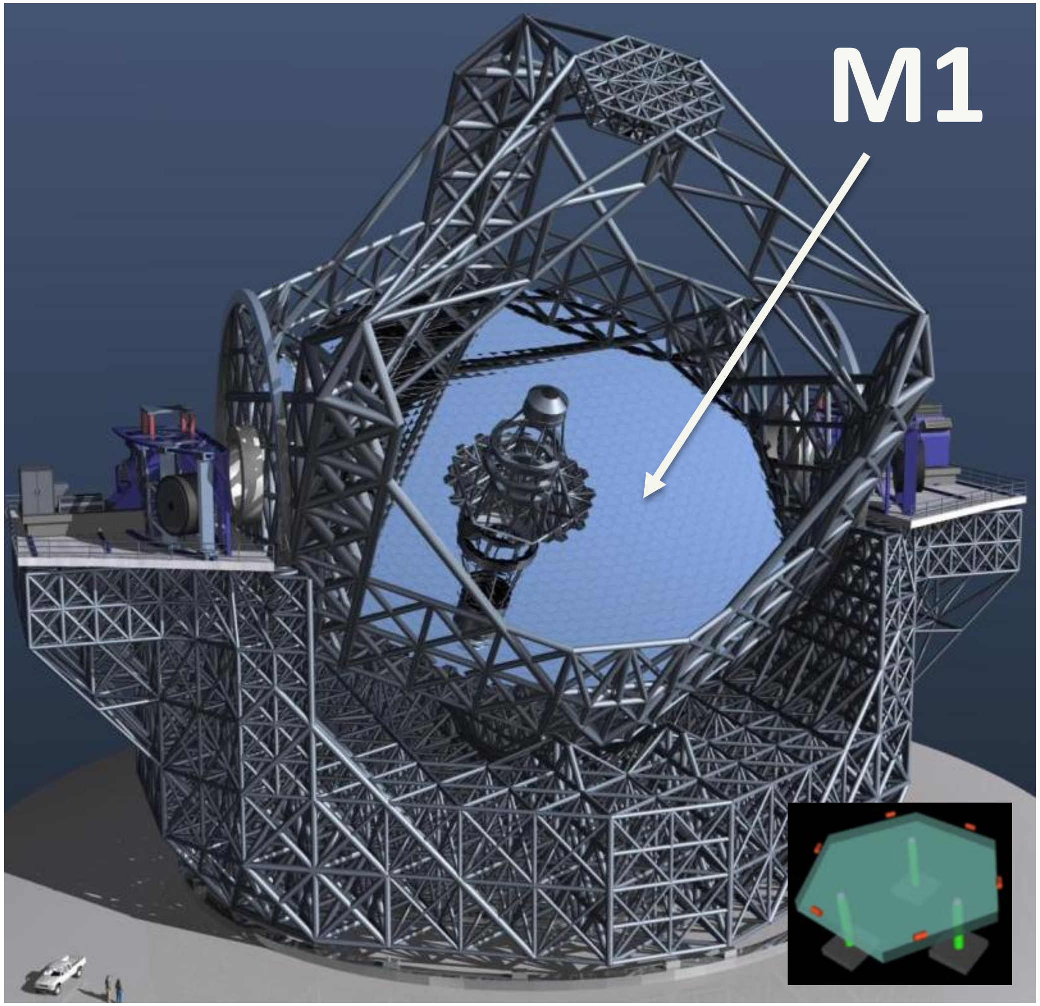


Early Cancer Detection



Structural Monitoring

ESO - ELT – Primary Mirror (M1) Control



984 MIRRORS

3,000 ACTUATORS

6,000 SENSORS

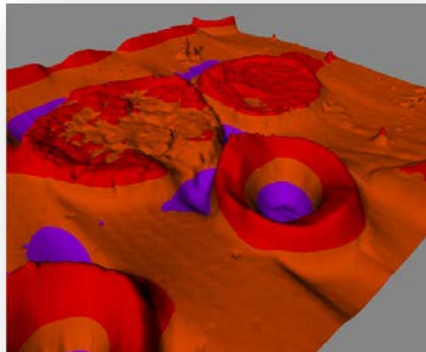
3k x 6k MATRIX

1 MILLISECOND

High Speed & High Precision Control with Real-Time & FPGA

