



NIDays

WORLDWIDE GRAPHICAL SYSTEM DESIGN
CONFERENCE

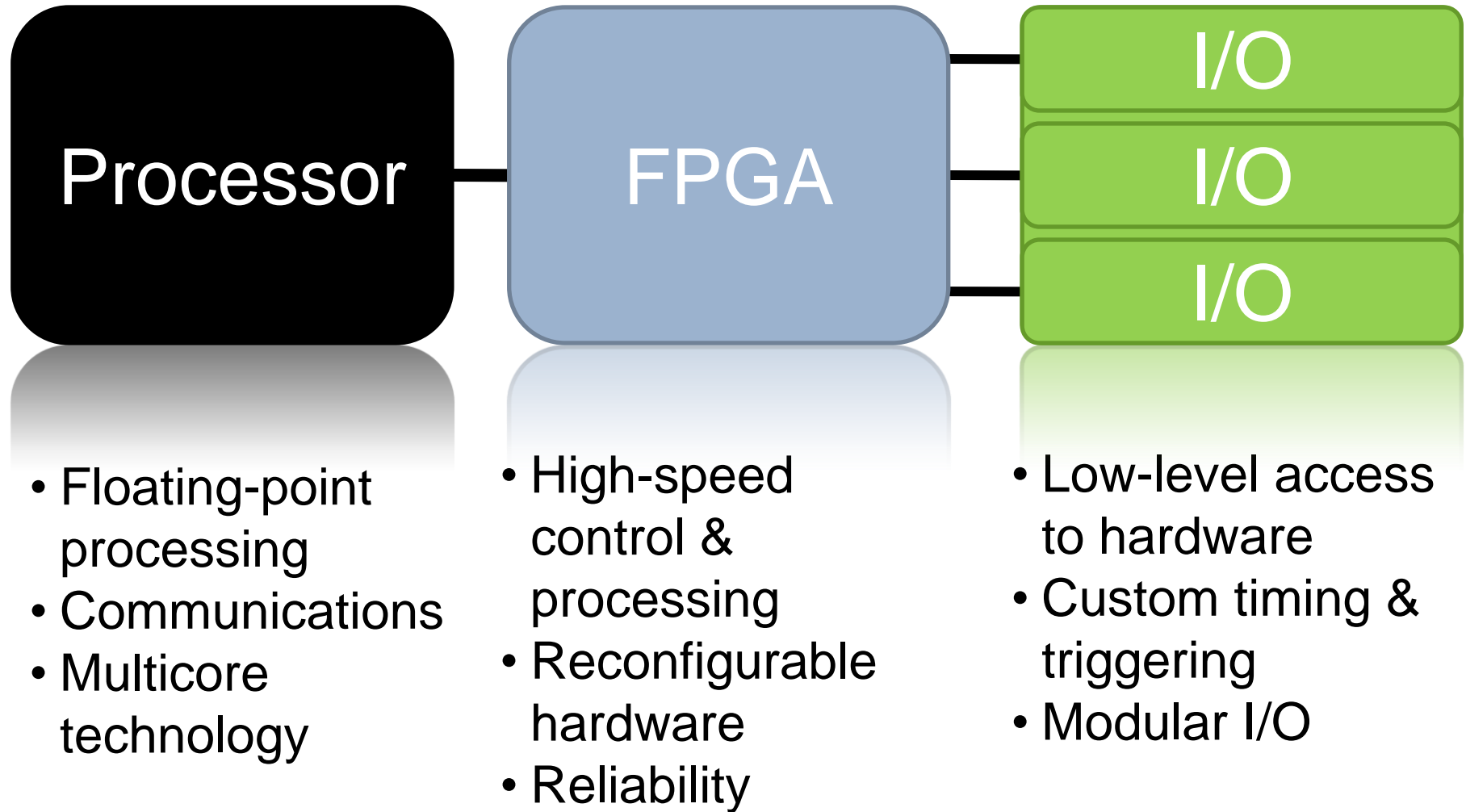


LabVIEW and RIO Applied: Introduction to LabVIEW Robotics

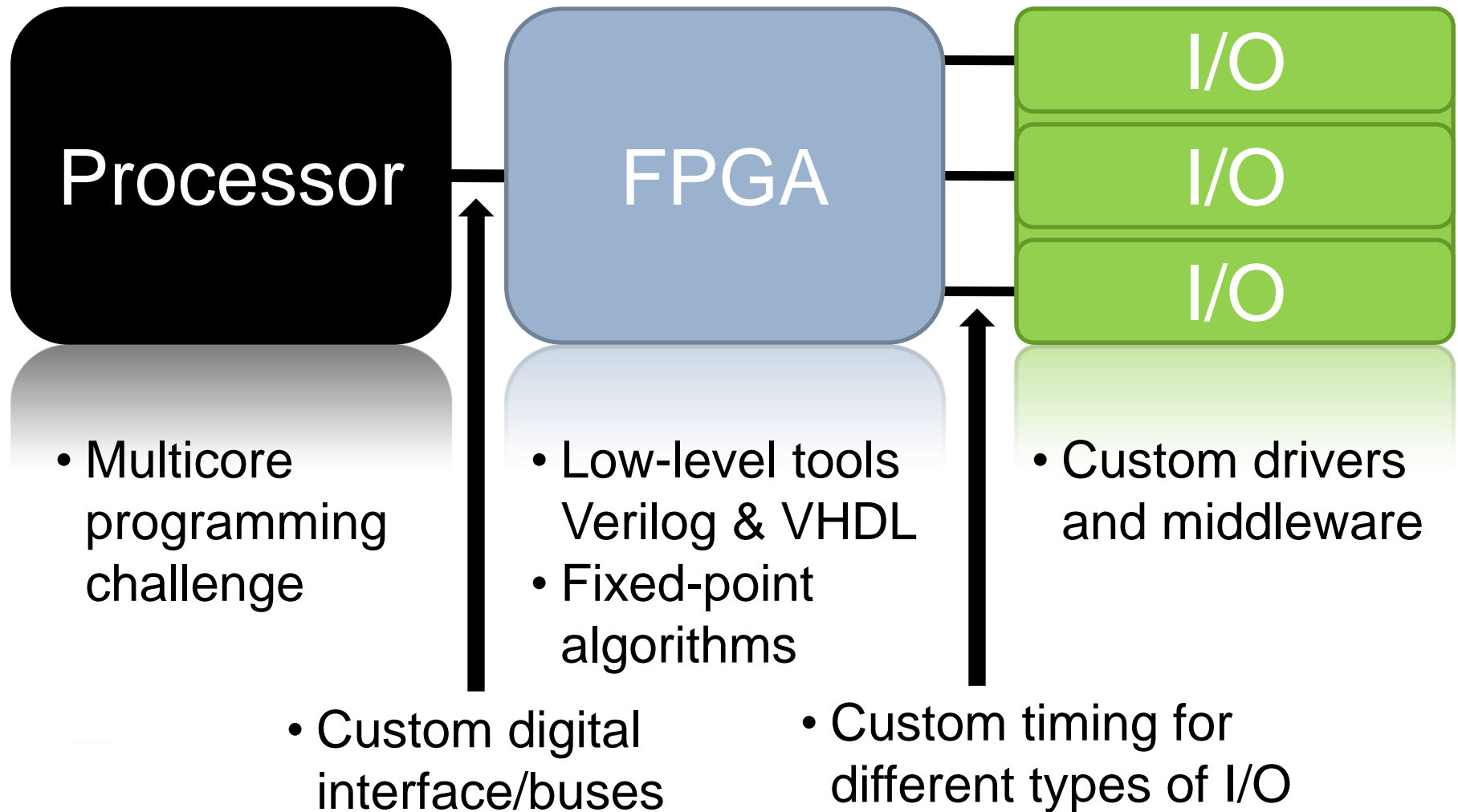
Session Agenda

- Introduction to RIO technology
- Why FPGAs for robotics?
- Introduction to LabVIEW Robotics
 - Sensors and actuators
 - Obstacle avoidance and path planning
 - Mapping and localization

