

# Welcome to NIDays 2009 !

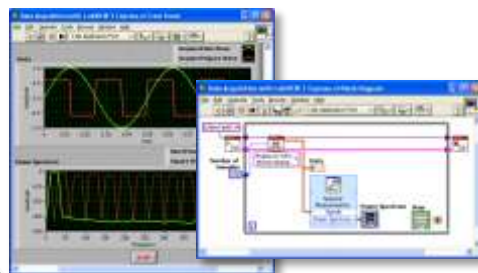
*Filip Langenaken  
Area Sales Manager  
National Instruments Belgium*

# What We Do

## Low-Cost Modular Measurement and Control Hardware



## Productive Software Development Tools



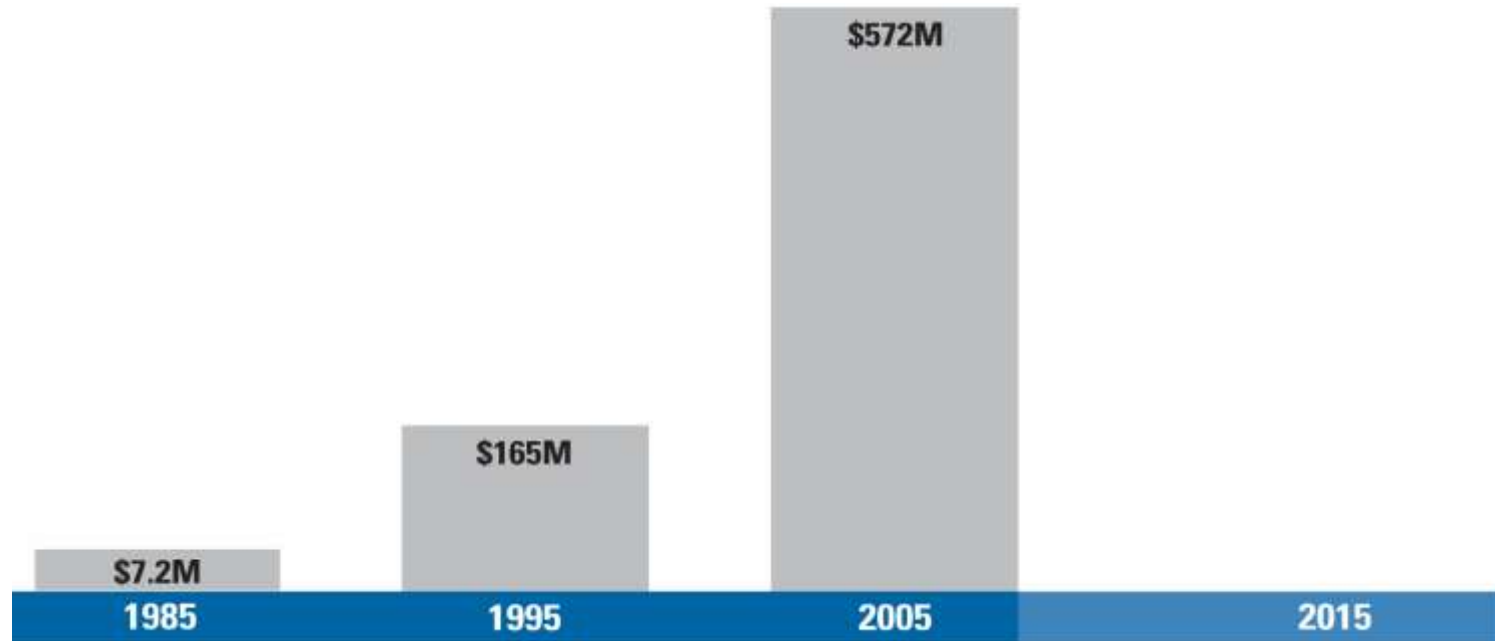
## Highly Integrated Systems Platforms



Used By Engineers and Scientists for Test, Design and Control



# National Instruments: Decades of Innovations



## First Decade

1985: Self-financing with GPIB

## Second Decade

1995: Virtual Instrumentation with GPIB, NI LabVIEW, and DAQ

## Third Decade

2005: Measurement and Automation (Modular Instruments and systems – PXI, FieldPoint, and CompactRIO)

## Fourth Decade

2015 : Test & Measurement and Graphical System Design

# Leveraging Technologies to Solve Next Generation Engineering Challenges

Shelley Gretlein

Senior Group Manager, Real-Time and Embedded

NIDays 2009

# Engineering Grand Challenges



Make solar energy economical



Provide energy from fusion



Develop carbon sequestration methods



Manage the nitrogen cycle



Provide access to clean water



Restore and improve urban infrastructure



Advance health informatics



Engineer better medicines



Reverse-engineer the brain



Prevent nuclear terror



Secure cyberspace



Enhance virtual reality



Advance personalized learning



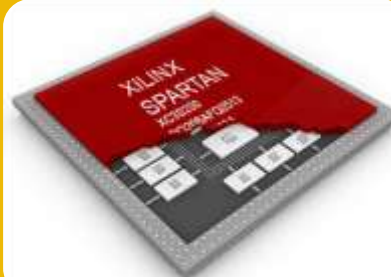
Engineer the tools of scientific discovery

