

Approaches to synchronize vision, motion and robotics

Martin Stefik, National Instruments

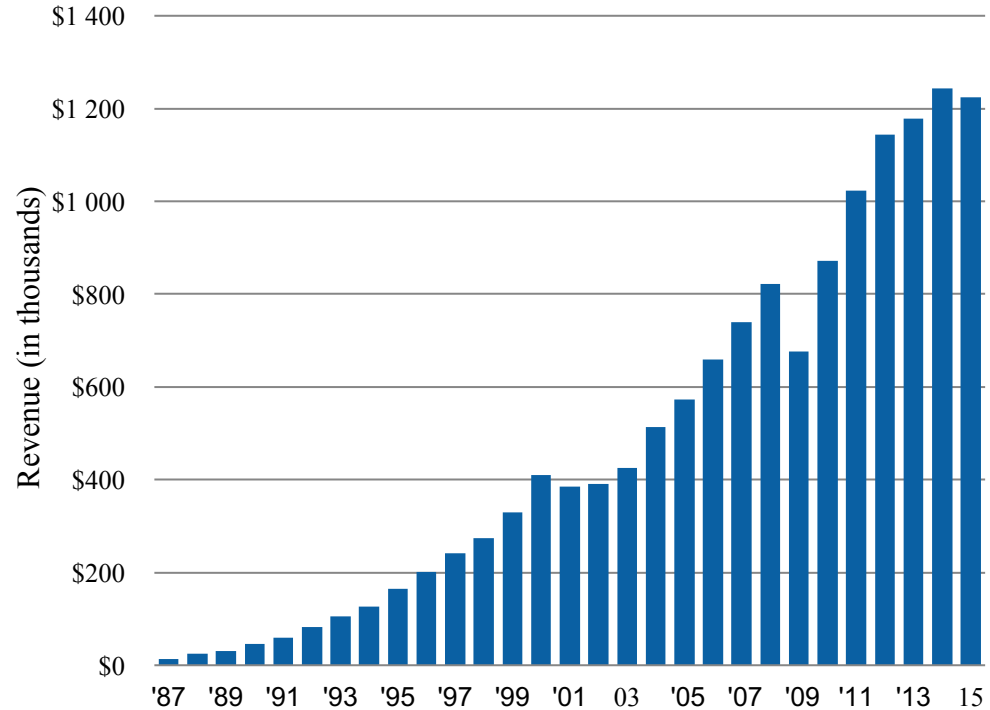
Long-Term Track Record of Growth

Revenue: \$1.23 billion in 2015

Global Operations: Approximately 7,400 employees; operations in almost 50 countries