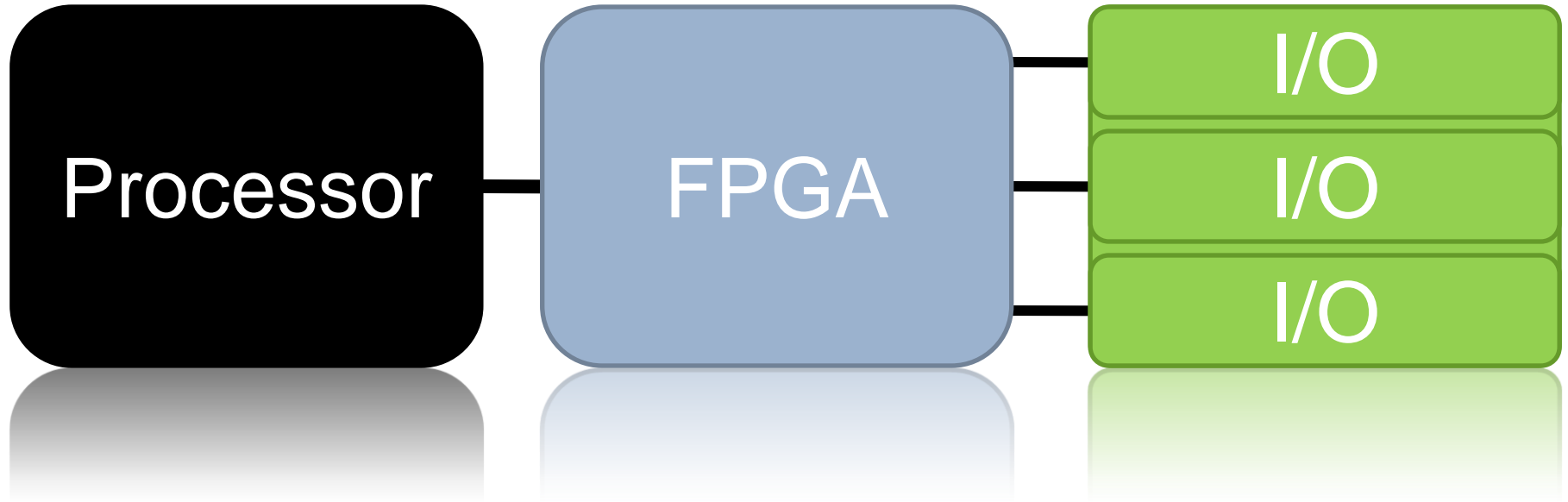
An Ideal Embedded Architecture



The Challenge



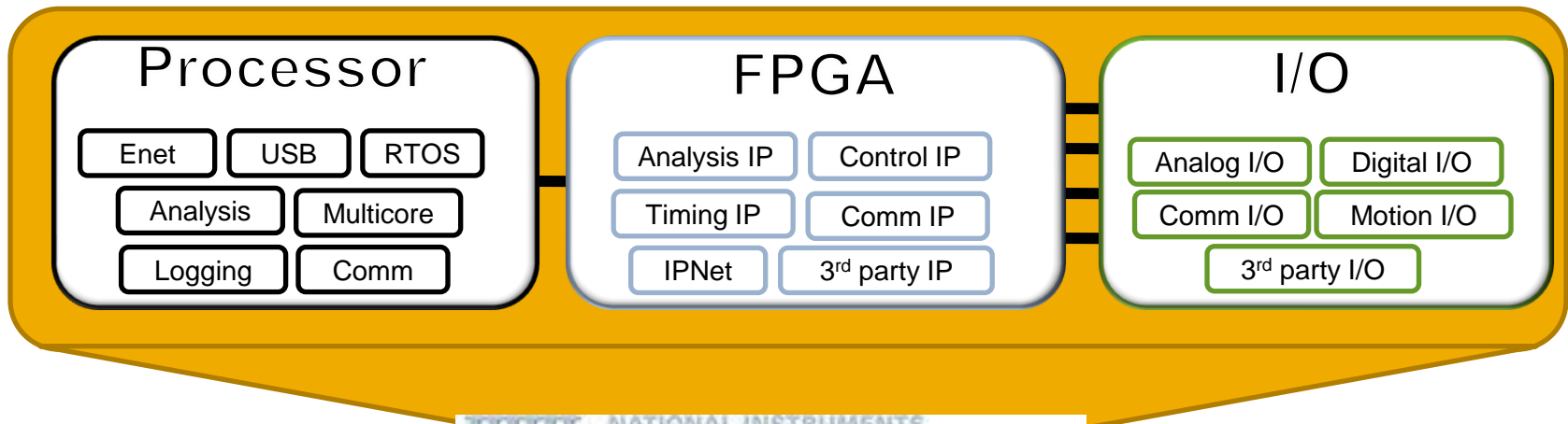
The Need



“There exists a need within the embedded market for a standard hardware architecture combined with a single software tool for quickly designing custom embedded systems.”

-Dr. James Truchard, CEO and Founder of National Instruments

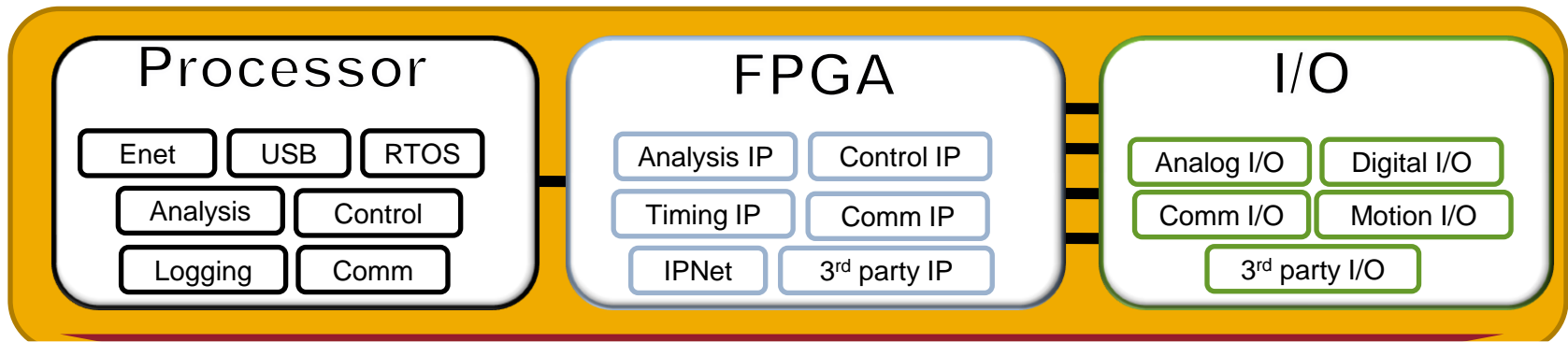
NI RIO Technology Platform



NI RIO Hardware



NI RIO Architecture Benefits



Standard architecture for design, control and test

Standard tool-chain across technologies and platforms

Integrated FPGA for co-processing, timing and control

NI RIO Hardware Benefits

Reconfigurable, off-the-shelf hardware

Breadth of high-quality I/O (analog, motion, vision, RF,...)

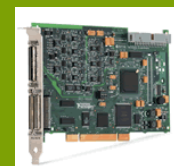
Variety of packaged and board-level form factors

Open platforms for integration with 3rd-party hardware

NI RIO Hardware



Packaged



Board-Level

NI RIO Software Benefits

Graphical programming for multicore/real-time processors and FPGAs

Advanced signal processing and control algorithms



Built-in drivers and middleware for I/O and communication

Open for integration of existing code/IP

NI RIO Applications and Industries

Embedded Design

- Embedded prototyping and control
- Medical devices
- Robotics



Industrial Control & Measurements

- Machine prototyping
- Industrial control
- Optimized automation



Test & Communications

- RF, wireless and custom test
- Hardware-in-the loop (HIL)



Data Acquisition

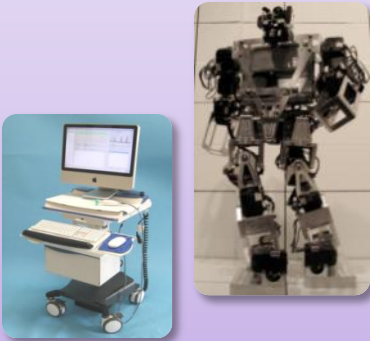
- Custom timing and triggering
- Custom signal processing and control