# Today's Technology: Core Value

Multicore



FPGA



Modular I/O



# Today's Technology: Core Value

Multicore

**Parallel &  
Scalable  
Processing**

FPGA

**Re-definable  
Silicon**

Modular I/O

**Combinable  
Measurements  
& Rapid Data  
Access**

# Today's Technology Potential

Multicore

Parallel &  
Scalable  
Processing



Desktop  
Supercomputing

FPGA

Re-definable  
Silicon



Rapid  
Embedded  
Development

Modular I/O

Combinable  
Measurements  
& Rapid Data  
Access

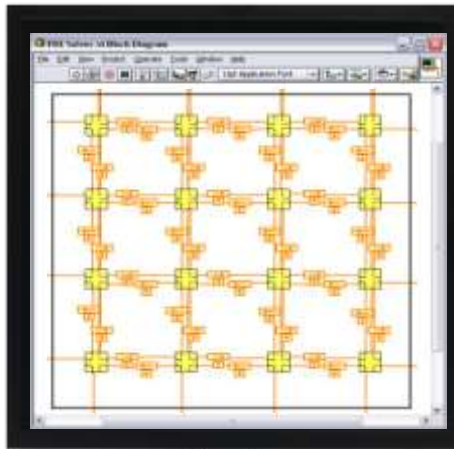


High  
Performance  
Interaction



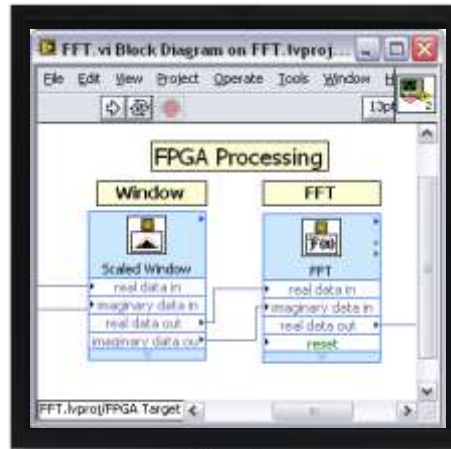
# Access through Graphical Programming

Multicore



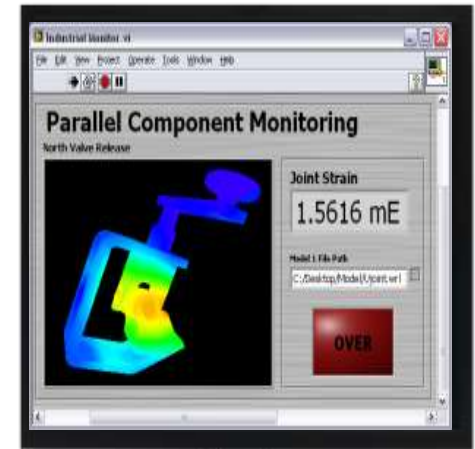
**Desktop  
Supercomputing**

FPGA



**Rapid  
Embedded  
Development**

Modular I/O

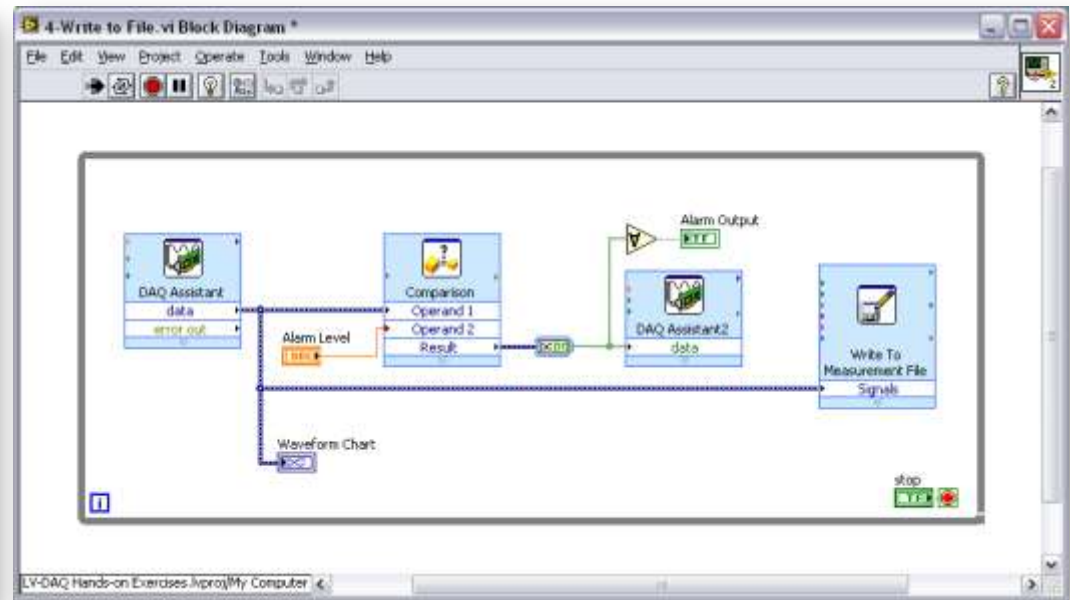
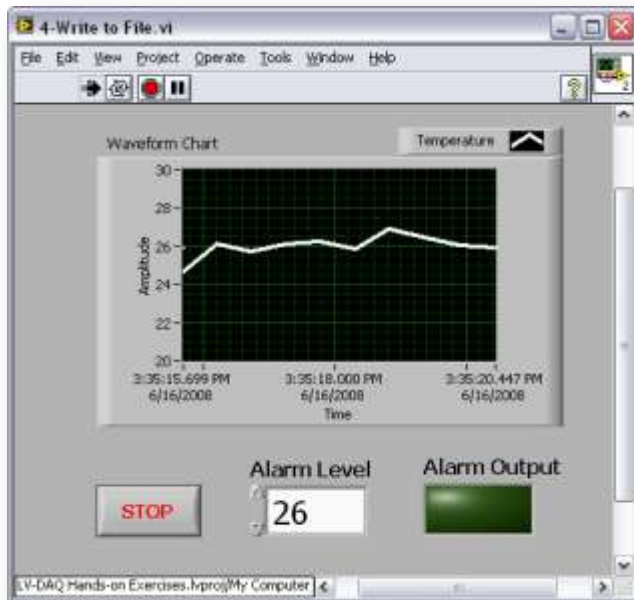


**High  
Performance  
Interaction**

# Graphical Programming:

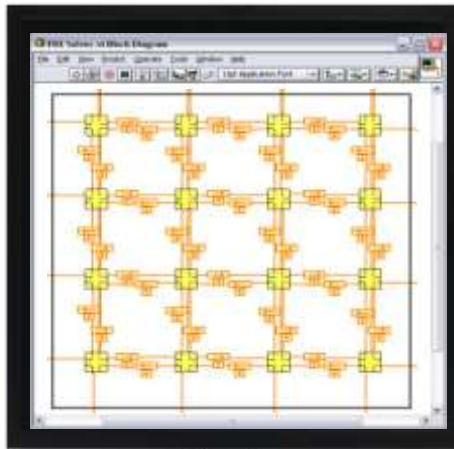
## Simplifying Design of Complex Engineering Systems