Broad customer base: More than 35,000 companies served annually

Diversity: No industry >15% of revenue



Platform-Based Approach



Platform-Based Approach

Solutions and Partner IP

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NI Platforms



Commercial Technologies



iOS



Machine Vision Applications

Pick & Place



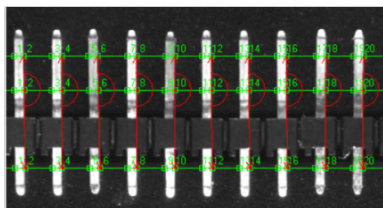
Tracking



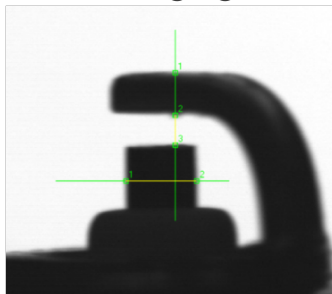
Sorting



Counting



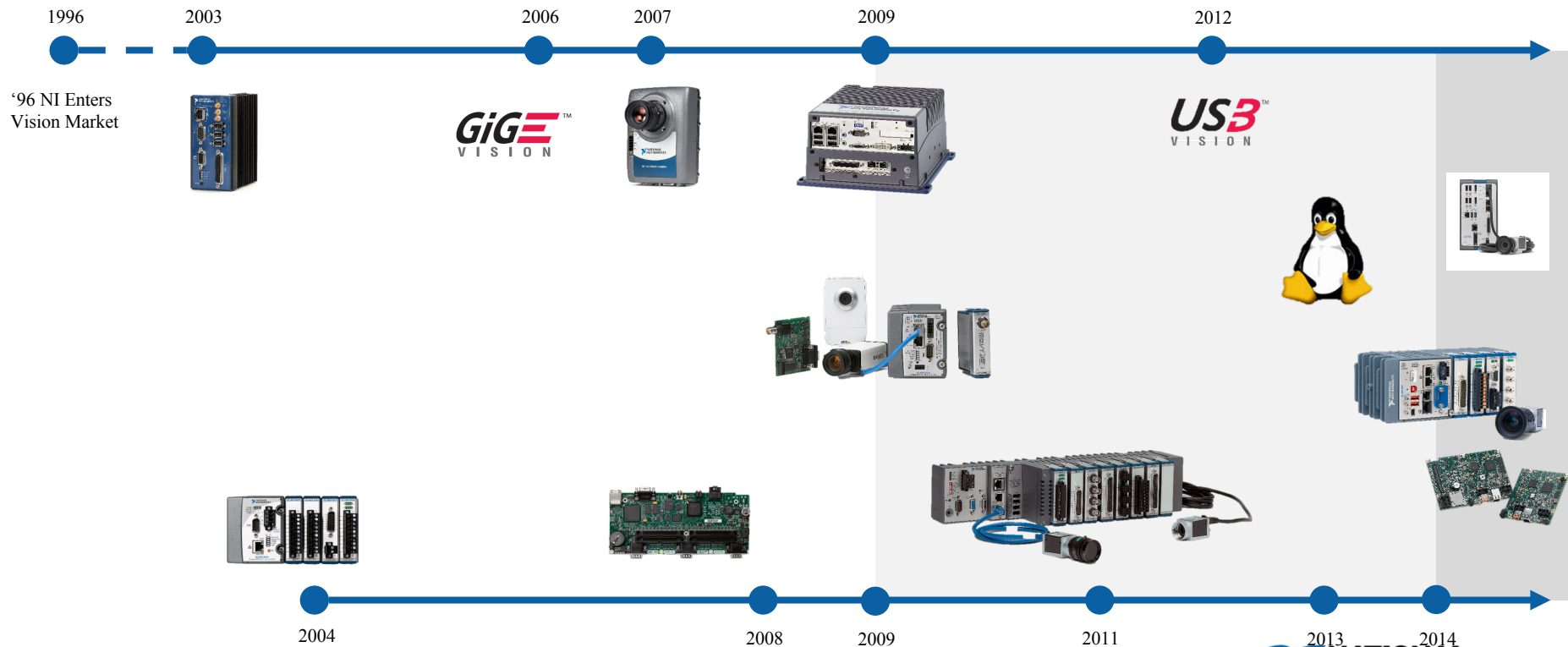
Gauging



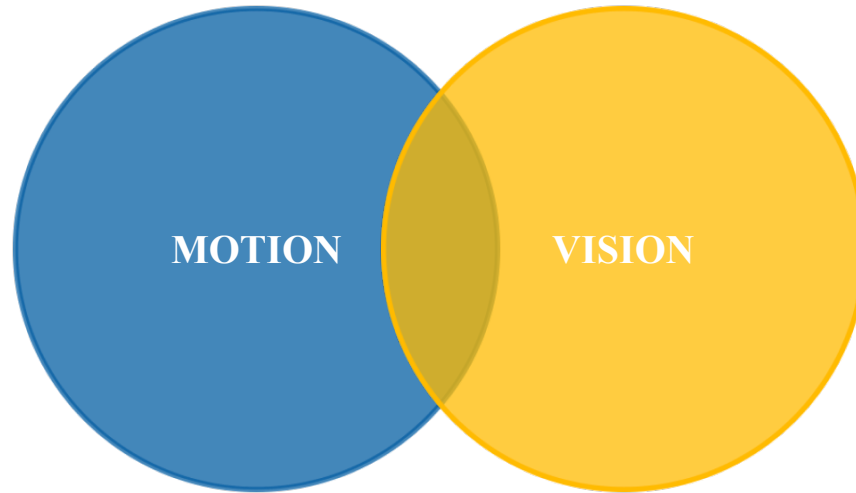
Defect Detection



History of Innovation



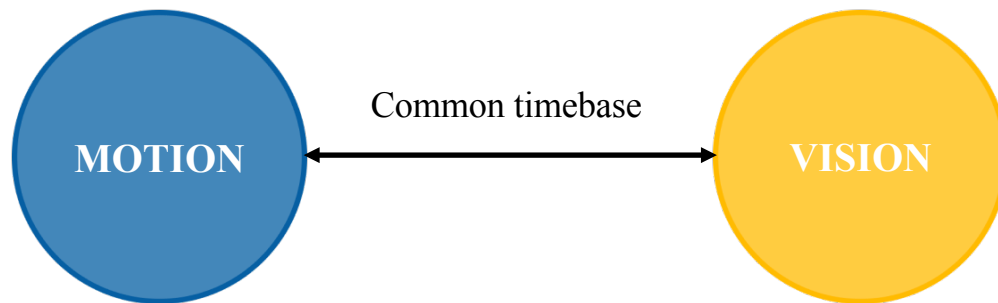
Vision Motion Integration



Vision Motion Integration

Synergetic Integration | Synchronized Integration | Vision Guided Motion | Visual Servoing

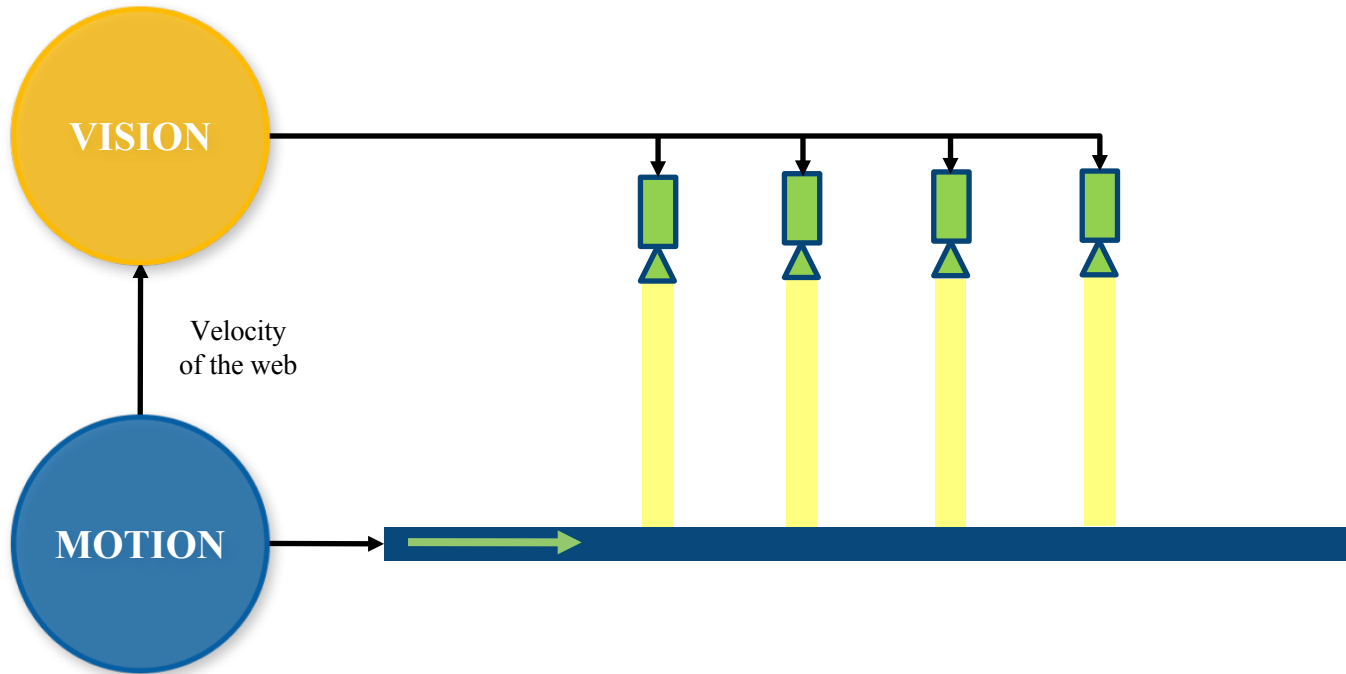
Vision Motion Integration



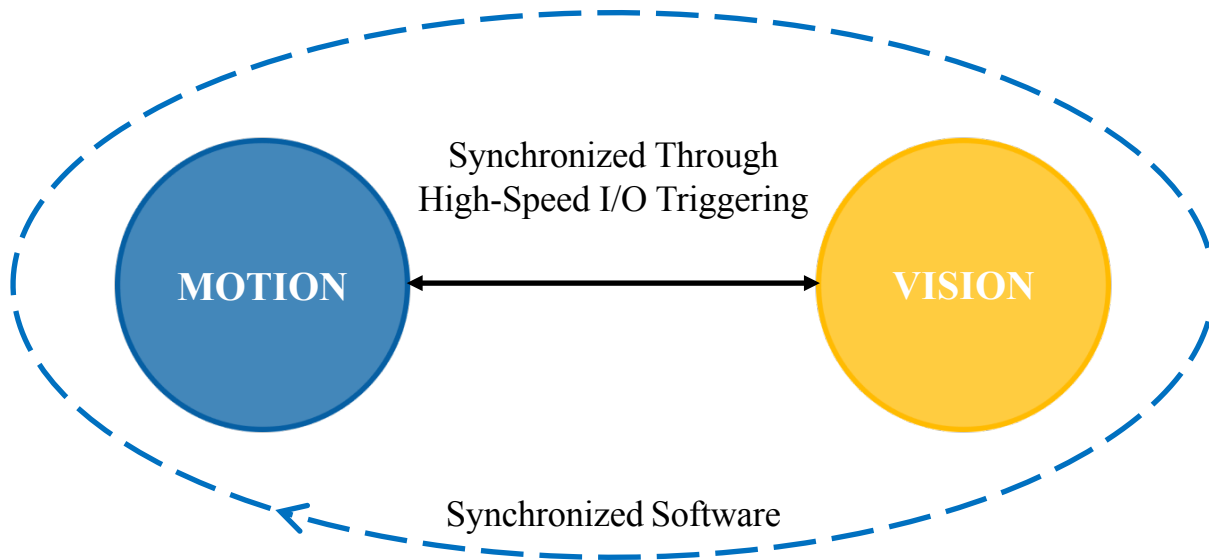
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Synergetic Integration: Web Inspection