NI RIO Applications and Industries

Embedded Design

- Embedded prototyping and control
- Medical devices
- **Robotics**



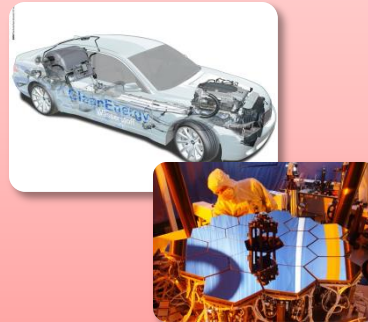
Industrial Control & Measurements

- Machine prototyping
- Industrial control
- Optimized automation



Test & Communications

- RF, wireless and custom test
- Hardware-in-the loop (HIL)



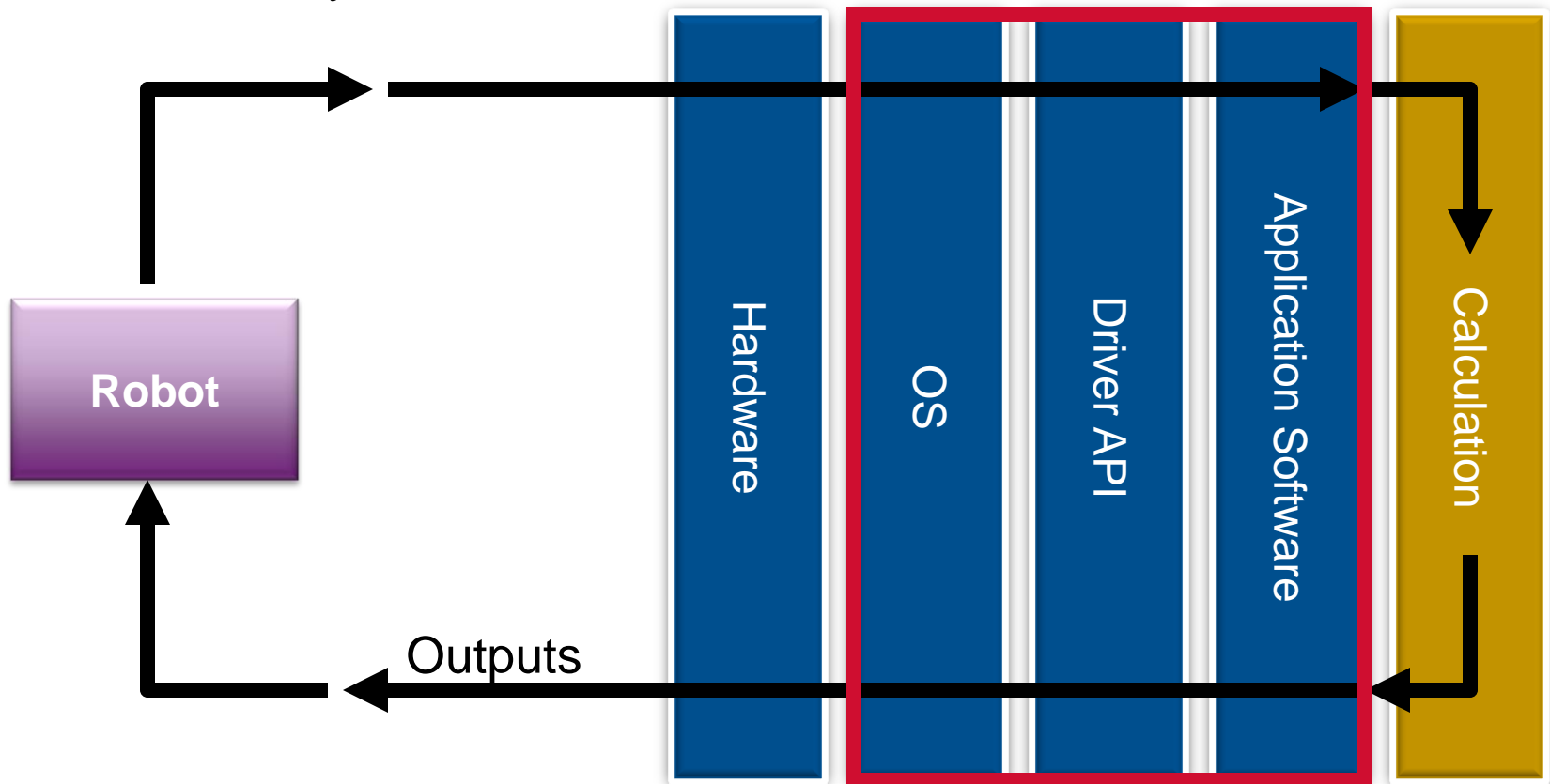
Data Acquisition

- Custom timing and triggering
- Custom signal processing and control



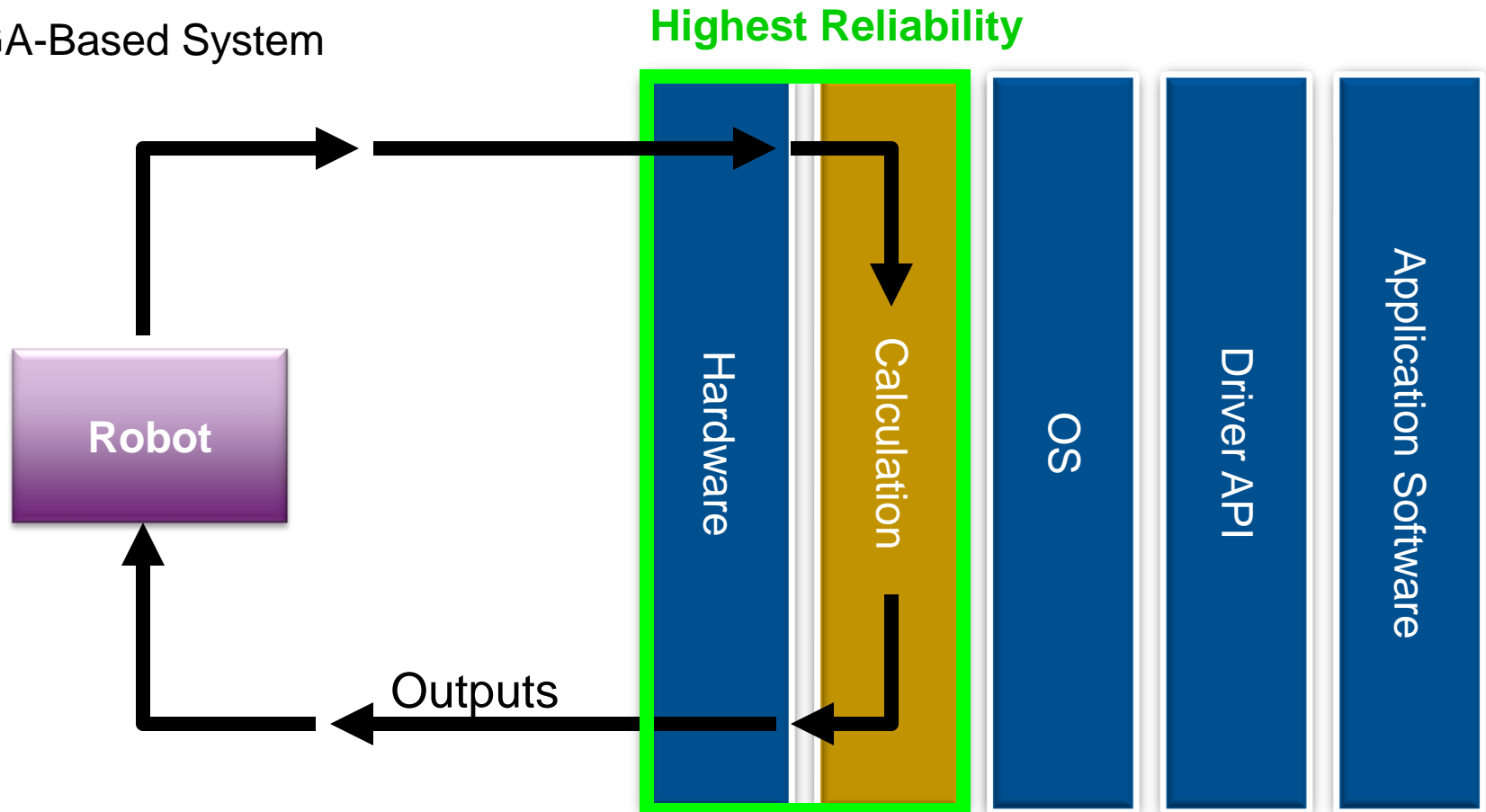
Decision Making in Software

Processor-Based System



Decision Making in Hardware

FPGA-Based System



ni.com/labview



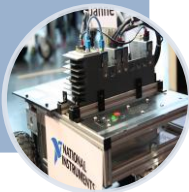
NATIONAL INSTRUMENTS

LabVIEW™ Robotics 2009

“What is” LabVIEW Robotics 2009?