- Symbolic
- Dataflow
- Hierarchical
- Interactive
- Inherent User Interface



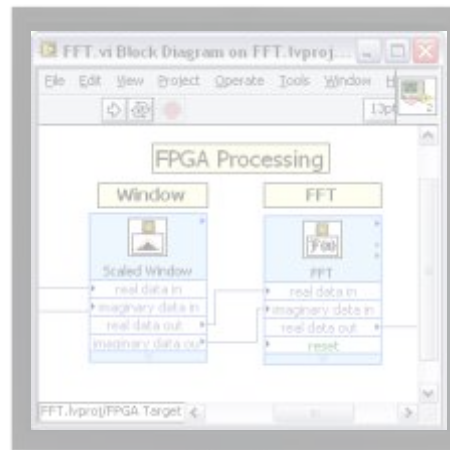
# Access through Graphical Programming

Multicore



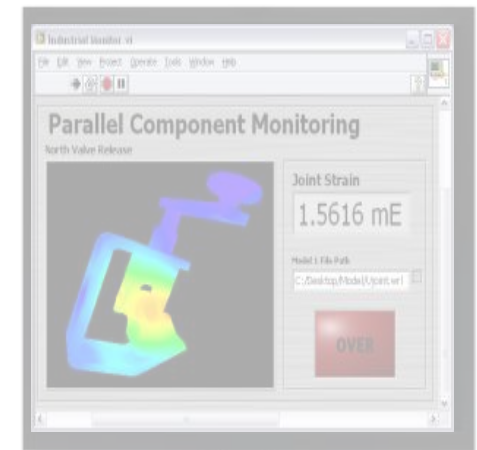
**Desktop  
Supercomputing**

FPGA



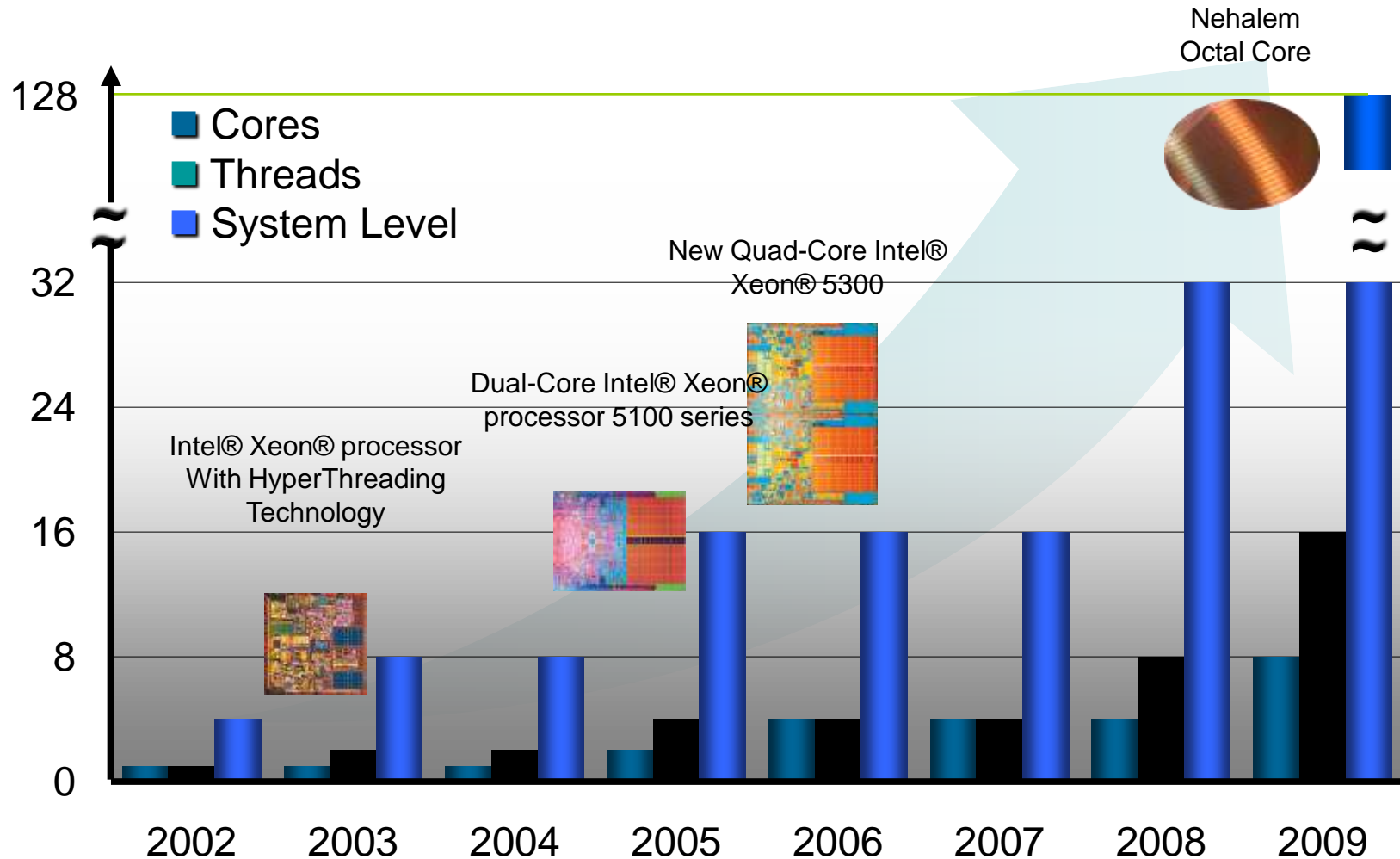
**Rapid  
Embedded  
Development**

Modular I/O

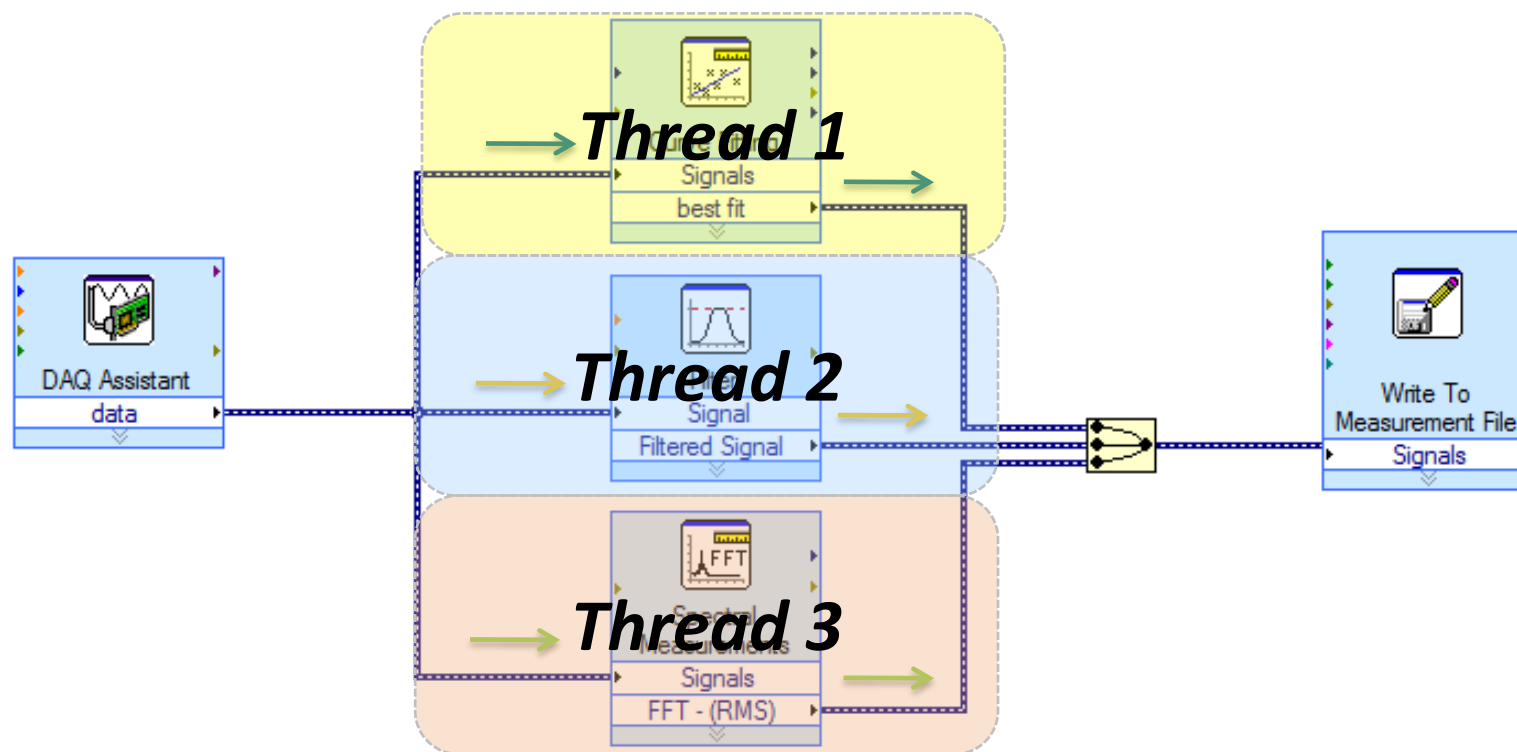


**High  
Performance  
Interaction**

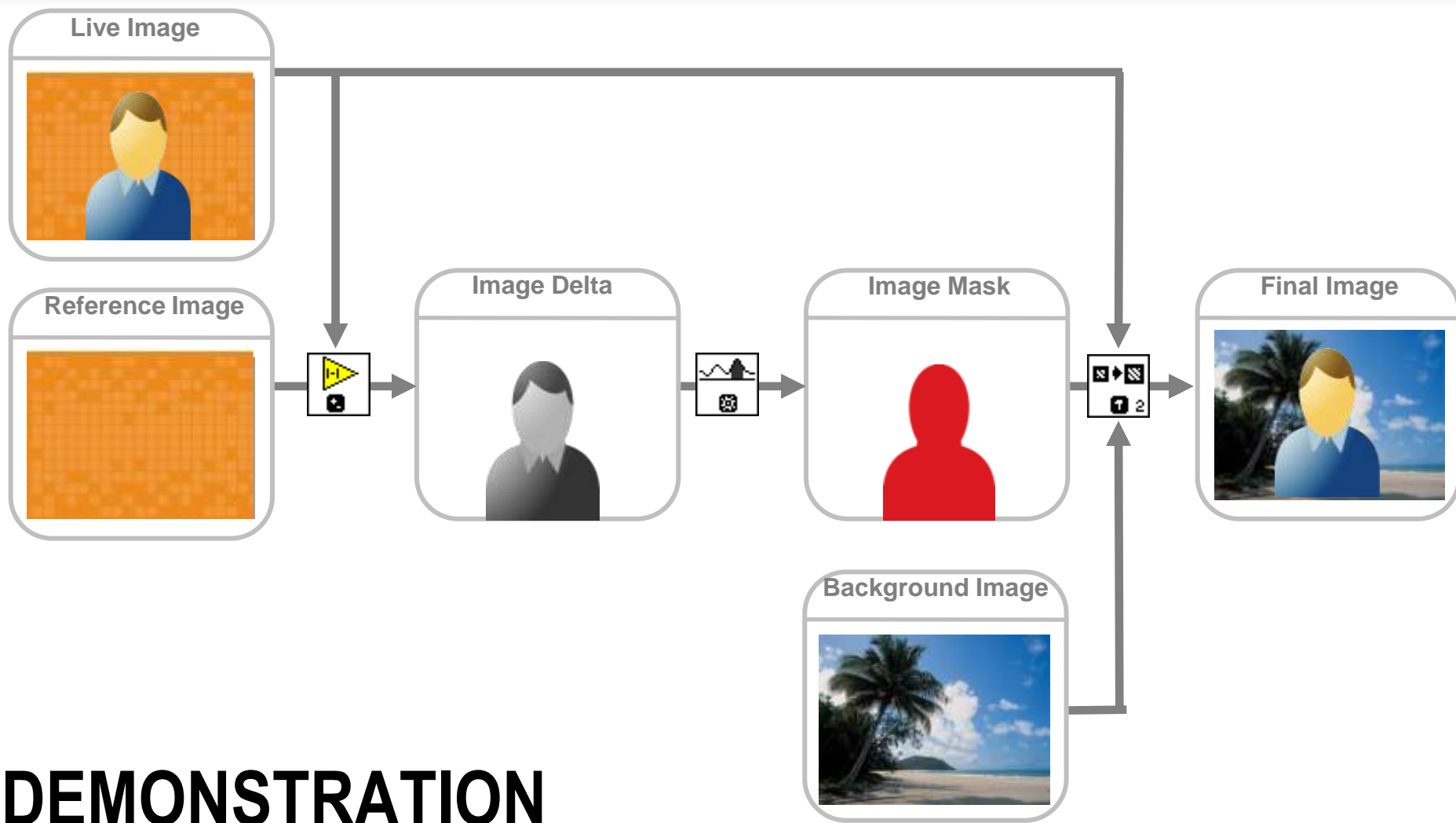
# Multi-core: Scalable Parallel Processing