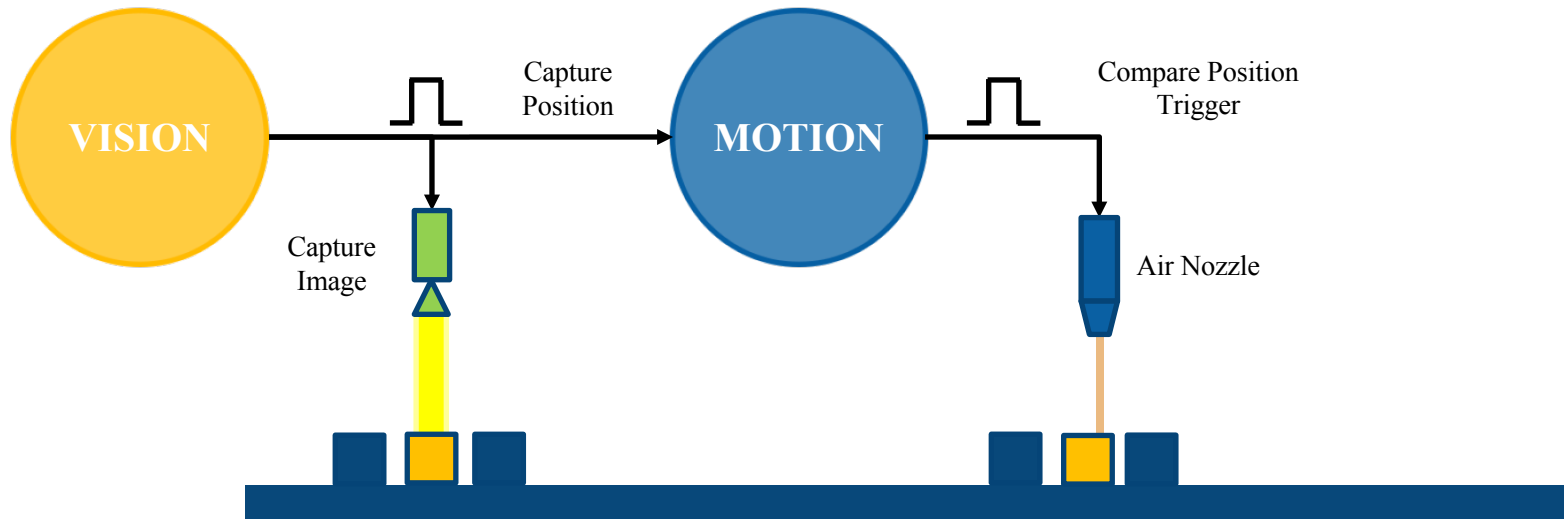
Vision Motion Integration



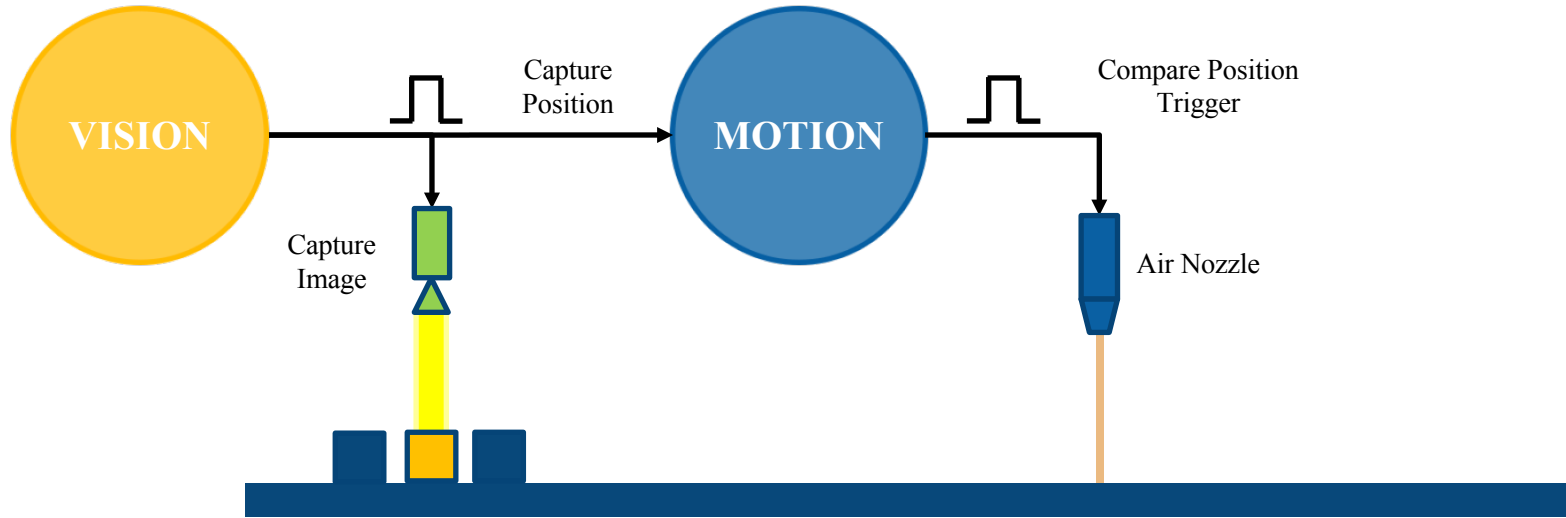
Vision Motion Integration

Synergetic Integration | **Synchronized Integration** | Vision Guided Motion | Visual Servoing

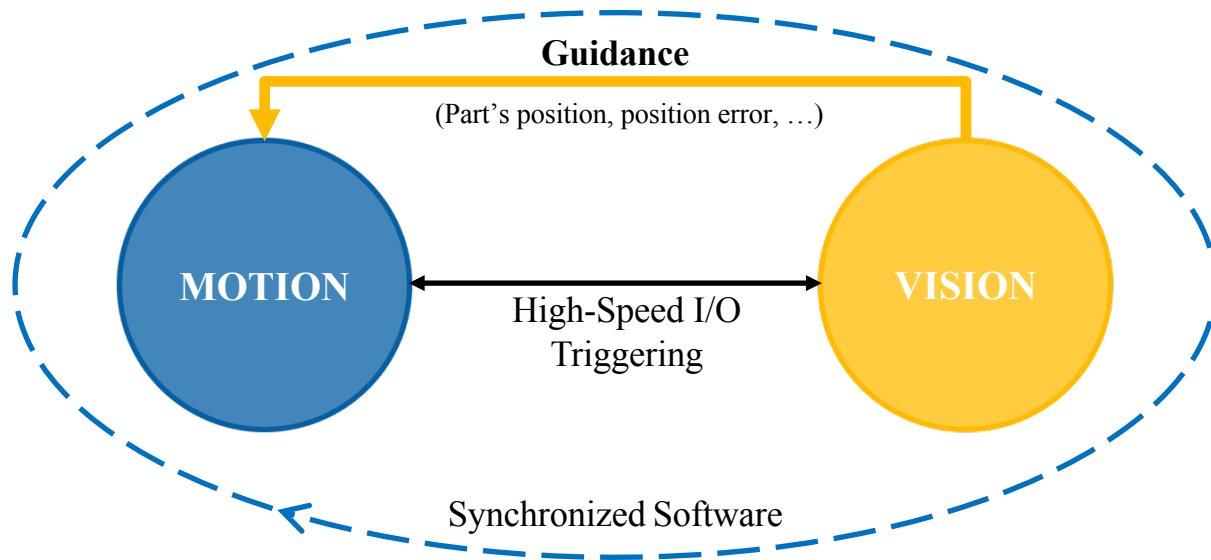
Synchronized Integration: High-Speed Sorting