- Getting Started Window
- Getting started wizard
- RIO hardware wizard
- Template architectures

“New”
Experience



- Search algorithms
- Robotics visualization
- Obstacle avoidance
- Kinematics
- Robotics Examples

Robotics
IP



- Sensor drivers
- Actuator drivers
- Driver project wizard

Drivers



LabVIEW Robotics Offerings Today



Data Acquisition
Machine Vision
ImagingLab Robotics
Library for DENSO



LabVIEW LEGO®
MINDSTORMS® NXT
Module
FIRST Robotics



LabVIEW Robotics 2009

Blind Driver Vehicle

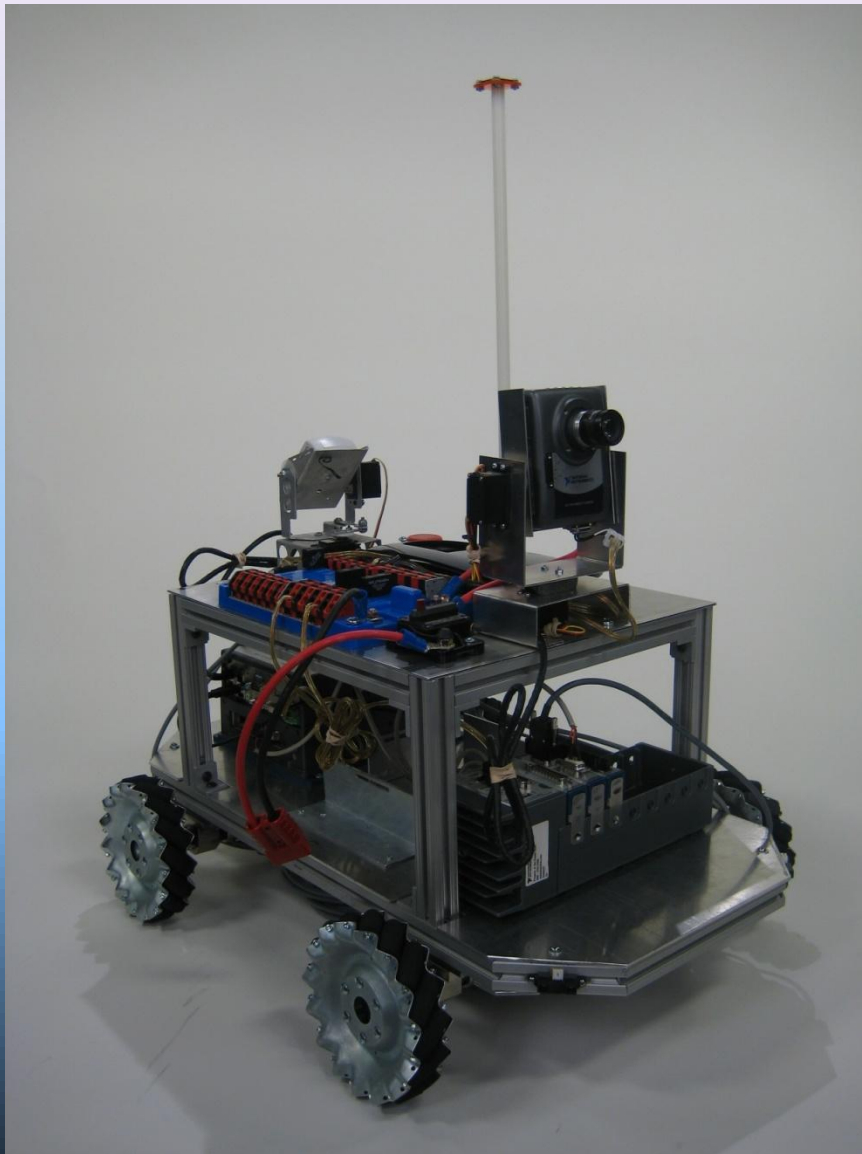




LEGO NXT 2.0



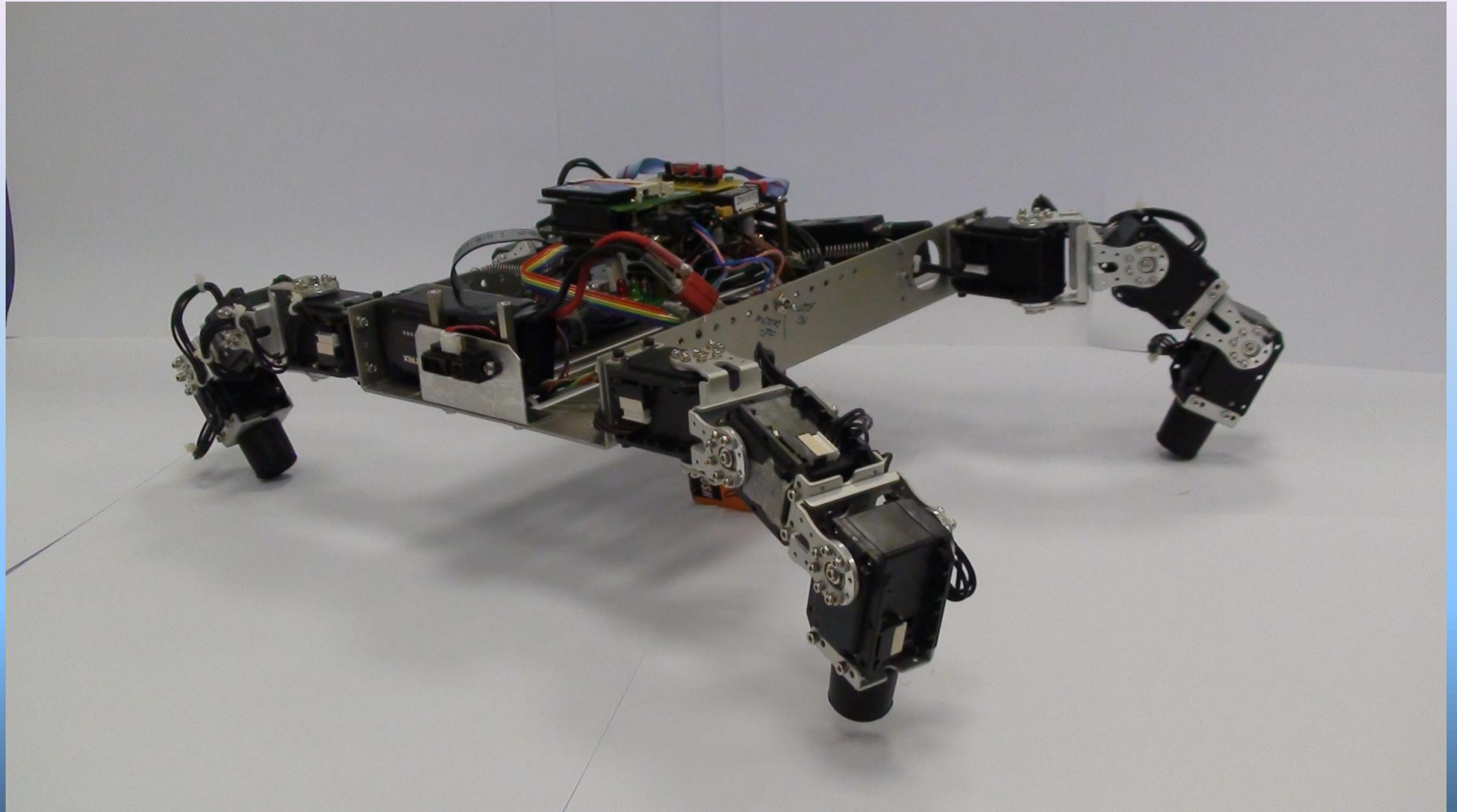
FIRST Robotics Competition



Dual-Controller Research Platform

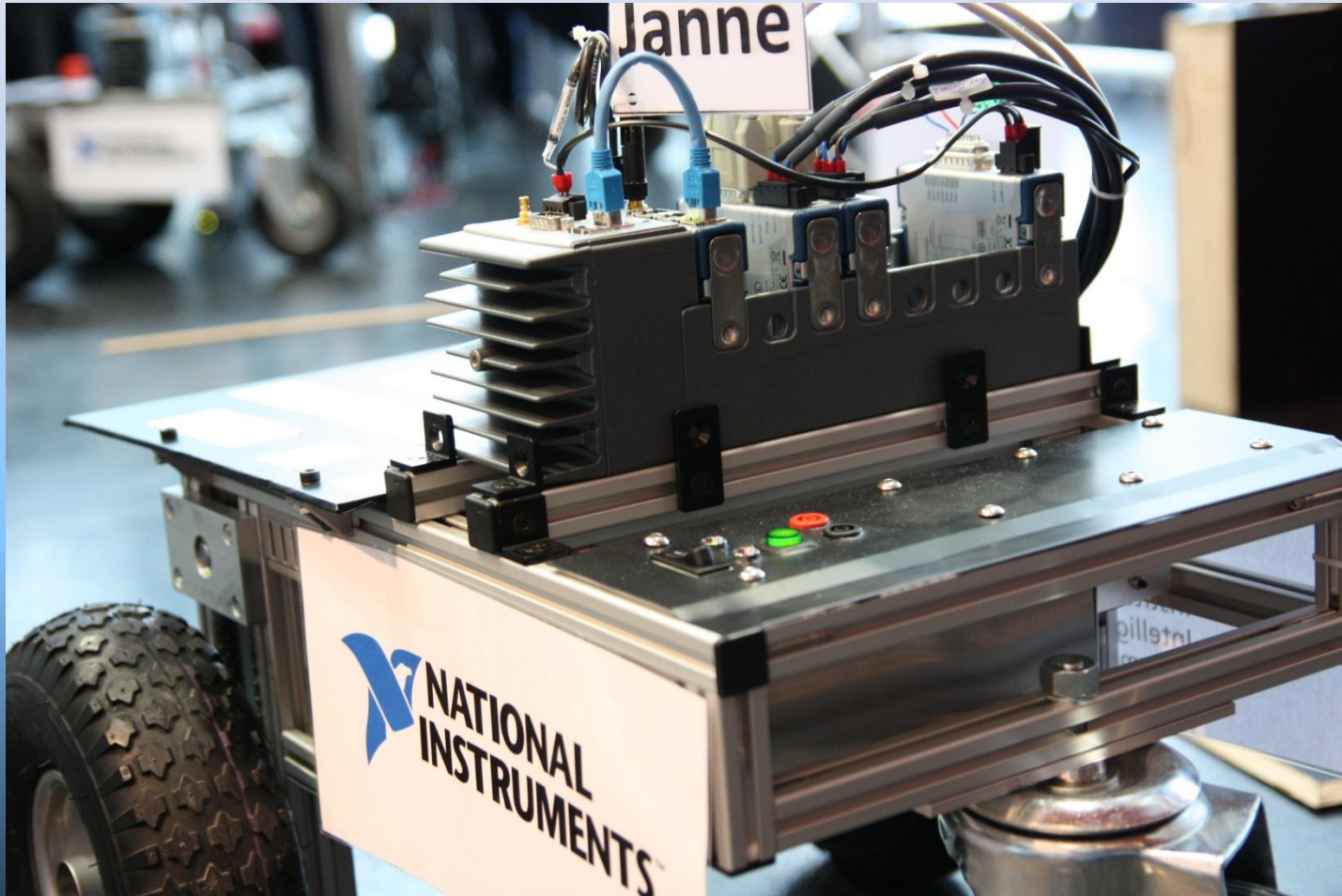
DARPA Autonomous Vehicle





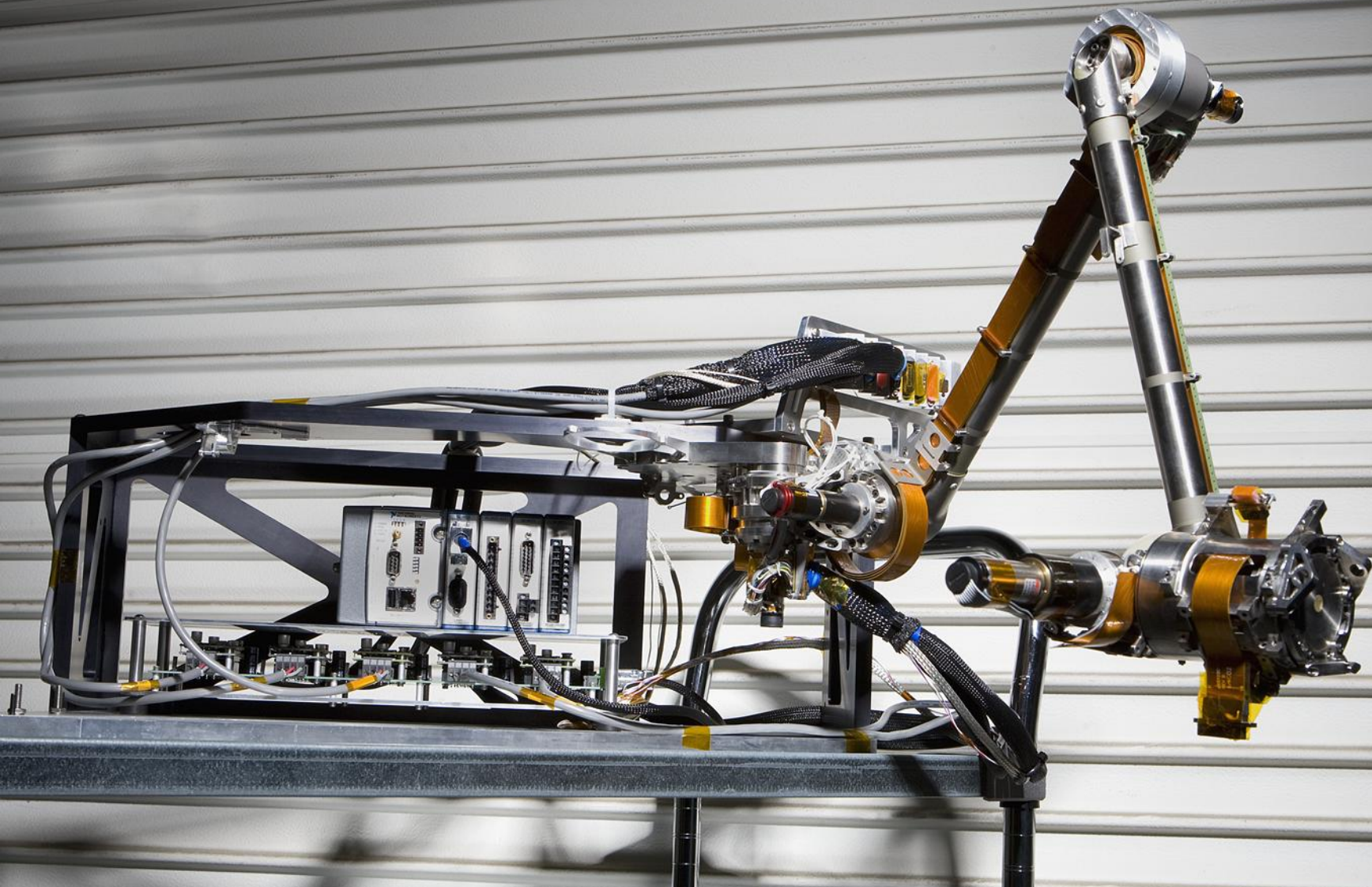
Rescue Robot Platform