# Realizing the Potential: Inherent Access to Automatically Scalable Parallelism



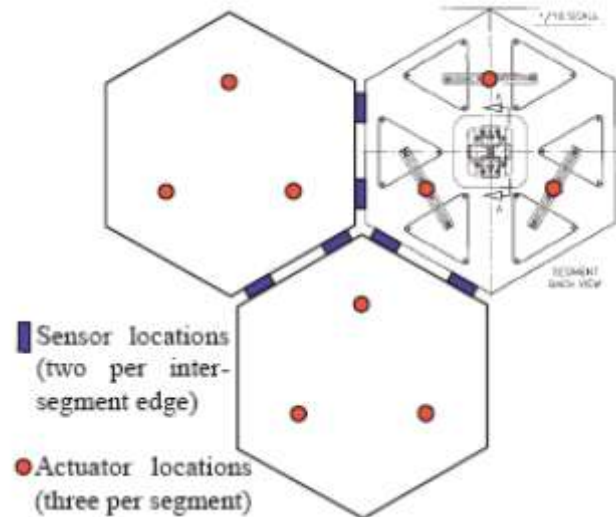
10 Year Anniversary of Multithreading



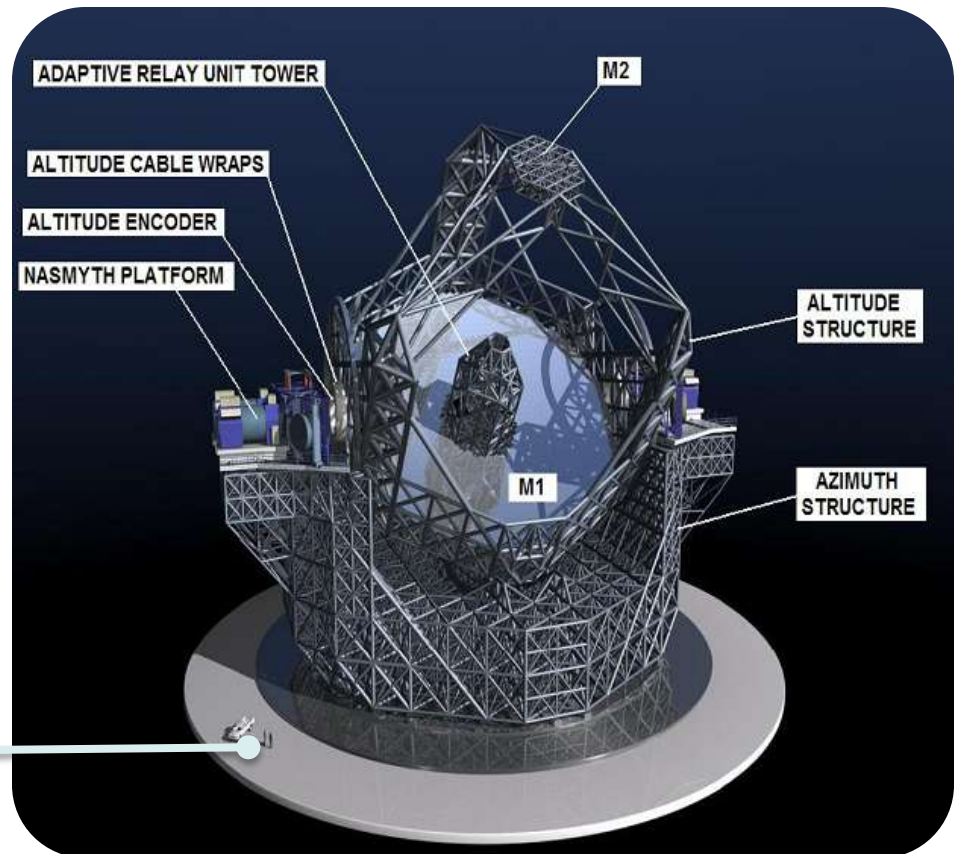
# DEMONSTRATION

## THE LABVIEW GREEN SCREEN

# Case study: Extremely Large Telescope

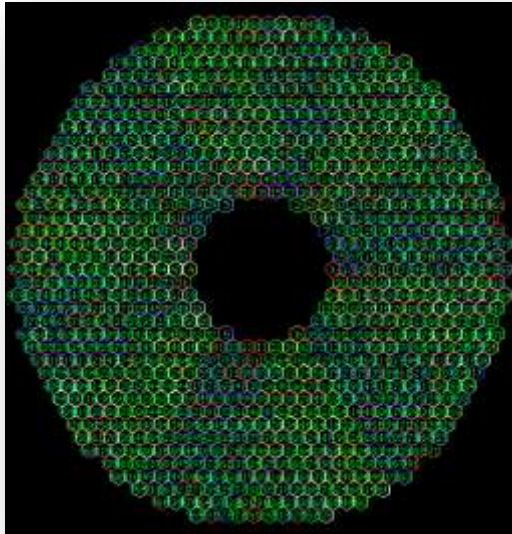


Physicists are getting smaller these days!





# Case study: Extremely Large Telescope

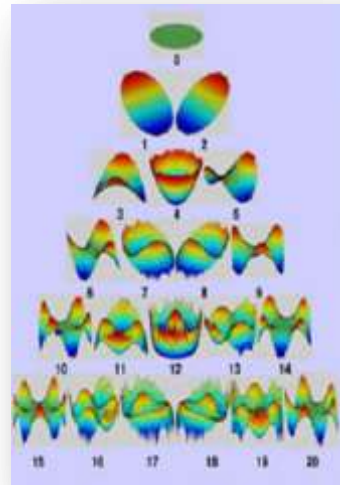


## M1 – mirror

984 hexagonal mirrors

6 sensors/3 actuators each

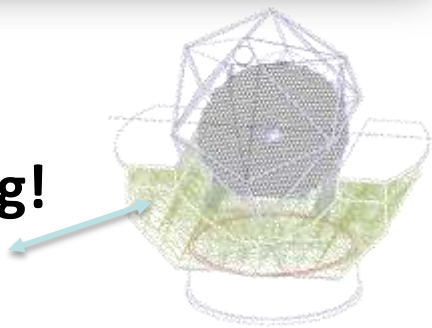
1 ms



## Fight the modes!

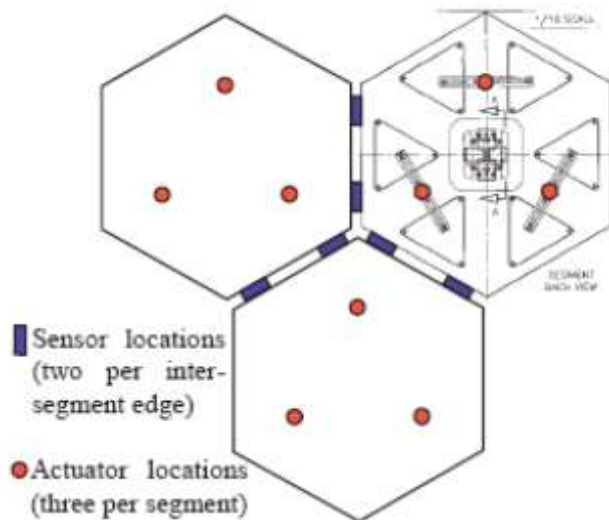
Translates into large matrix operations (3K-by-3K)

Shaking!





# Case study: Extremely Large Telescope



$$\begin{aligned} \text{pinv}(\text{newIM}) &= (\text{newIM}^T \text{newIM})^+ \text{newIM}^T \\ &= ((\text{IM} - e_i a_i^T)^T (\text{IM} - e_i a_i^T))^+ (\text{IM} - e_i a_i^T)^T \\ &= (\text{IM}^T \text{IM} - a_i a_i^T)^+ (\text{IM}^T - a_i e_i^T) \end{aligned}$$