Synchronized Integration: High-Speed Sorting



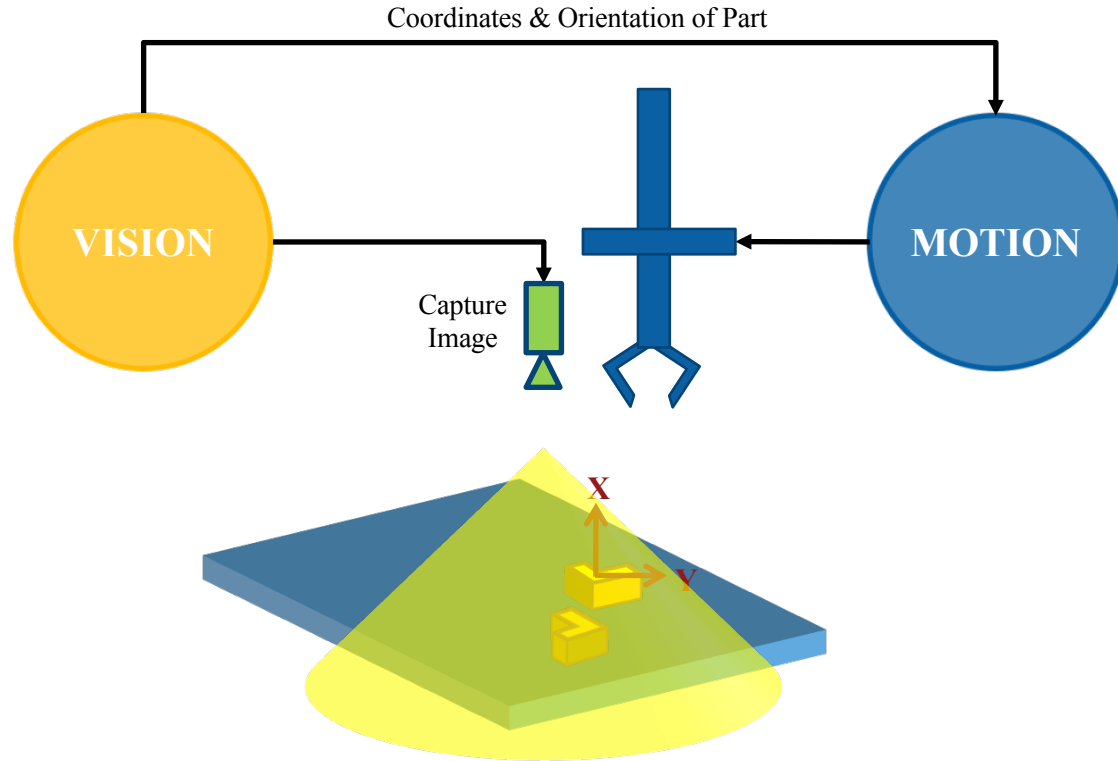
Vision Motion Integration



Vision Motion Integration

Synergetic Integration | Synchronized Integration | **Vision Guided Motion** | Visual Servoing

Vision Guided Motion: Flexible Feeding



LabVIEW Robotics Library by DigiMetric

- Available from LabVIEW Tools Network
- Support for DENSO, Epson, FANUC, Kawasaki, Toshiba Mitsubishi, KUKA, etc.