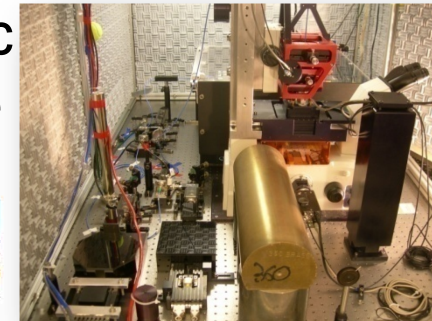
Scanning Probe Microscope w/ PLL

NANONIS
The SPM Application Experts

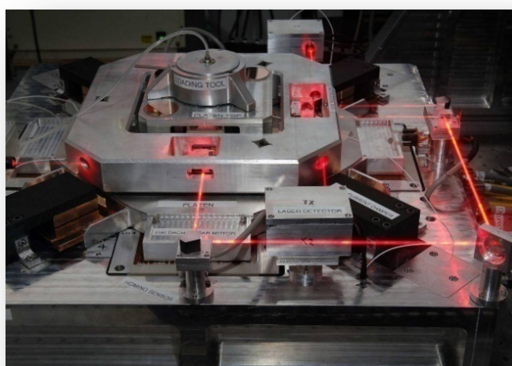


Ultrastable Atomic Force Microscope

Colorado
University of Colorado at Boulder



Nanoimprint Lithography