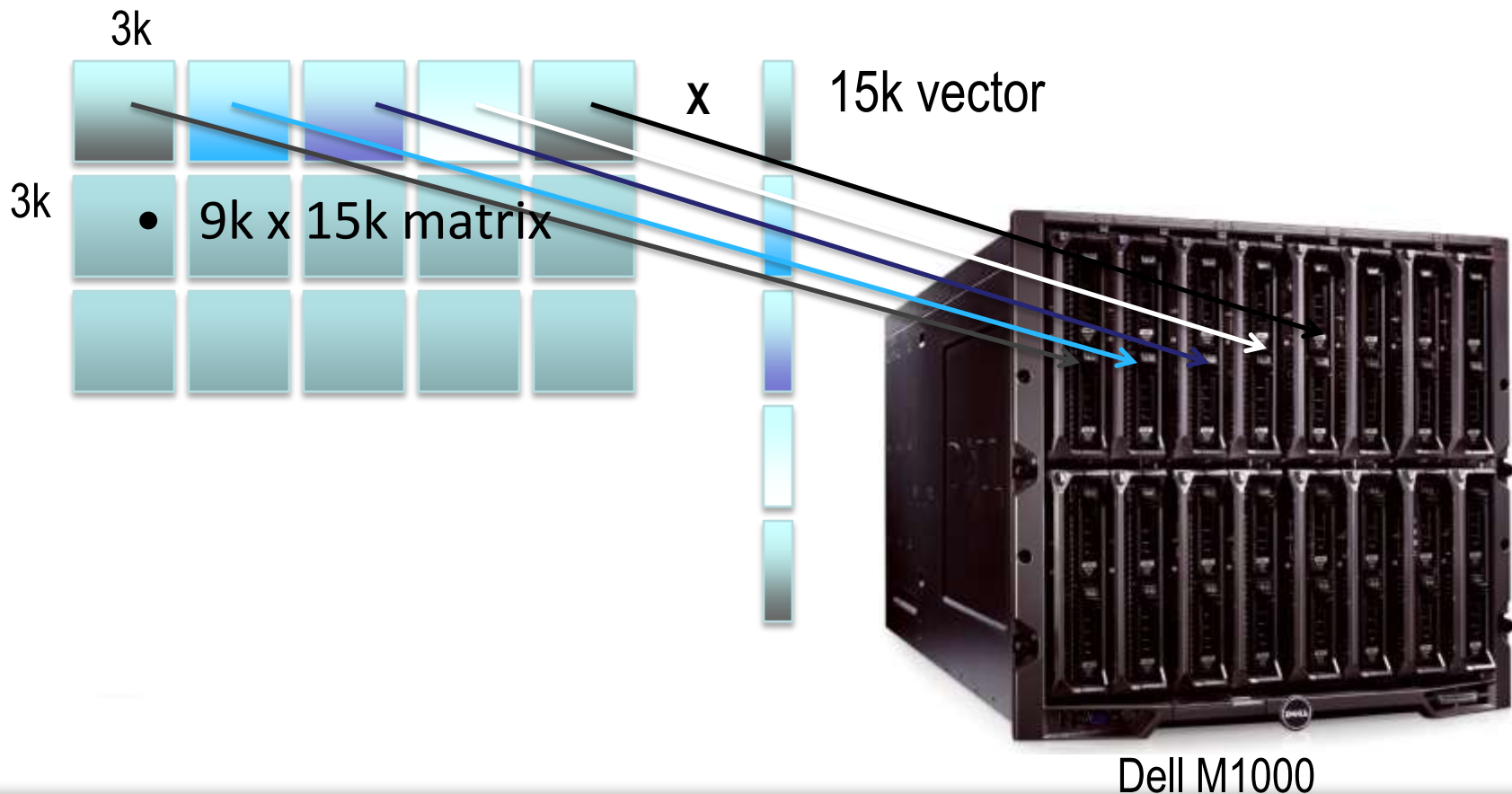
$$\begin{aligned} (\text{IM}^T \text{IM} - a_i a_i^T)^+ &= (\text{IM}^T \text{IM})^{-1} + \frac{(\text{IM}^T \text{IM})^{-1} a_i a_i^T (\text{IM}^T \text{IM})^{-1}}{1 - a_i^T (\text{IM}^T \text{IM})^{-1} a_i} \\ &= (\text{IM}^T \text{IM})^{-1} + \frac{b_i b_i^T}{1 - a_i^T b_i} \end{aligned}$$

$$\begin{aligned} \text{pinv}(\text{newIM})ES &= ((\text{IM}^T \text{IM})^{-1} + \frac{1}{1 - a_i^T b_i} b_i b_i^T) (\text{IM}^T - a_i e_i^T) ES \\ &= (\text{IM}^T \text{IM})^{-1} (\text{IM}^T \cdot ES) - (\text{IM}^T \text{IM})^{-1} a_i \cdot es_i + \\ &\quad \frac{b_i^T (\text{IM}^T \cdot ES) - (a_i^T b_i) \cdot es_i}{1 - a_i^T b_i} b_i \end{aligned}$$

Requires to recalculate pinv of 3K-by-3K matrix in 100 ms  
 → Sherman Morrison

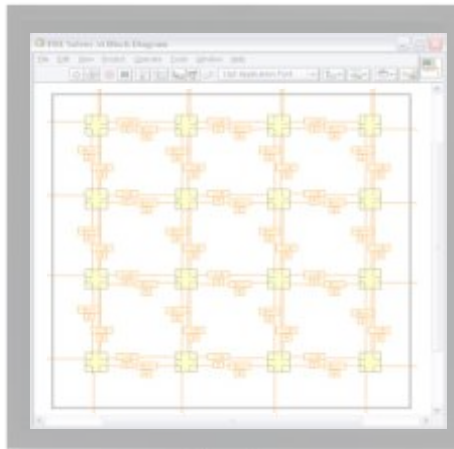
# Adaptive Optics

## Distributing LabVIEW computations



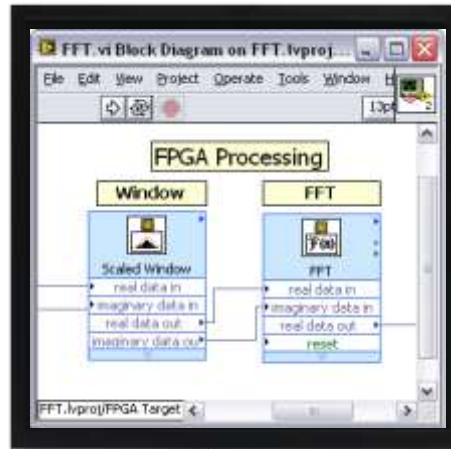
# Access through Graphical Programming

Multicore



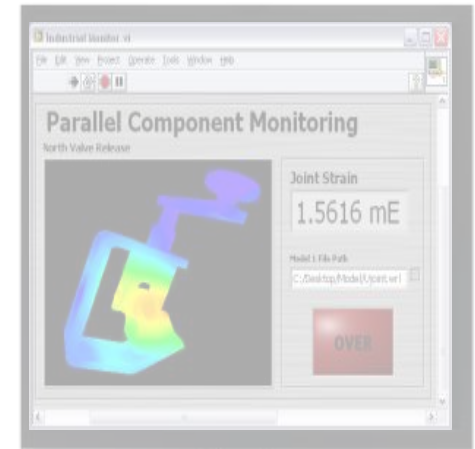
Desktop  
Supercomputing

FPGA



Rapid  
Embedded  
Development

Modular I/O



High  
Performance  
Interaction

# Advances in FPGA Technology

## Size

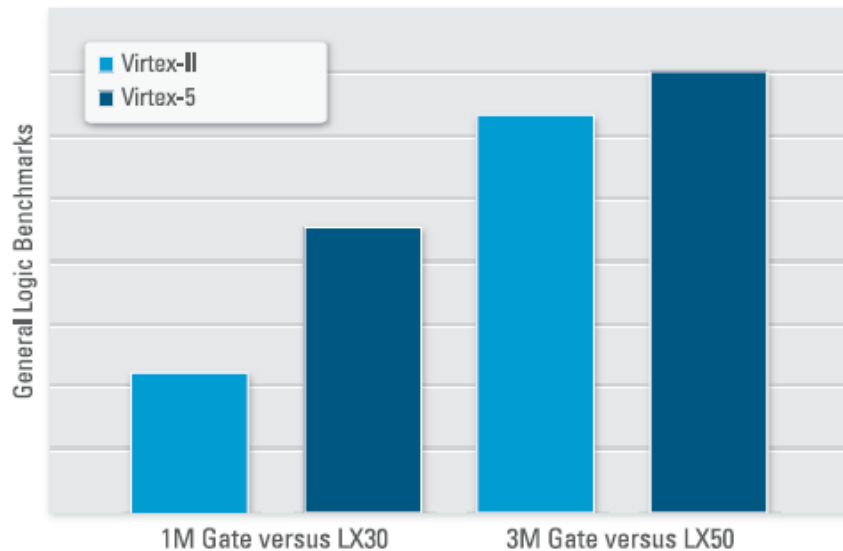


Figure 1. General logic benchmarks show that Virtex-5 FPGAs offer larger sizes when compared to Virtex-II FPGAs.

## Speed

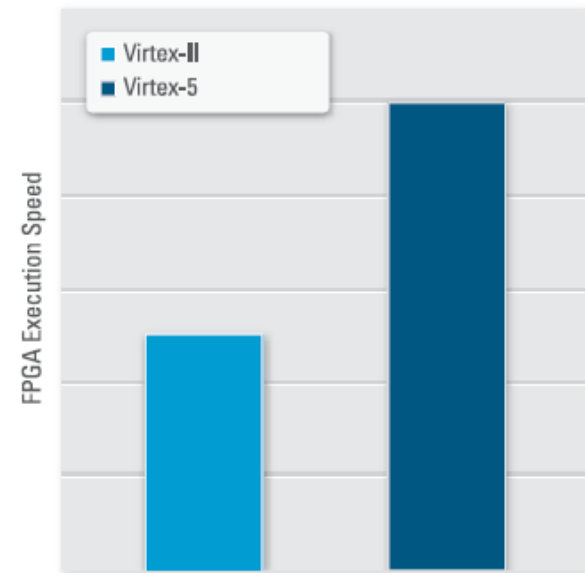


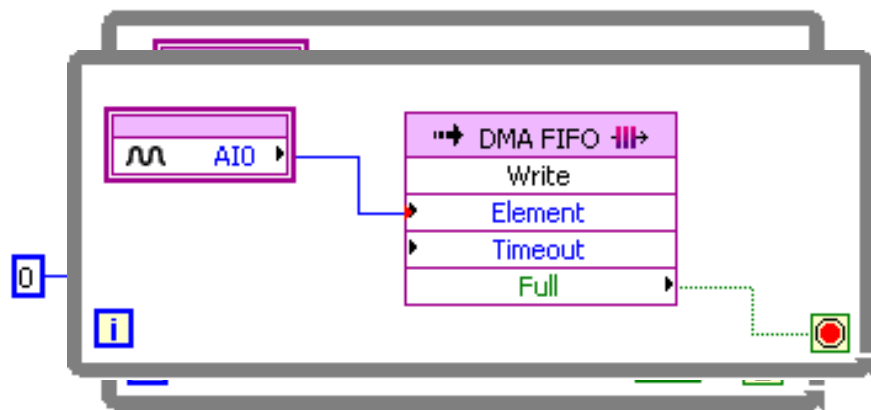
Figure 2. Execution speed benchmarks show that Virtex-5 FPGAs feature faster processing capabilities when compared to Virtex-II FPGAs.