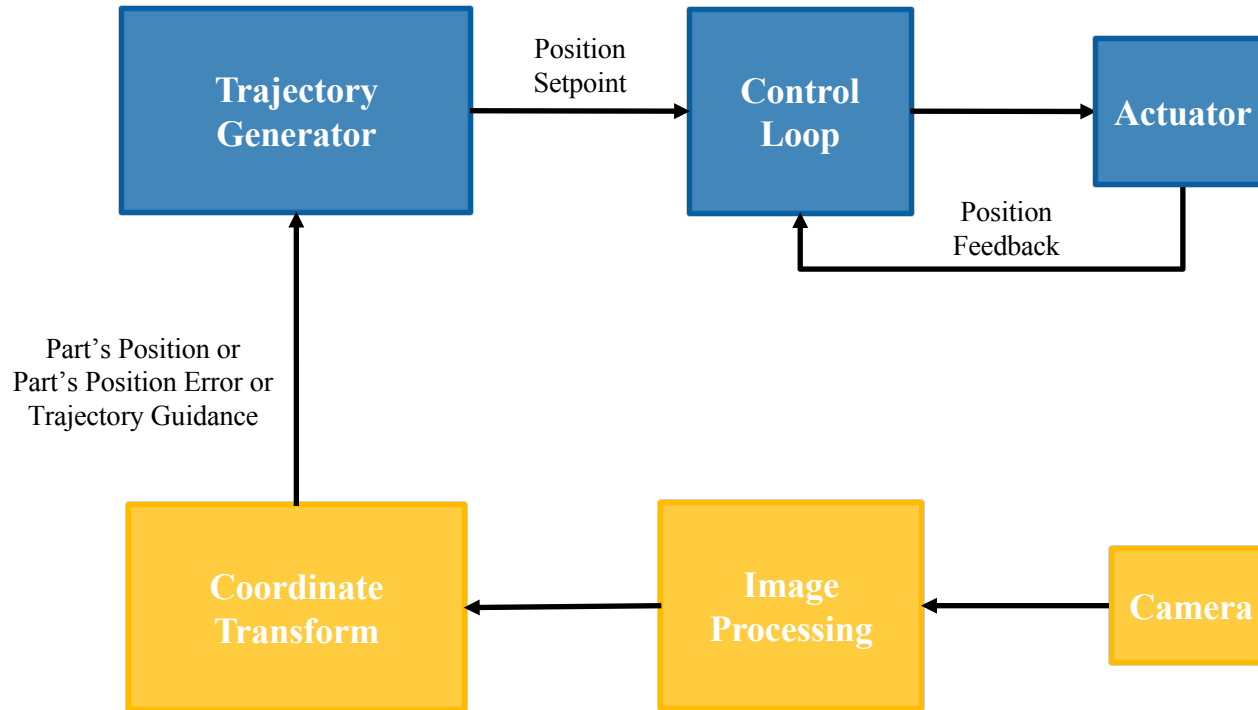
Advantages of Vision Guided Motion

Eliminates fixtures and positioning equipment

Increases adaptability to new products and tasks

Improves accuracy of a placement task

Vision Guided Motion

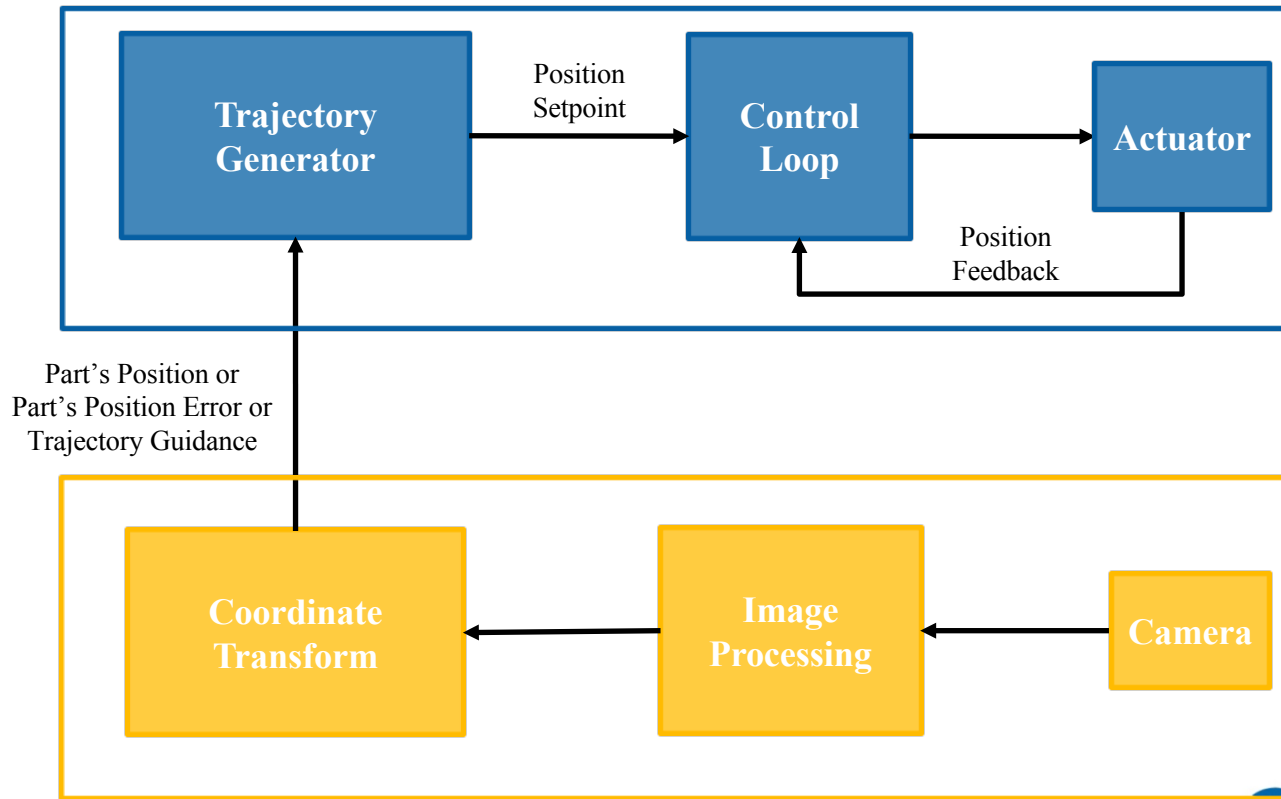


Common Implementation Architectures

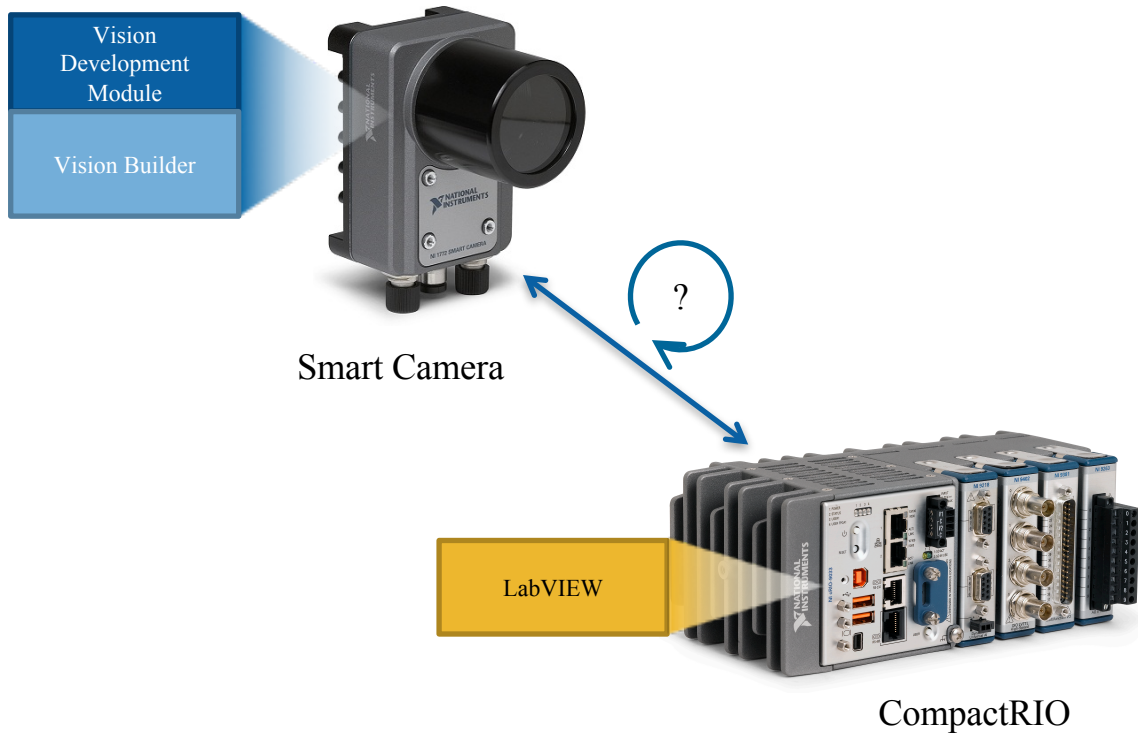
Distributed Processing

Centralized Processing

Distributed Processing



Distributed Processing



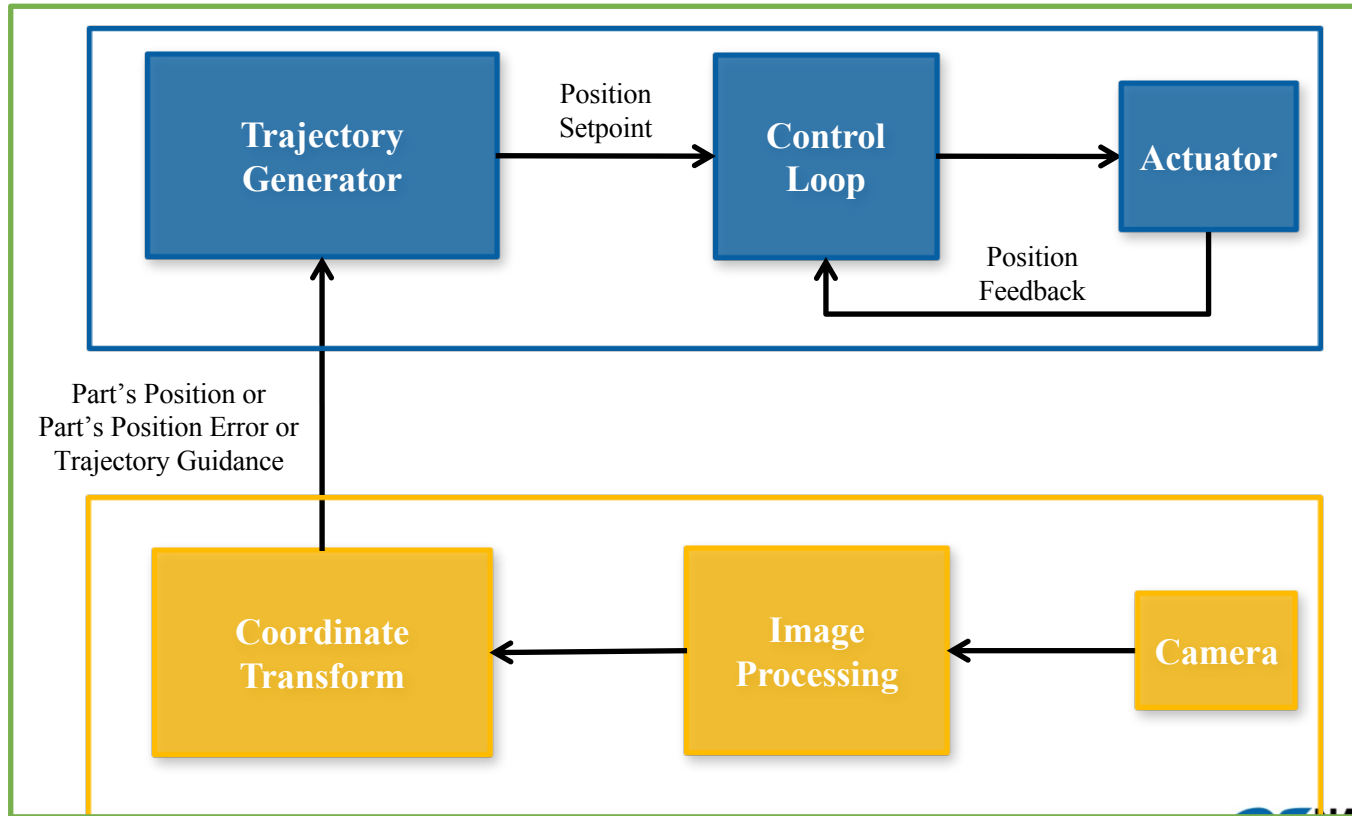
NI Smart Camera Overview

- Monochrome or color across all sensors
- Intel Celeron N2807 dual-core @ 1.58GHz (2.15 GHz turbo)
- NI LinuxRT 64-bit or Windows Embedded 7 64-bit
- Vision Builder for Automated Inspection Included
- 32GB eMMC storage, 2GB memory
- Gigabit Ethernet interface
- VGA and USB interfaces for HMI
- Compact IP67-rated design with robust M12 connectors
- Real-time digital I/Os:
 - 2 opto-coupled inputs (with incremental rotary encoder support)
 - 4 opto-coupled output