Precision Servo-Hydraulic Control

Product Technology Partners

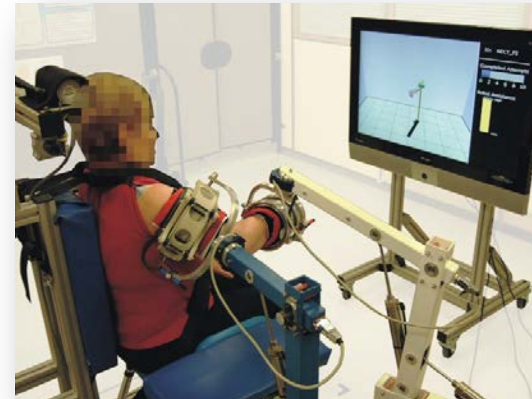
Biomedical Design

Controlled pacifier

KCBioMedix

Robotic rehabilitation

UNIVERSITY OF LEEDS



Closed-loop control of anesthesia

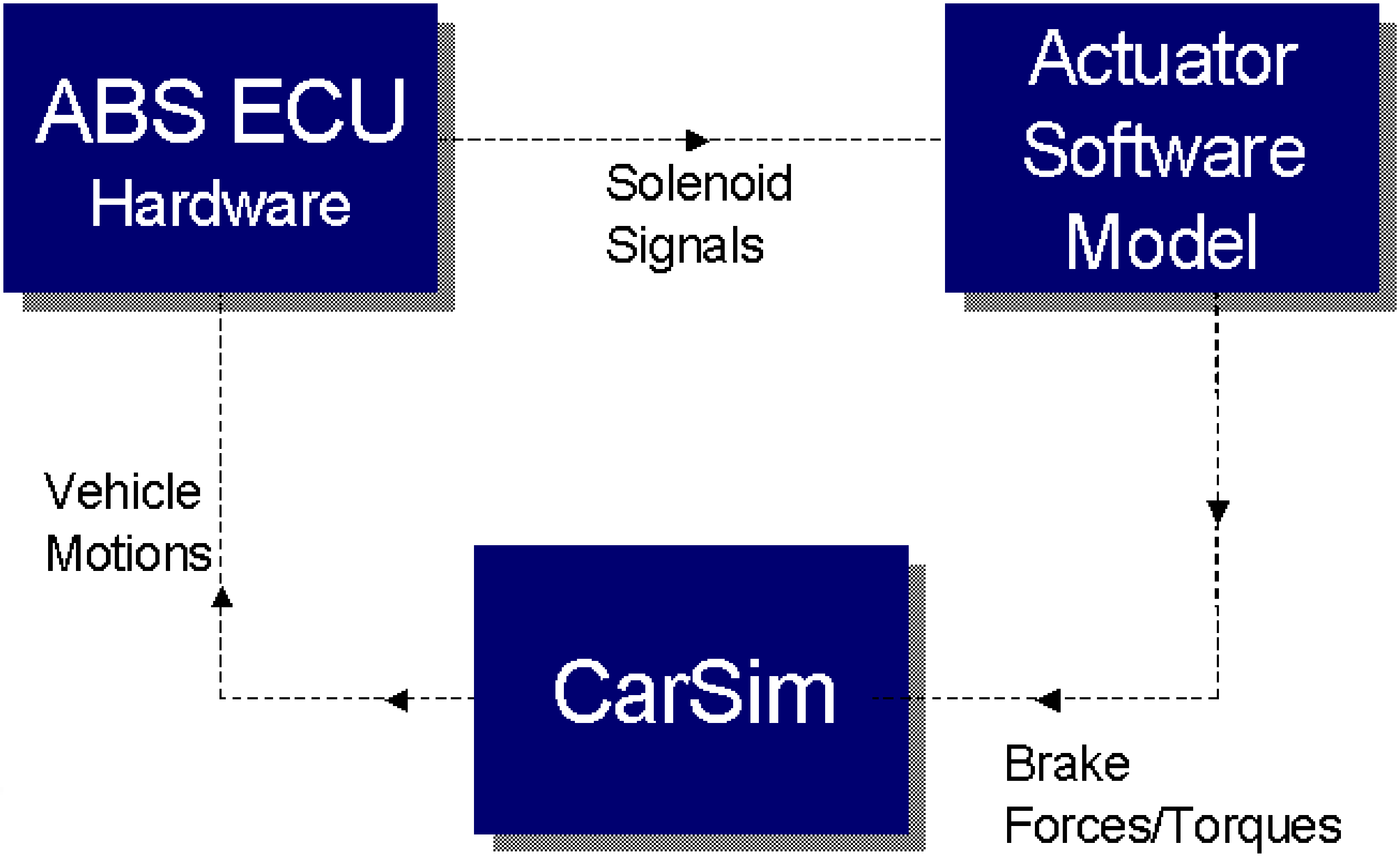