# Realizing the Potential: Simplify Access to FPGAs

# Counter

# Analog I/O

# I/O with DMA

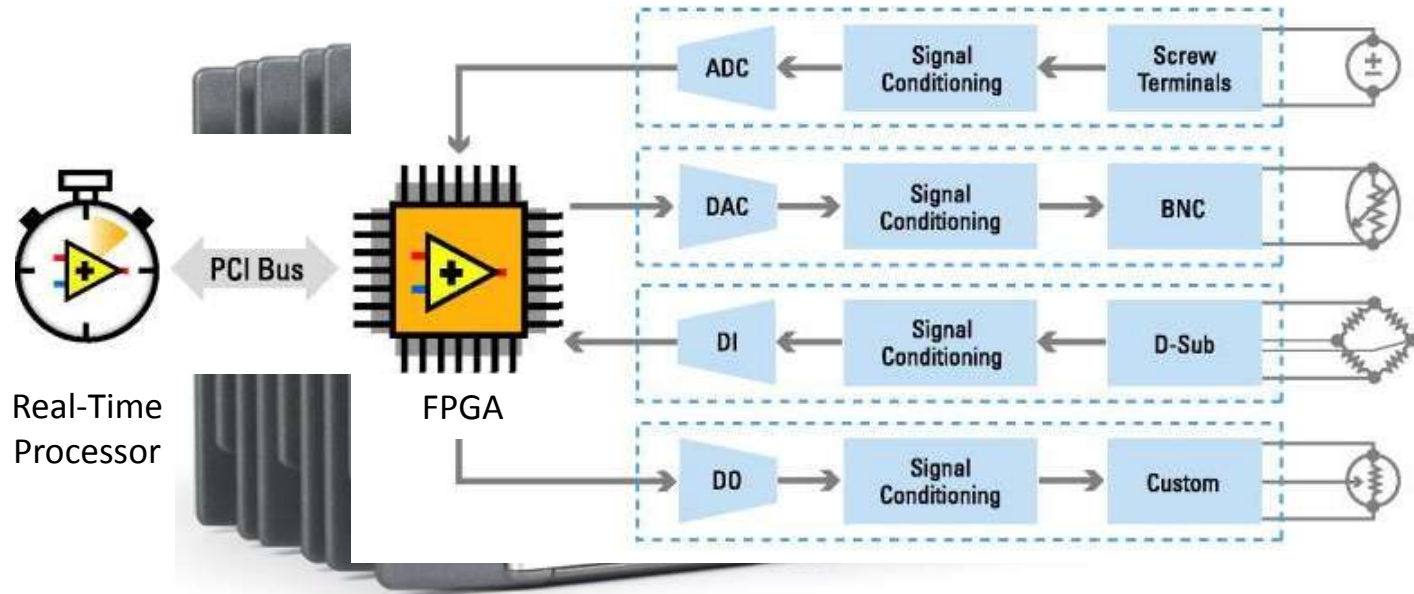


# LabVIEW FPGA

[illegible]

## VHDL ~4000 lines

# Blending Technologies for New Architectures: CompactRIO



- **Reconfigurable FPGA** for high-speed and custom I/O timing, triggering, and control
- **I/O modules** with built-in signal conditioning for connection to sensors/actuators
- **Real-time processor** for reliable measurement, analysis, connectivity, and control

# Blending Technologies for New Architectures: FlexRIO



## NI FlexRIO Adapter Module

- Interchangeable I/O
- Customizable by users
- Adapter Module Development Kit

## NI FlexRIO FPGA Module

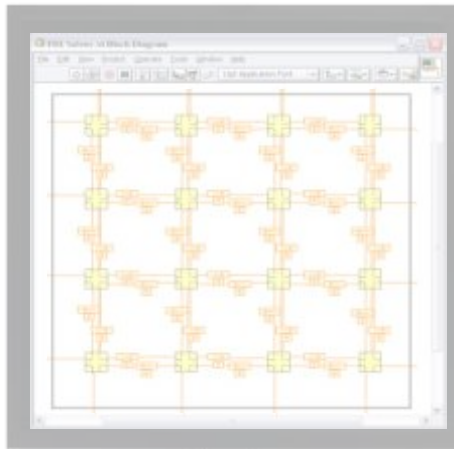
- Virtex-5 FPGA
- Up to 132 channels
- Up to 128 MB of DDR2 DRAM

# Introducing NI FlexRIO



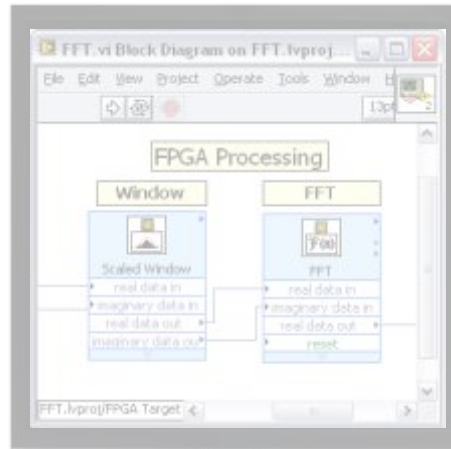
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Multicore



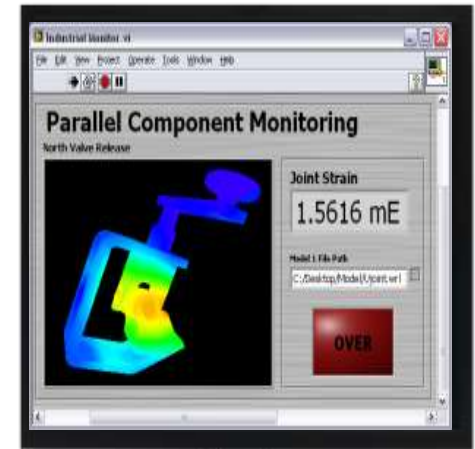
Desktop  
Supercomputing

FPGA



Rapid  
Embedded  
Development

Modular I/O

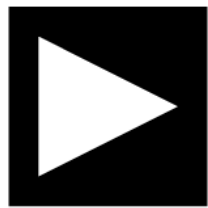


High  
Performance  
Interaction

# Modular I/O:

## Combinable Measurements & Rapid Data Access

- Combinable Measurements
  - Mix and match I/O to meet exact requirements
  - Access to leading edge measurement technology
- Rapid Data Access



**ANALOG  
DEVICES**

the latest bus technologies  
synchronization

**TEXAS  
INSTRUMENTS**

- integrated through a single, unified software language

**PCI  
EXPRESS**

**HI-SPEED  
CERTIFIED  
USB**



# C Series Modular I/O Platform



More than 60 Measurement modules

# POGO Stick DEMONSTRATION

# C Series Modular I/O Platform



More than 60 Measurement modules

# Introducing Wi-Fi Data Acquisition

- IEEE 802.11b/g radio
- 10/100 Base-T/X Ethernet
- NI-DAQmx driver
- DC powered (9-30 VDC)
- C Series module support
  - NI 9211 (4-ch thermocouple)
  - NI 9215 (4-ch SSH  $\pm 10\text{V}$  inputs )
  - NI 9234 (4-ch IEPE accelerometers)
  - NI 9237 (4-ch strain gauges)
  - NI 9219 (4-ch universal inputs)



# NI System with Deterministic Distributed I/O



Host Computer

(TCP/IP)



NI cRIO-9074

(Deterministic Ethernet)