RoboCup Mobile Robot



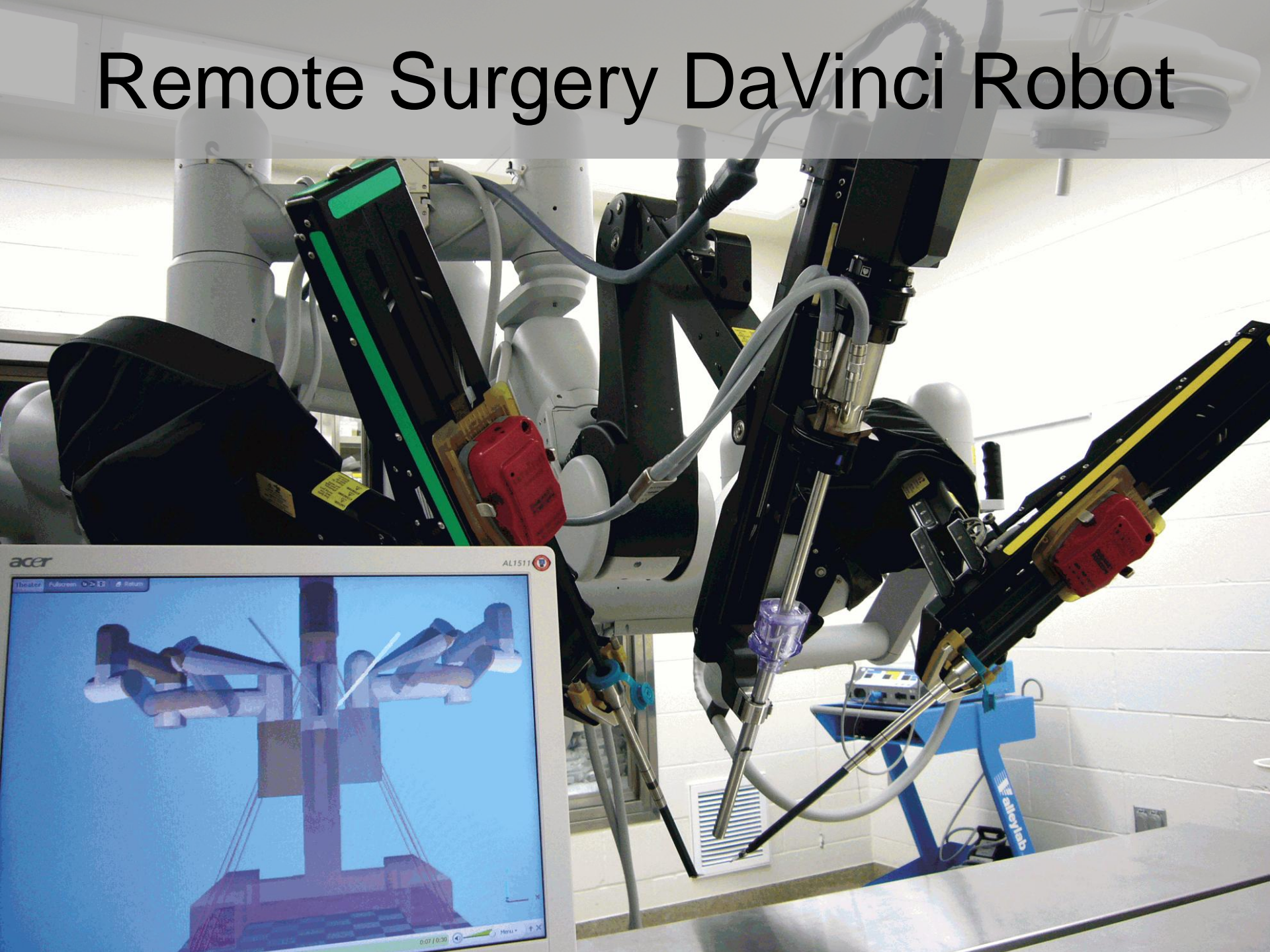


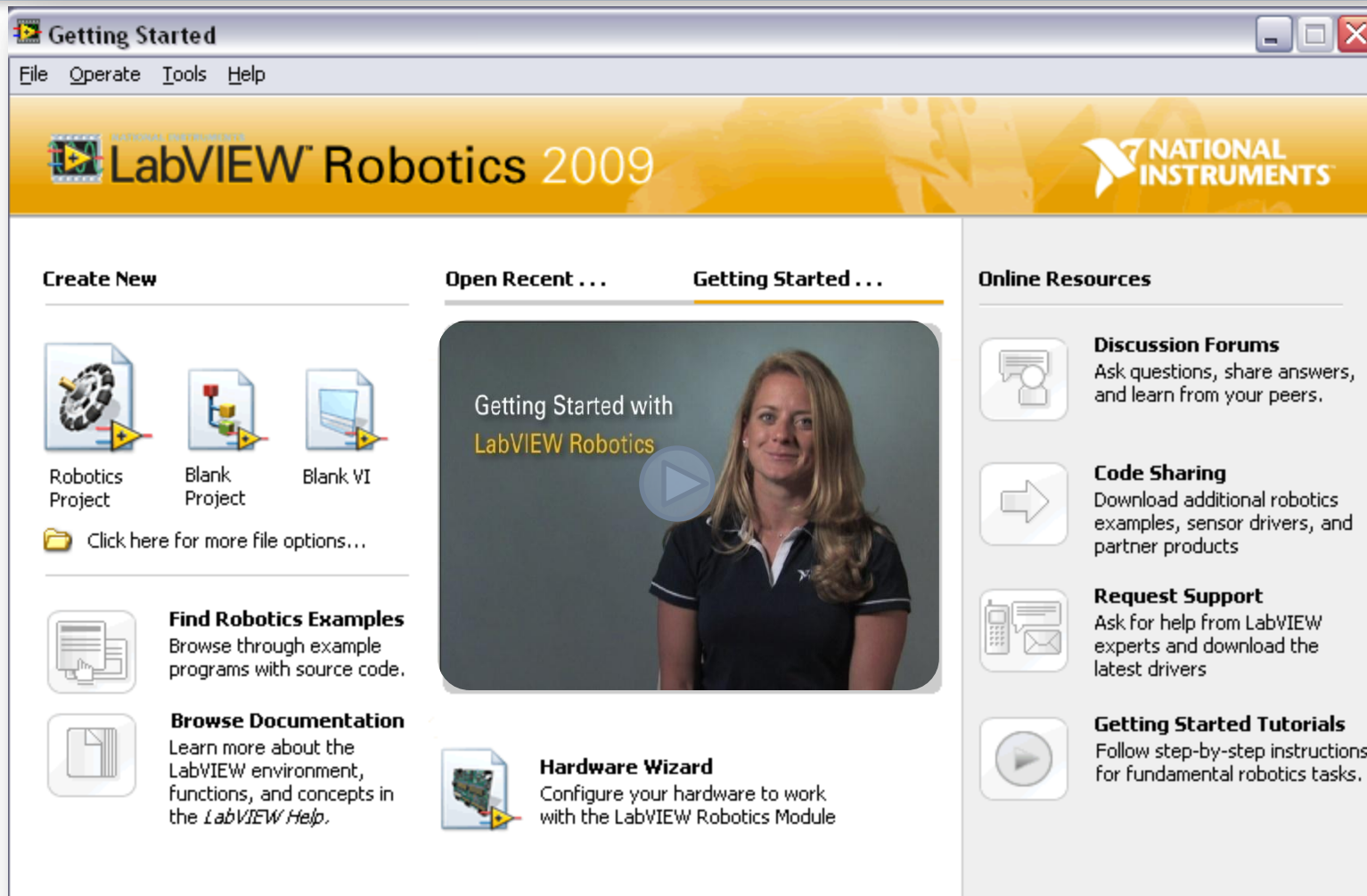
Advanced Humanoid Robot



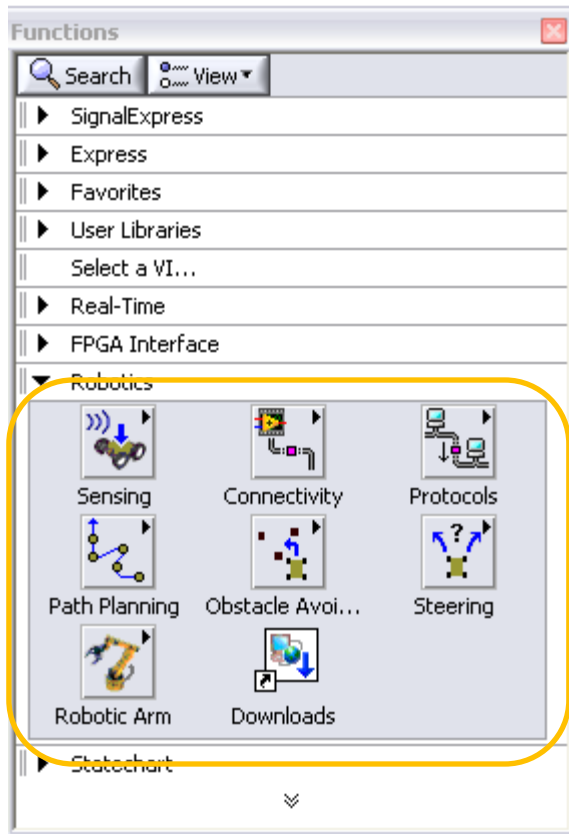
NASA Space Exploration Robot

Remote Surgery DaVinci Robot





DEMONSTRATION



Sensing

Connectivity

Protocols

Path Planning

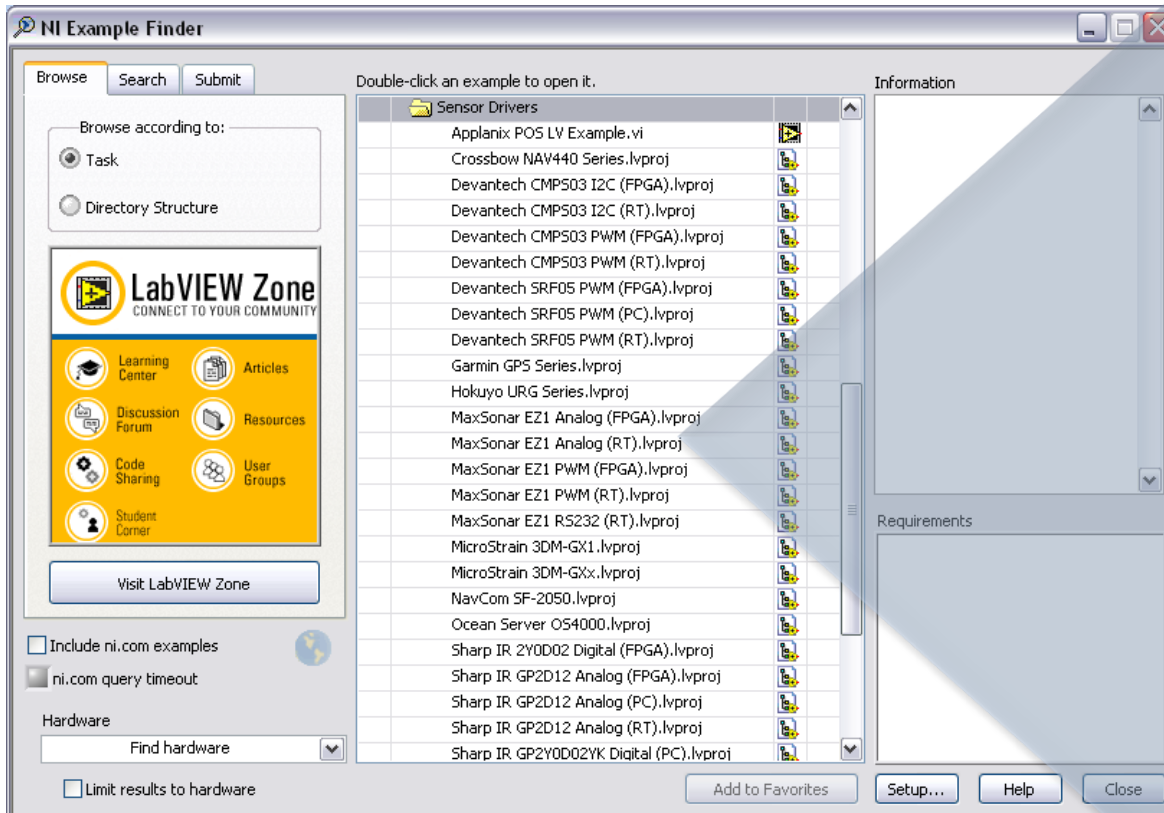
Obstacle Avoidance

Steering

Robotic Arm (kinematics, etc)