McGill

Breast tumor treatment device

SANARUS®
The visible difference in breast care®

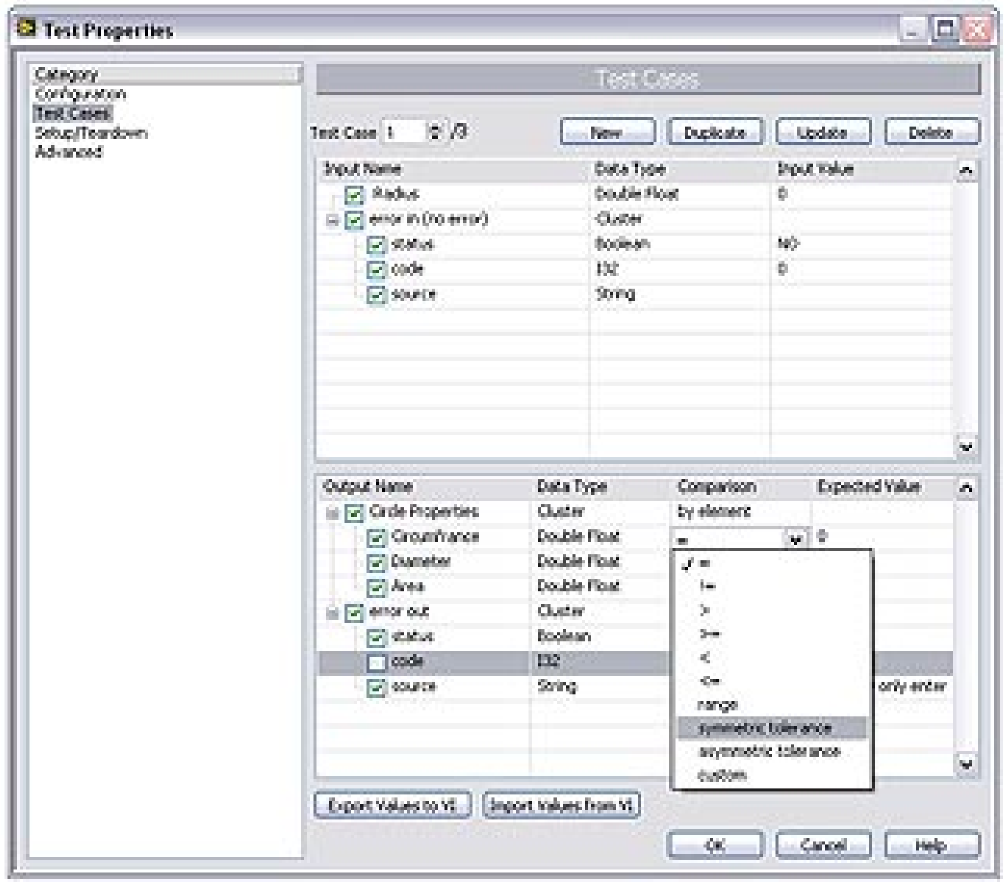
OUR VERIFICATION TOOLS TODAY

Hardware in the Loop



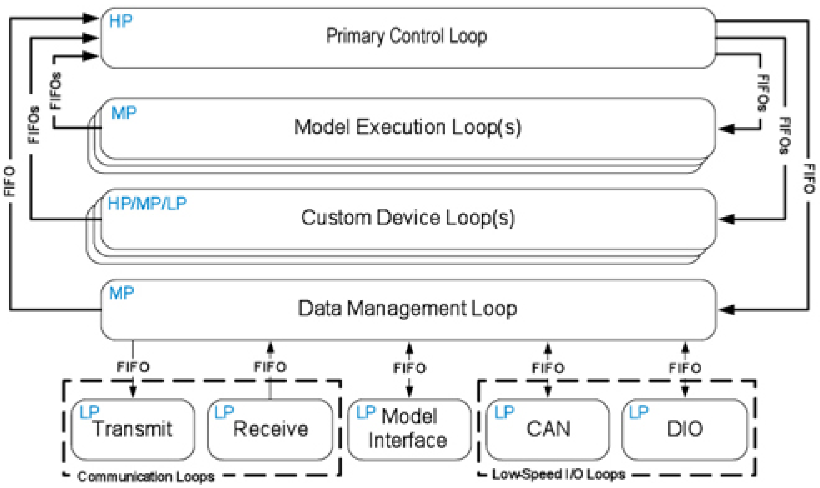
LabVIEW Unit Test Framework Toolkit

- Validation