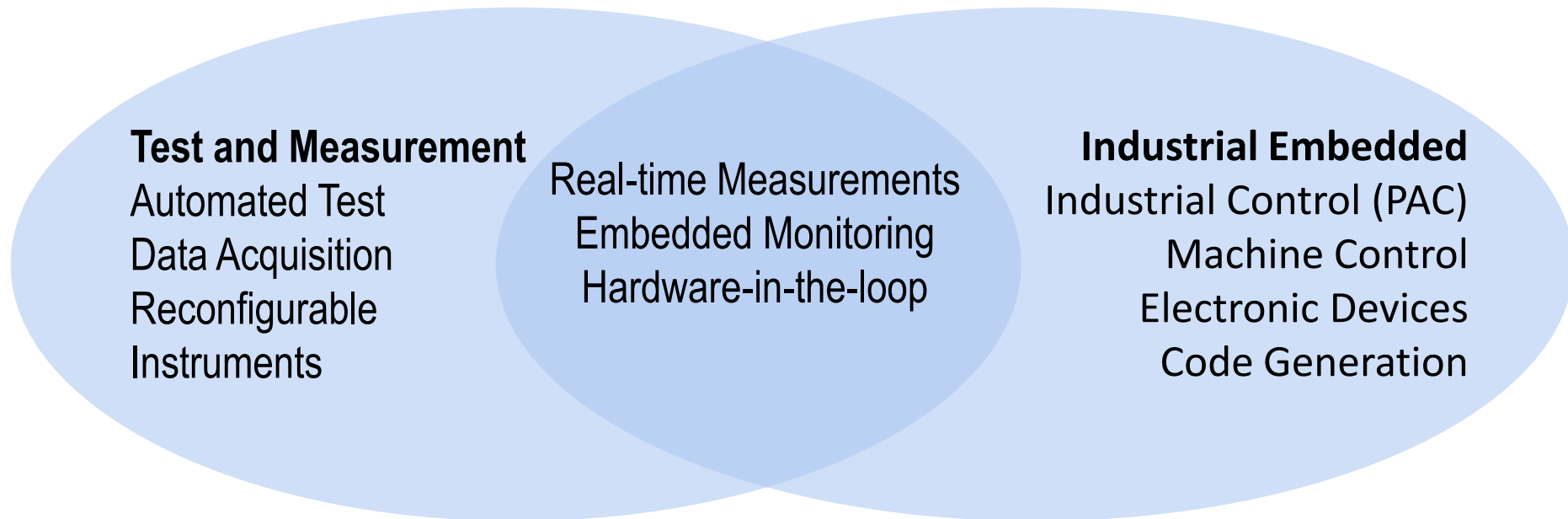
NI 9144 Expansion Chassis

# The Engineering Design Transformation



# National Instruments Vision

## Graphical System Design

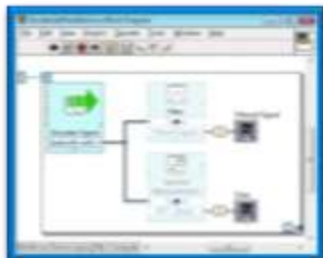


“To do for test and measurement  
what the spreadsheet did  
for financial analysis.”

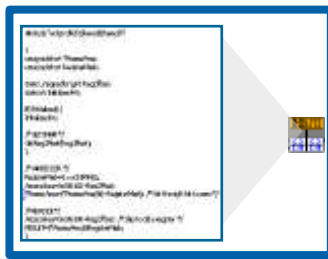
“To do for embedded what the  
PC did for the desktop.”

# Models of Computation

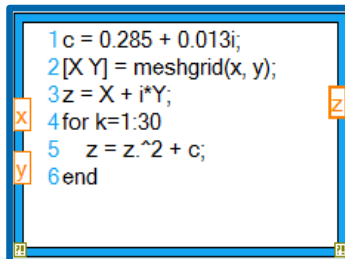
Dataflow



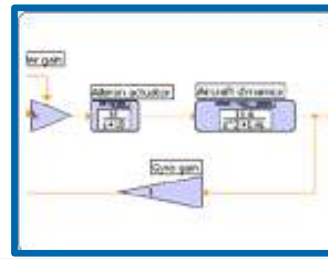
C / HDL Code



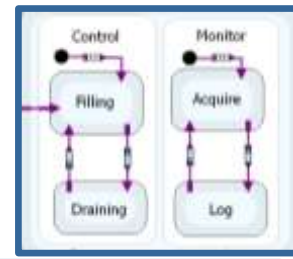
Textual Math



Simulation



Statechart



LabVIEW



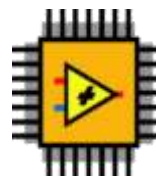
Desktop

LabVIEW



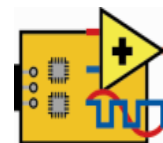
Real-Time

LabVIEW



FPGA

LabVIEW



MPU/MCU



Personal Computers



PXI Systems



CompactRIO



Single-Board RIO

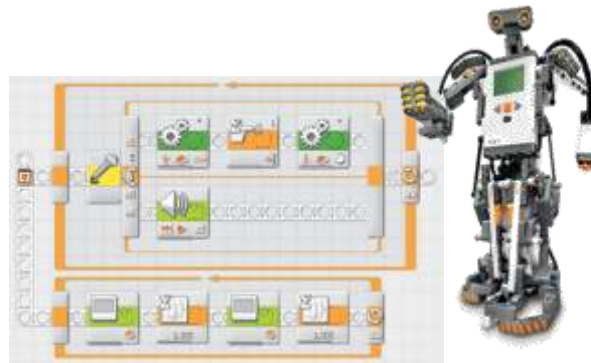


Custom Design

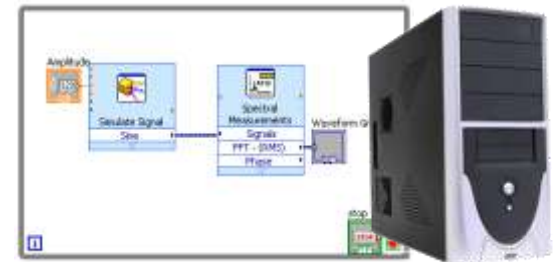
# Graphical System Design: From Kindergarten to Rocket Science



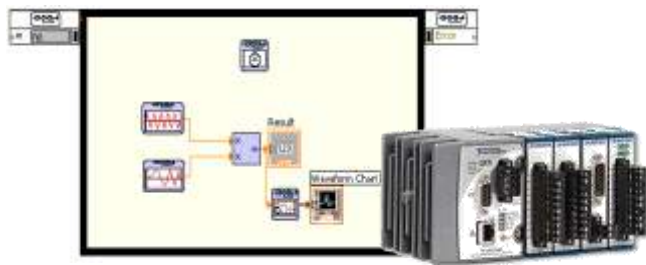
LEGO® Education WeDo Loop



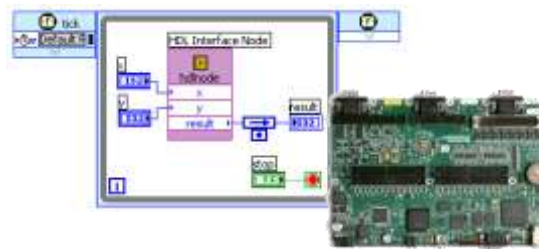
LEGO MINDSTORMS® NXT Loop



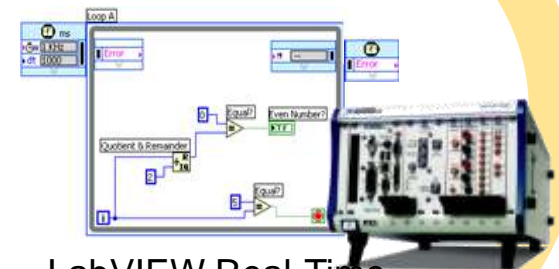
LabVIEW While Loop



LabVIEW Simulation Loop



LabVIEW FPGA  
Single-Cycle Timed Loop



LabVIEW Real-Time  
Timed Loop

# Training and Certification



Together, the National Instruments training and certification programs deliver the fastest, most certain route to increased proficiency and productivity using NI software and hardware.

**NI Training: Build Your Skills and Knowledge**

**NI Certification: Validate Your Expertise and Differentiate from the Competition**

Visit [ni.com/training](https://ni.com/training) to learn more

# Engineering Grand Challenges



Make solar energy economical



Provide energy from fusion



Develop carbon sequestration methods



Manage the nitrogen cycle



Provide access to clean water



Restore and improve urban infrastructure



Advance health informatics



Engineer better medicines



Reverse-engineer the brain



Prevent nuclear terror



Secure cyberspace



Enhance virtual reality



Advance personalized learning



Engineer the tools of scientific discovery

# Wind turbine HIL Testing

## Application:

Design a HIL test system that simulates the effects of wind, pitch and blade position to test turbine controller

## Technologies:

- LabVIEW Control Design and Simulation
- LabVIEW Real-Time, LabVIEW FPGA
- PXI, multicore, FPGA



*“Working in close collaboration with NI support engineers, we were able to successfully create a highly complex wind turbine hardware-in-the-loop test system based on the intuitive LabVIEW graphical programming environment and high-performance PXI platform.”*



# Tumor Treatment Medical Device

## Application

Design a prototype of a medical device for treatment of breast tumors in only four months (no room for firmware errors, strict regulatory guidelines (Class II)).