 - 1 dedicated opto-coupled trigger
- Dedicated 0-10V LED lighting intensity control
- Dedicated interface for Varioptic Caspian auto-focus lens
- C-mount lens
- Operating Temperature: 0°C to 50°C (32°F to 122°F)
- Power consumption: 450 mA @ 24VDC or 10.8W (typical)

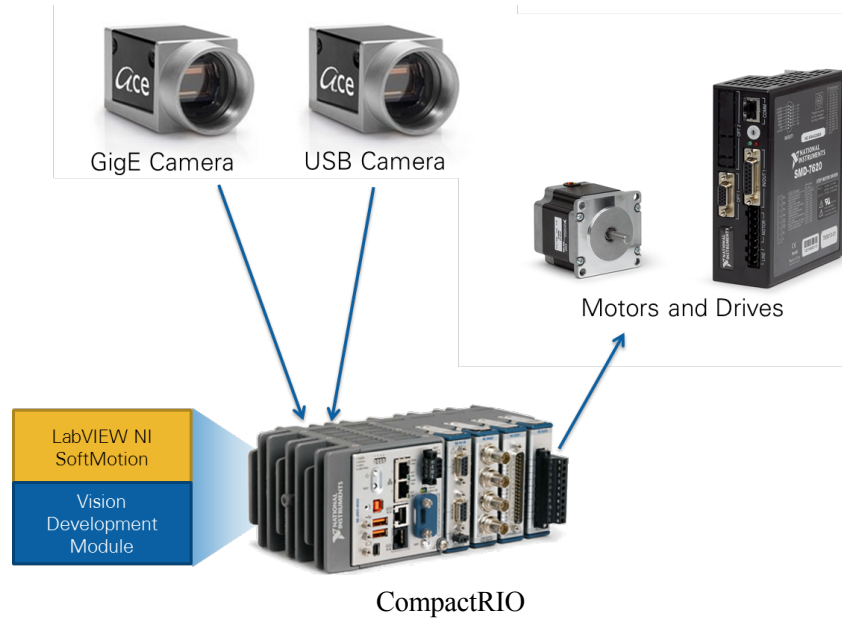


Model	ISC-1780	ISC-1781	ISC-1782	ISC-1783
Sensor (CMOS)	PYTHON 300	PYTHON 1300	PYTHON 2000	PYTHON 5000
Sensor Size	1/4"	1/2"	2/3"	1"
Resolution (H x V)	640 x 480	1280 x 1024	1920 x 1200	2592x2048
Frame rate (effective)	Up to 293 fps	Up to 85 fps	Up to 45 fps	Up to 21 fps

Centralized Processing



Centralized Processing



Centralized Processing Advantages

Improves performance by removing networking bottleneck

Reduces development complexity

Uses single development environment

Enables vision in the control loop for advanced applications like visual servo control

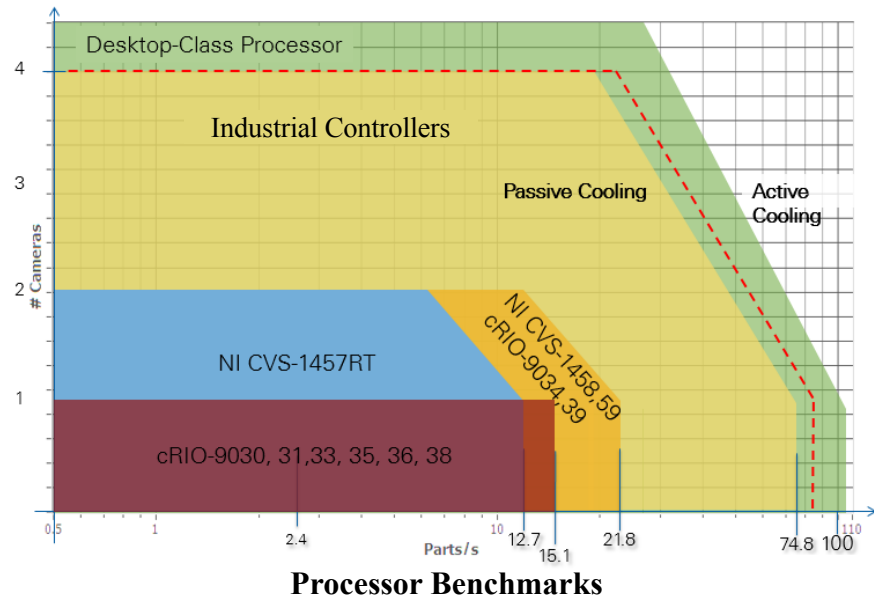
New Industrial Controllers

What Would You Do With More Performance?