Other: JAUS, simulators, etc

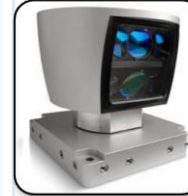
Sensor Drivers



IR Sensors



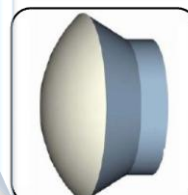
GPS
Sensors



LIDAR
Sensors



Stereo Vision



Radar
Sensors

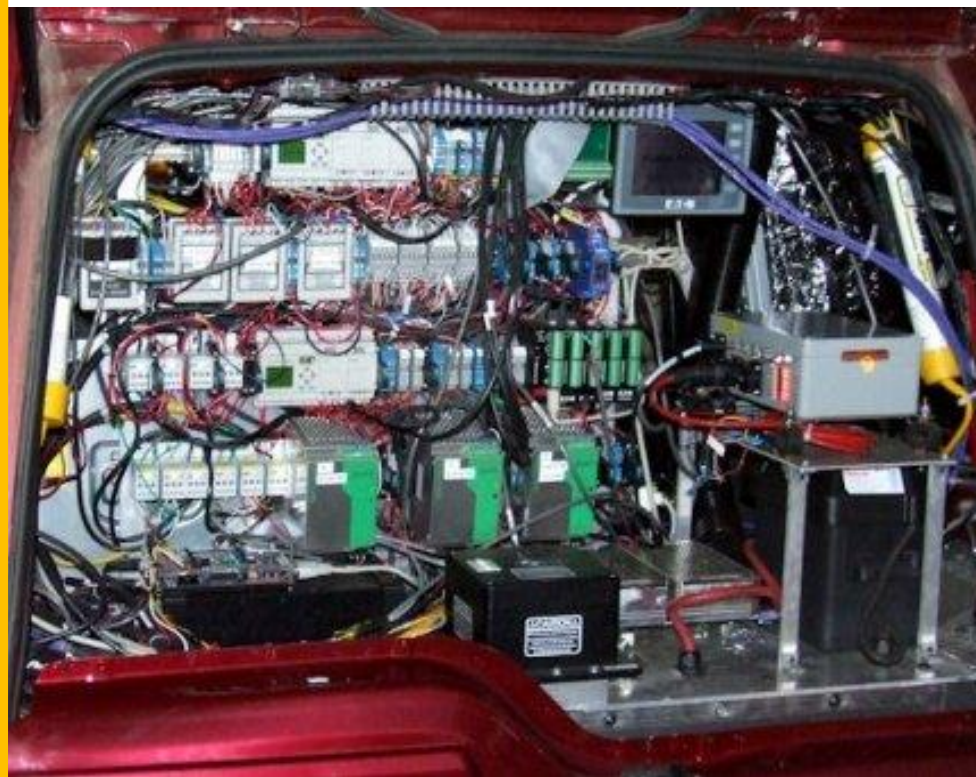
LabVIEW / RIO for Robotics

Virginia Tech DARPA Vehicle



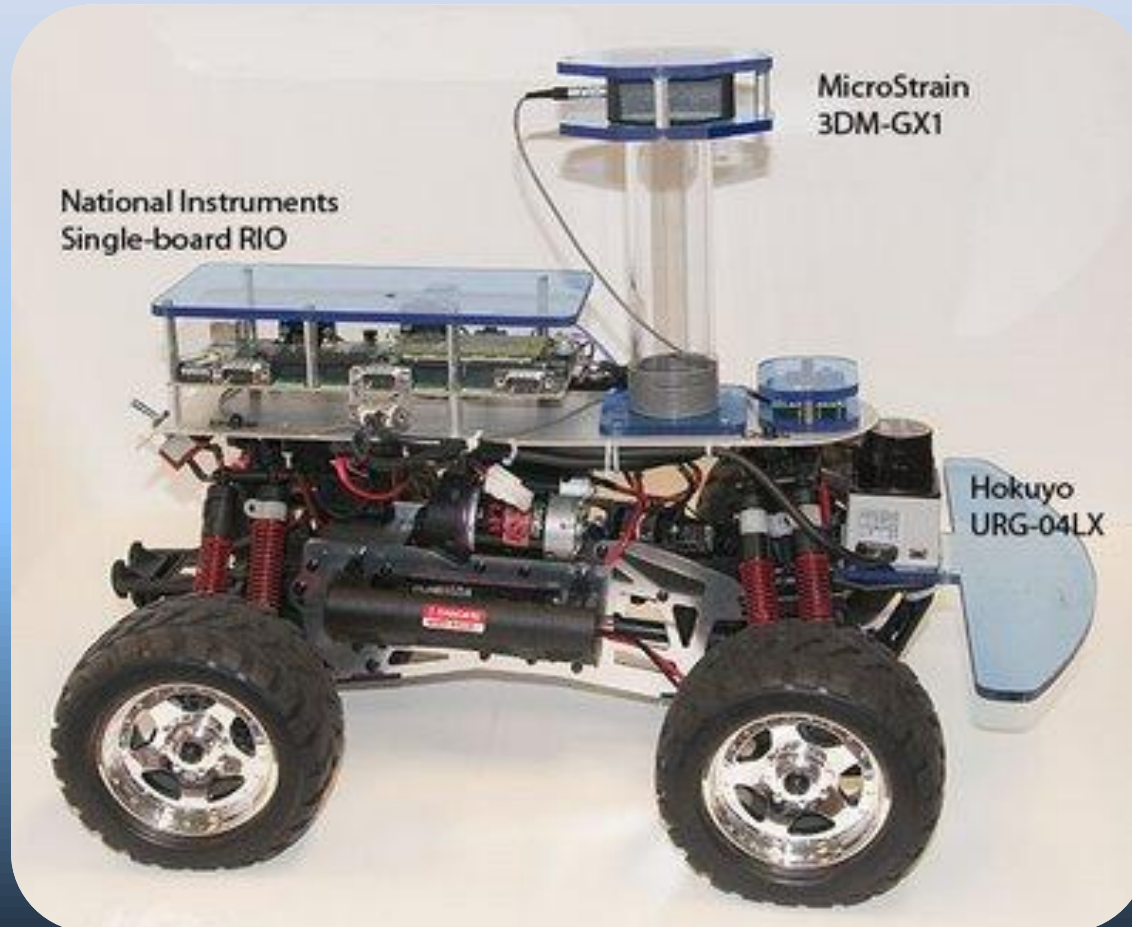
Do-it-yourself

MIT (C with a 40 core Linux cluster)



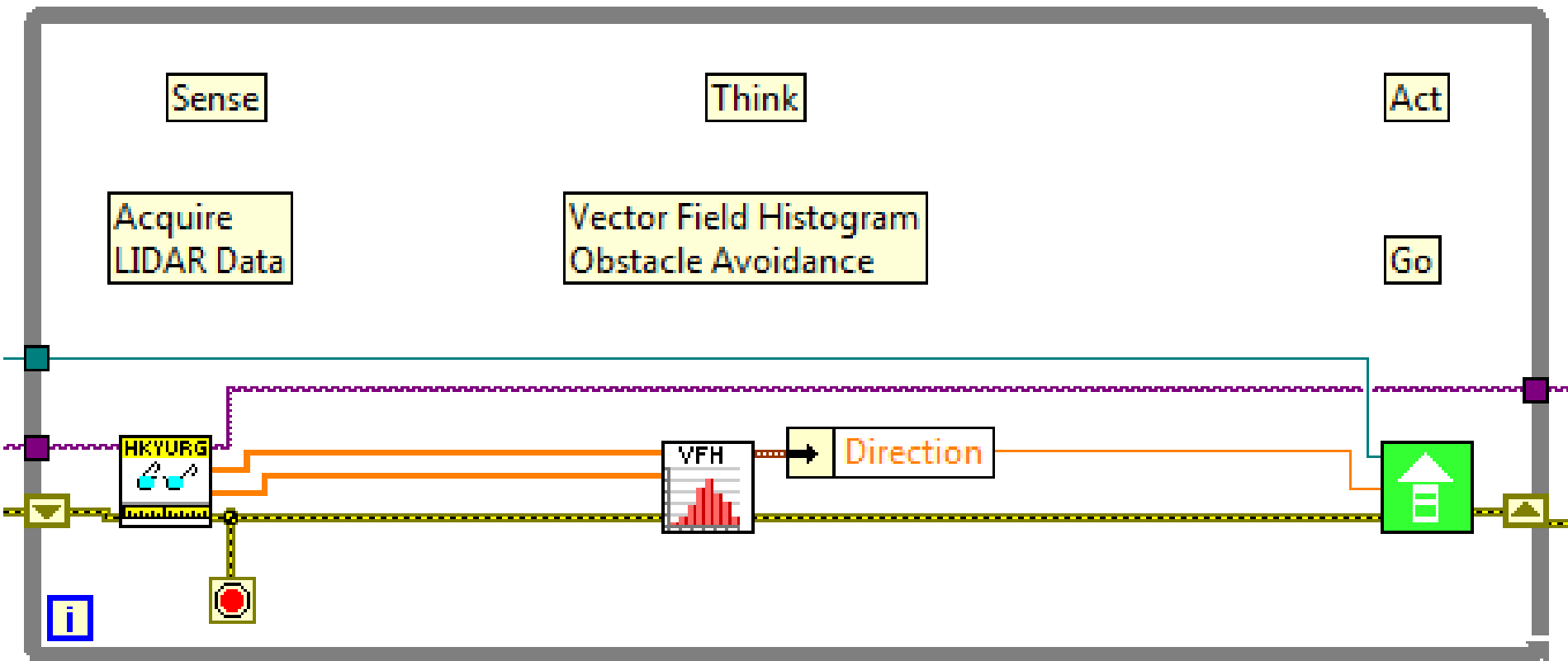
“Nicholas”

LabVIEW and SingleBoard RIO-based Autonomous System



“Nicholas”

LabVIEW and SingleBoard RIO-based Autonomous System



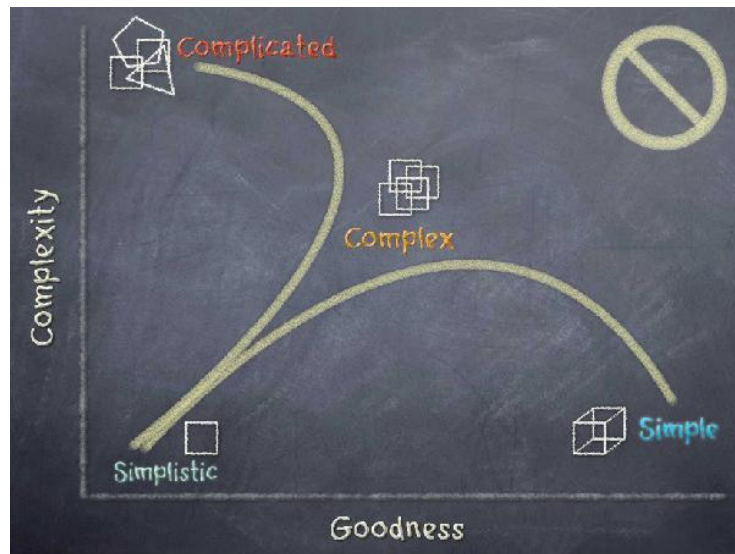
Dr. David Barrett



"The growing robotics industry badly needs an industrial-grade, hardened, richly supported software development system to build intelligent, autonomous, mobile robots that can sense, think, and act in the complex real world around them."

Why is LabVIEW right for Robotics ?

- 1) **Simplicity:** Creating a new robot starts with defining functionality via white board sketches and block diagrams. LabVIEW removes the need to abstract those into procedural code. The white board block diagram is the code. Less abstraction=good !



www.dau.mil/pubs/dam/11_12_2005/war_nd05.pdf

Maj. Dan Ward, USAF

Why is LabVIEW right for Robotics ?

2) Teach-ability/Accessibility: A \$400B robotics industry will need ~10M new skilled workers. The graphical nature of LabVIEW will make it inherently easy for them to learn\train\work with.

The ability to use one language and one environment from K through graduate school, from the most exotic/Ph'd/level robot algorithm developer to the technicians assembling the robots on the factory floor is a phenomenal advantage.

Why is LabVIEW right for Robotics ?

3) Community: Imagine what a community of 1000 LabVIEW robotics developers could produce in 10 years.....

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NI Developer Zone What is Developer Zone? Netherlands

Document Type: Tutorial
NI Supported: Yes
Publish Date: Apr 22, 2009

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Overview



Autonomous mobile robots essentially perform three tasks: sense, think, and act. These three tasks include communication with sensors to obtain data from the robot's environment, execution of algorithms for localization and planning, and driving actuators to control the robot's motion. LabVIEW addresses each task by providing drivers for interfacing with sensors, tools for developing or reusing existing algorithms, and integration with NI hardware for driving motors.

Table of Contents

1. Sense
2. Think
3. Act
4. Application Areas and Other Related Links

Evolve with us.



ni.com/labview



ni.com/robotics