- Dead code identification
- Identify behavior-modifying changes

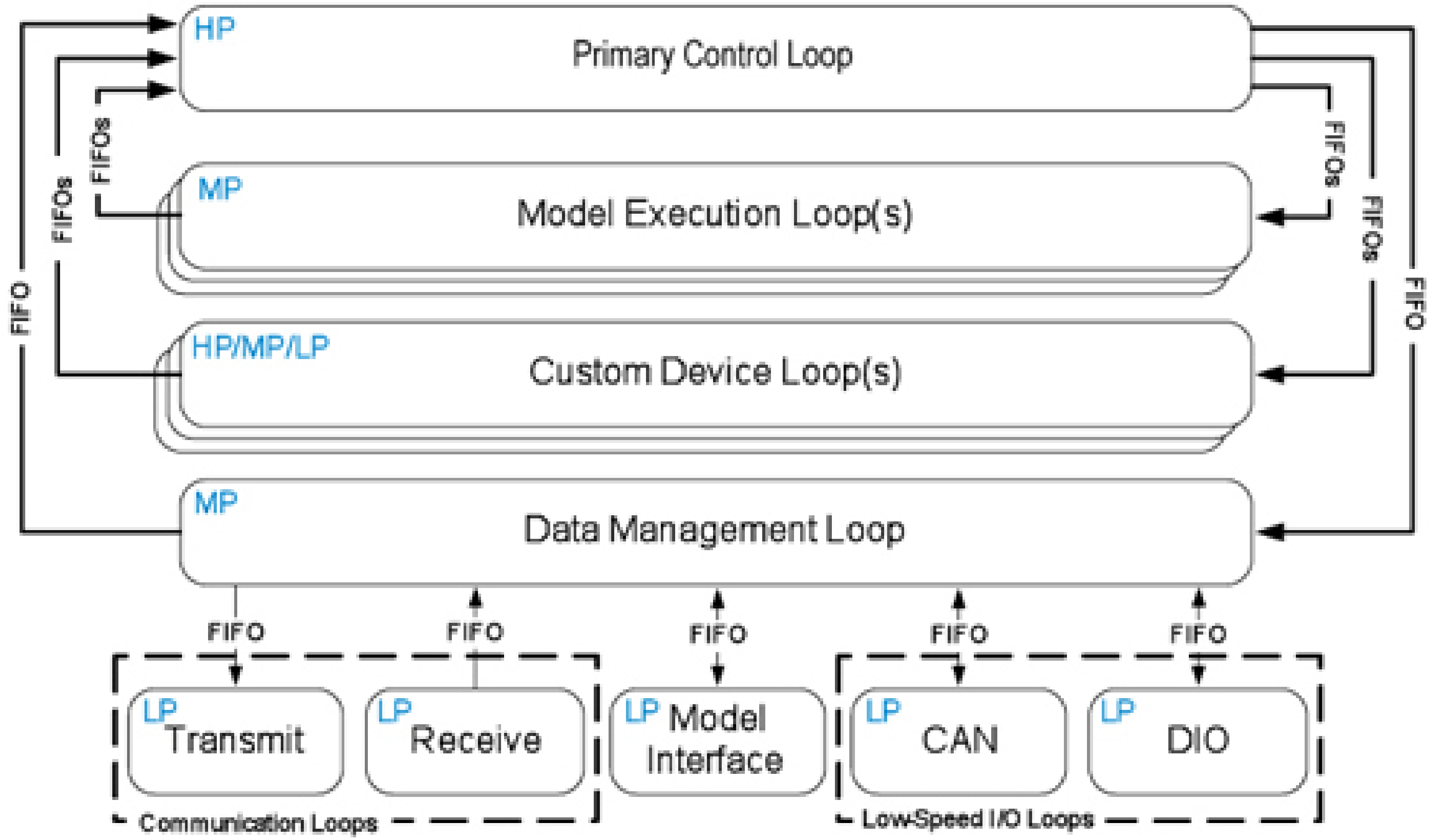


NI VeriStand

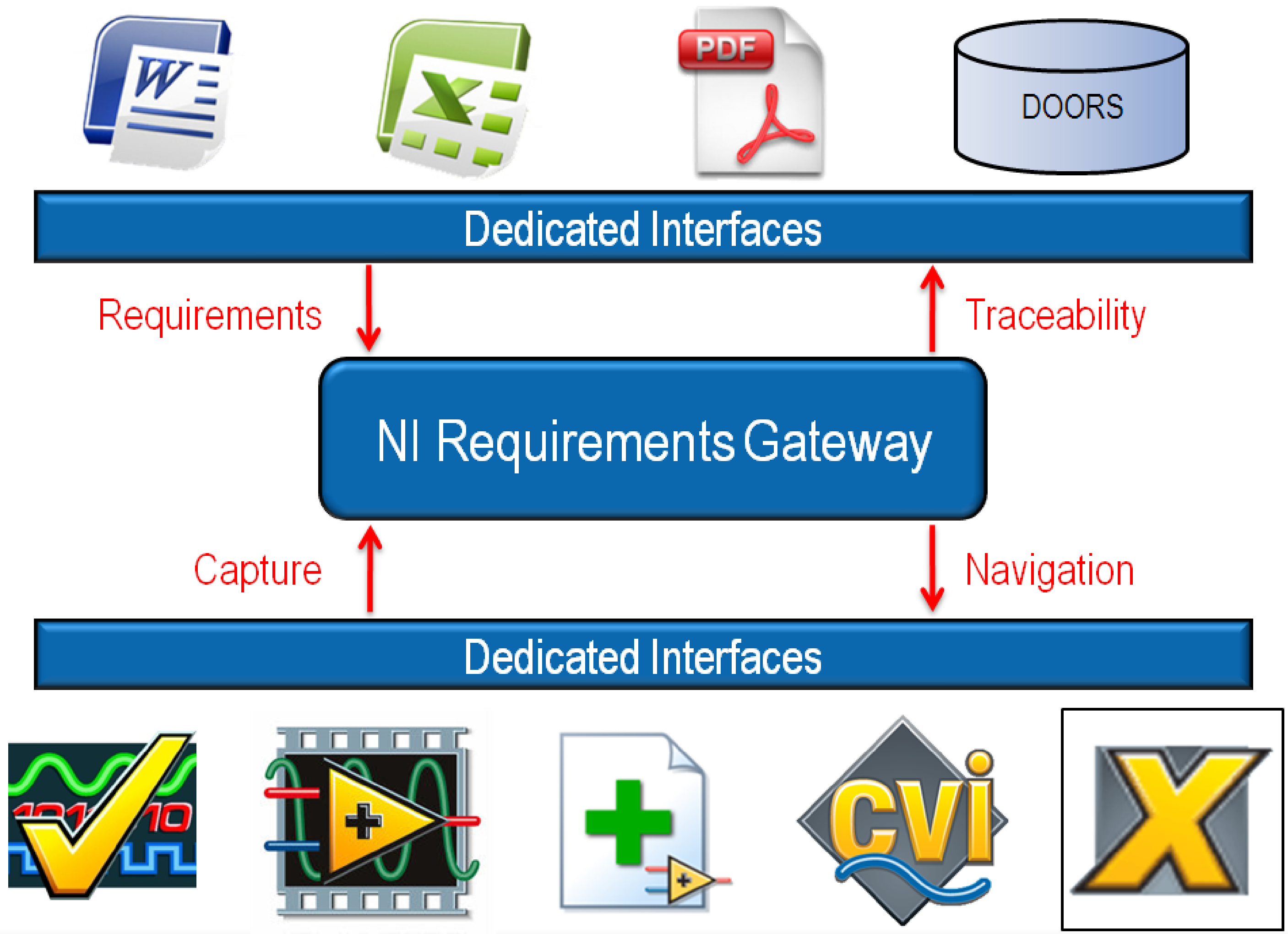
- Test sequence creation & reuse
- Dynamic pass/fail analysis
- Real-time stimulus generation
- Event alarming & response