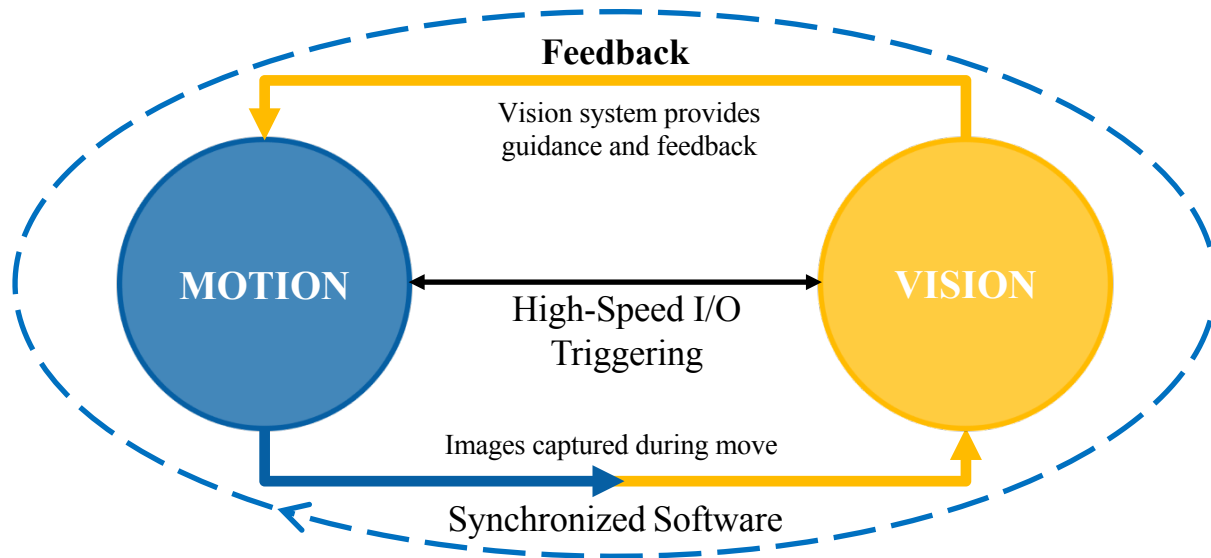


USB™ GIGE™
VISION VISION

EtherCAT®



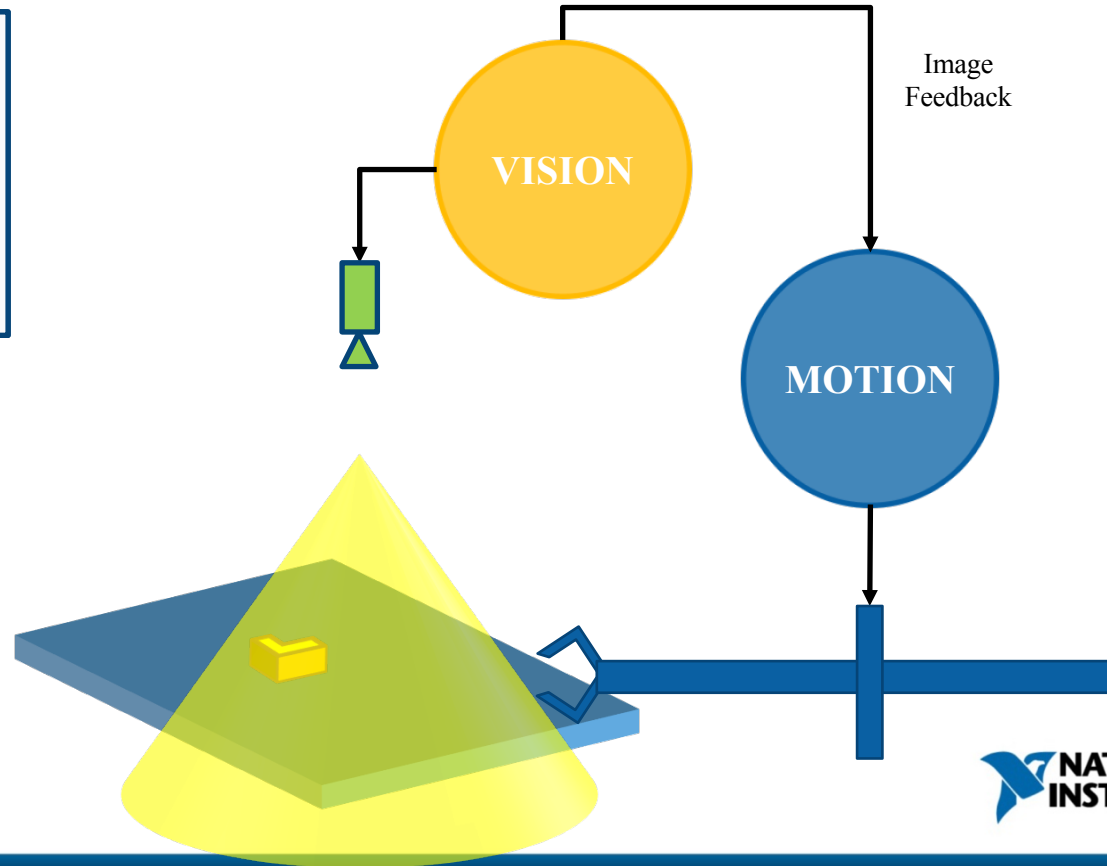
Vision Motion Integration



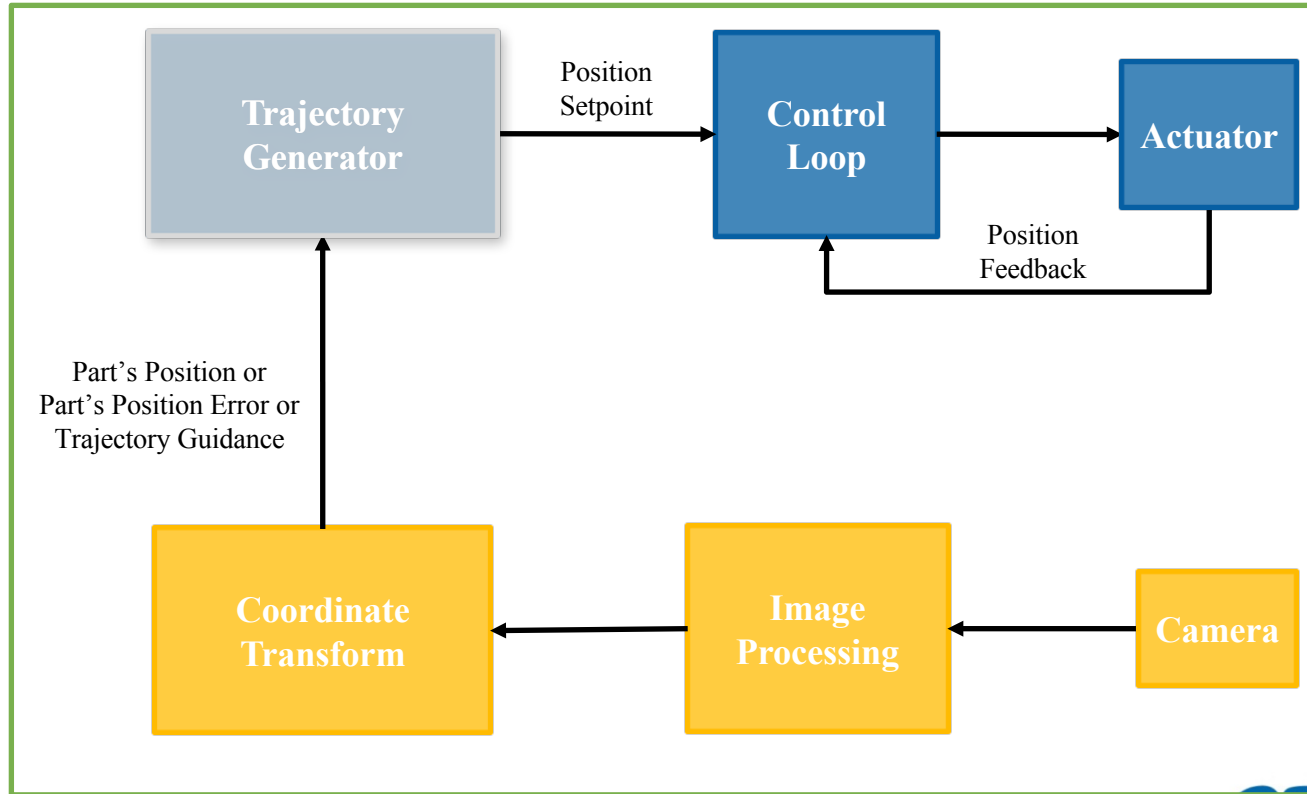
Vision Motion Integration

Synergetic Integration | Synchronized Integration | Vision Guided Motion | **Visual Servoing**