## Technologies:

- LabVIEW Real-Time, LabVIEW FPGA
- CompactRIO, Panel PC

*“The [CompactRIO](#) embedded system and LabVIEW graphical tools from National Instruments gave us the power to design, prototype, and deploy the control system within our Visica2 medical device quickly and beat our time-to-market goals while saving money by eliminating the need for building custom hardware.”*

Jeff Stevens, Principal Systems Engineer, Sanarus Medical





# NI Solar Photo shoot

*Green Engineering*





# Testing proprietary computer hardware on naval vessels

## Application

Replace an outdated and obsolete proprietary naval computer test system, used on-board of naval ships.

## The Solution:

Use commercial-off-the shelf components such as NI PXI and the NI PMA-1115 together with LabVIEW FPGA to interface to the dedicated computer bus.

*“Our naval engineers and technicians are very satisfied with the ease-of-use and performance of the NI FPGA PXI-based systems.”*

Royal Dutch Navy



# Engineering Grand Challenges



Make solar energy economical



Provide energy from fusion



Develop carbon sequestration methods



Manage the nitrogen cycle



Provide access to clean water



Restore and improve urban infrastructure



Advance health informatics



Engineer better medicines



Reverse-engineer the brain



Prevent nuclear terror



Secure cyberspace



Enhance virtual reality



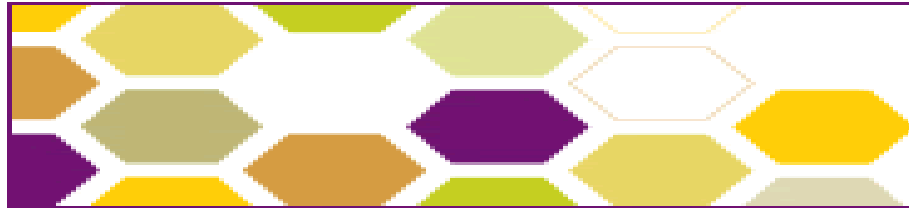
Advance personalized learning



Engineer the tools of scientific discovery

# Partner Introductions

National Instruments  
Technical Symposium 2009



**NIDays09**  
WORLDWIDE GRAPHICAL SYSTEM DESIGN  
**CONFERENCE**

Media partner NIDays 2009

**Control &  
Automation**  
MAGAZINE  
Engineering  
Net.be

**Industrie**  
**TECHNISCH  
MANAGEMENT**

2009 **Industrie**  
**Awards** **TECHNISCH  
MANAGEMENT**



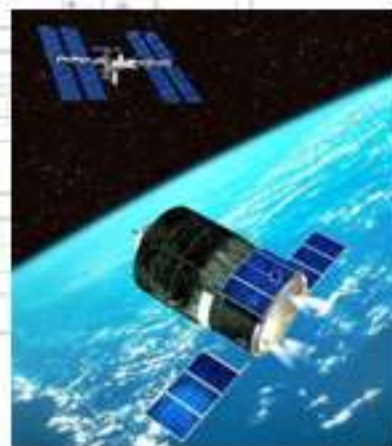
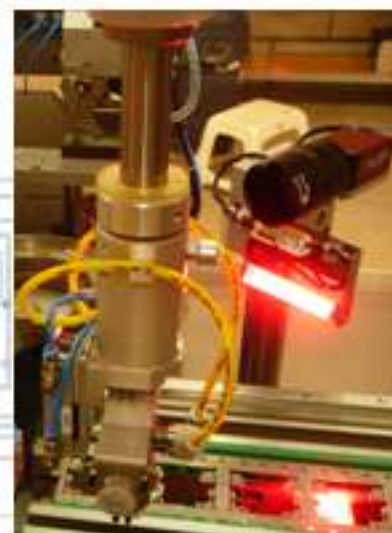
# ES International - CIT Engineering GROUP

## Profile

- Alliance Member for over 10 years
- System integrator
- Specialist in Test & Measurement
- Turn-Key Solutions
- Concurrent Engineering Partner

## Business Units

- Virtual Instrumentation
- Industrial Vision
- Electrical & Mechanical design
- Inkjet Proofing Systems
- Lighting – Spectroscopic Analysis
- Training Centre







# Test Solutions Hasselt, Belgium

## JABIL HASSELT

**Design**

**Prototyping  
NPI**

**Product  
Validation**

**Total Test  
Solutions**

- **Design For Test**
- **Test Strategy Proposals**
- **Test Spec Development**
- **Functional Testers**
- **SW, HW, BS and Mechanical engineering**
- **GOS TD Proj.Manag.**

→ **For internal JABIL**

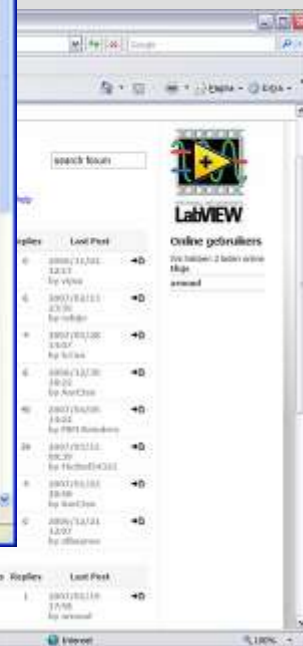
→ **For JABIL customers**

→ **For Local for Local customers**

# JABIL

# LVUG.BE / NL

- Voor Nederlandstalige LabVIEW gebruikers



*LabVIEW User Group*

**LVUG.NL**



[www.maxonmotor.be](http://www.maxonmotor.be)

**maxon motor**

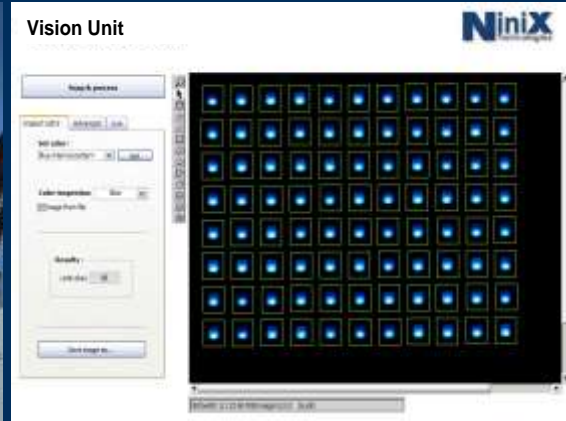
**driven by precision**

*the Leading Supplier of High Precision Drives  
and Systems.*

*When it is all about precision. Try us!*



## ENGINEERING & PROCES AUTOMATION



- . Realization of automated assemblylines
- . Development & automation of process technologies
- . Total solutions
- . Test & Measurement
- . Visual inspection systems
- . 20 years of manufacturing excellence
- . Subcontracting production

## ELECTRONIC COMPONENTS, MODULES & SYSTEMS



- . Thickfilm Resistor Technology
- . Sensor modules for automotive
- . LED-displays
- . Medical systems
- . Development, Mass production & Customer-specific solutions



Alliance partner



ISO 9001 & TS  
certified



Member Flanders' Mechatronics  
Technology Center

# Key expertise

## xMove

Complex test solutions for electronic control units, used in automotive and other industry.

### Application areas:

- Functional test
- Hardware In the Loop (HIL) test
- Repair test

## HSDH-RT

**High Speed Data Handling**  
- in **Real Time**  
Complex solutions for telecom, defence and data applications.

### Application areas:

- Simulators in general
- High speed data
- RF simulations and analyses

## Large RT-Systems

Real Time systems used in control, measurement and test applications for a number of industries.

### Main characteristics:

- Real Time
- Gbps data rate
- >20 interconnected computers
- Handling >2000 signals
- Scalable
- Distributed

The Göteborg design centre

- Engineering expertise in: LabVIEW, LabVIEW-RT, Multicore etc.
- Engineering expertise in: HW-design, FPGA, RF, interface design etc.



# T&M Solutions

- Founded in 2001, >7 years experience in delivering Test & Measurement Solutions.
- More than 300 projects succeeded in different industries.
- Offices in Arnhem and Eindhoven,
- Total of 11 technical skilled employees.
- Experienced in small and large LabVIEW projects.



## Mission:

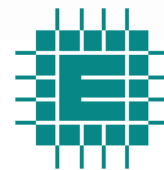
*“T&M Solutions BV goal is to increase customer satisfaction in Test & Measurement automation by being a reliable engineering partner. We can achieve this goal with the help of graphical system design tools.”*



**From the Instrument to the UUT  
(Unit Under Test) and all in between.**



Represented in the Benelux by:



**Euroelectron**

# Announcements

- Try-it-yourself-demos
- Feedback forms: Return / collect your goodies
- Lunch : Vegetarian / Allergies
- In expo area at the end of day:
  - Expo / Wrap-up / Snacks and Drinks / Lottery

**Have your best NI Days ever !**