NI VeriStand

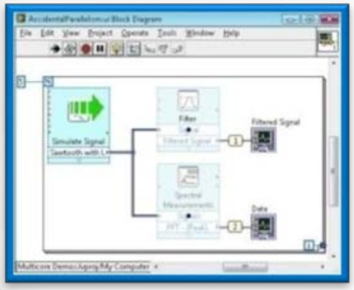


NI Requirements Gateway



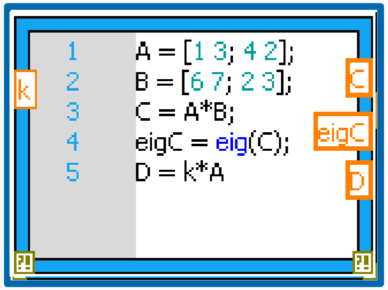
High-Level Design Models

Data Flow

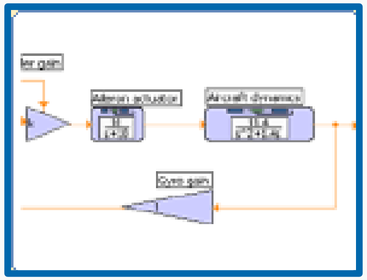


C Code

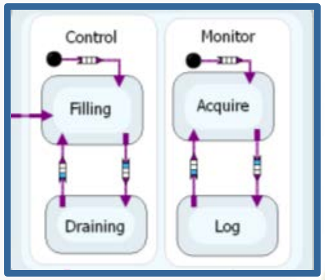
Textual Math



Simulation



Statechart



NATIONAL INSTRUMENTS LabVIEW™

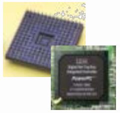
Graphical System Design Platform

PC/Mac/Linux

PXI

CompactRIO

FlexRIO



Custom

OUR VERIFICATION TOOLS TOMORROW

Analyzing LabVIEW Code

- G in its current state is very expressive
- G can be ‘pruned’ to achieve greater analyzability
- Enables tools to accelerate V&V and certification

Future Work

- Definition of an analyzable subset of G
- Refinement of LabVIEW Statecharts
- Development of formal verification tools
- Collaboration with YOU

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