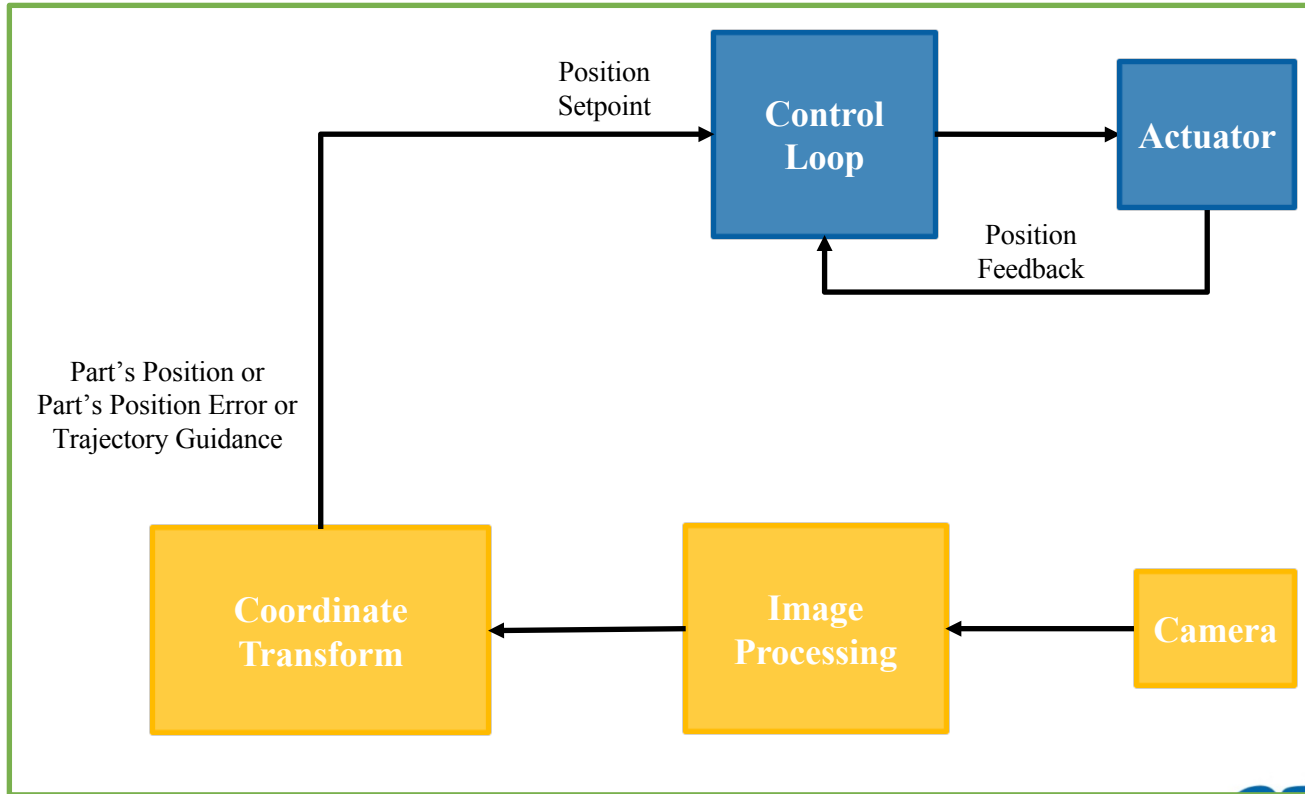
Visual Servoing



Centralized Processing



Visual Servo Control: Dynamic Look and Move



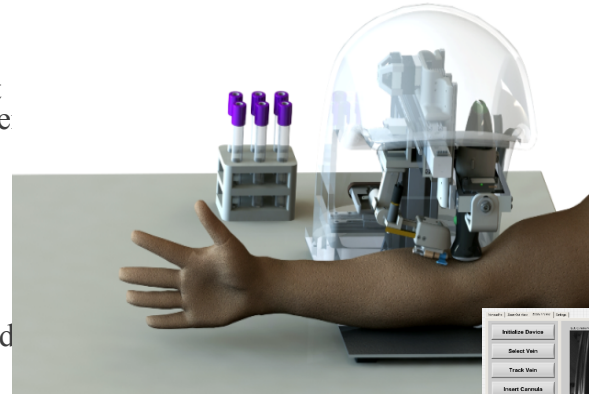
Developing a Portable 3D Vision-Guided Medical Robot for Autonomous Venipuncture

The Challenge:

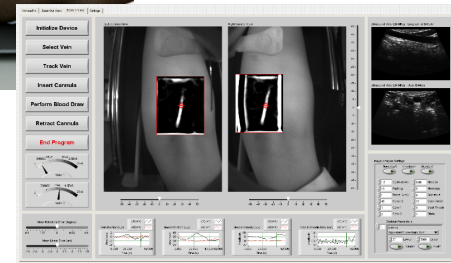
Developing a portable, image-guided, medical robot that autonomously performs blood draws and other IV procedures when medical professionals are unable to successfully access veins.

The Solution:

Combining the performance of NI CompactRIO hardware, the flexibility of NI LabVIEW system design software, and the extensive NI robotics and machine vision libraries to deliver a safe portable medical device for initial human testing.



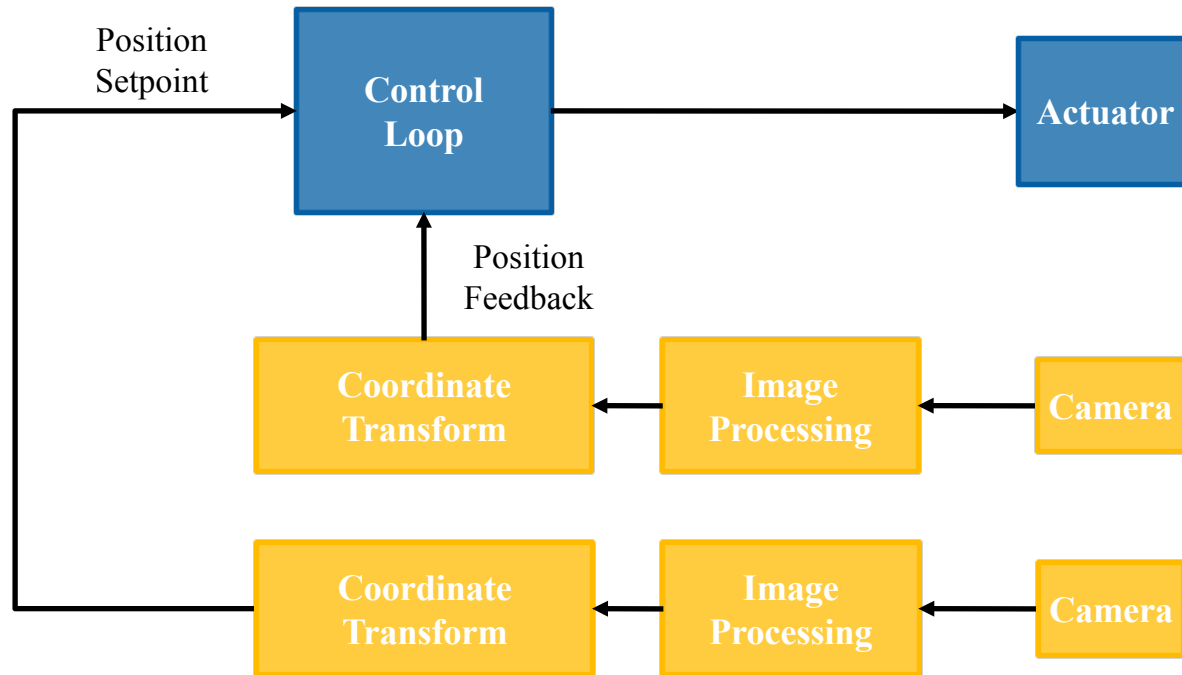
[Case Study Link](#)



"The NI platform provided our start-up the flexibility to pursue cutting-edge engineering research as well as the reliability to hit time-critical development milestones. NI products empowered our company to rapidly develop and test a disruptive medical technology."

- Alvin Chen , [VascuLogic](#)

Visual Servo Control: Direct Servo



Vision and Motion Integration Takeaways

Integrating vision and motion systems can reduce costs, increase efficiency, and improve quality

Advanced integration methods can greatly improve the performance of tomorrow's smart machines

Distributed processing allows easy scalability and a variety of performance options

Centralized processing provides a small footprint and improves determinism and latency between tasks