Robotics and Machine Vision Based Assembly

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Objective

- **Discuss Vision based Assembly**
  - Traditional Vision guidance
    - What is vision guidance
    - Why Vision Guidance
  - “Vision-on-the Fly” technology
    - Technology explained
    - Improving throughput using the technology
  - Integrated Vision- Explained

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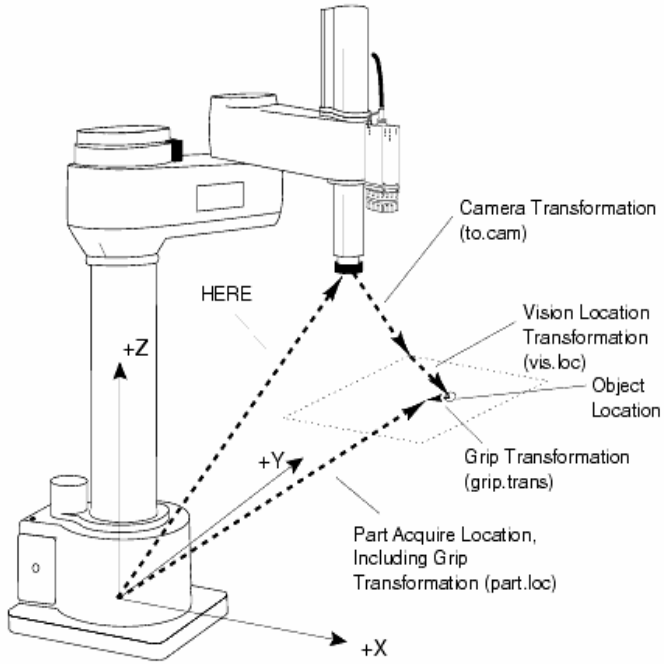
Vision Guidance - Explained

"Vision Guidance" is a feature that allows the vision system to take a picture and compute the part's location and orientation in terms of robot space and guide to robot to the part using robot-camera transformation obtained through an automated calibration process.



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Key Questions for Vision Guidance Application

- Does the robot/controller/operating system support vision guidance? If so, to what extent?
- Is vision integrated into the system?
- How hard is it to teach the vision?
- Will this approach work as well in production as it does during integration?
- If the part changes after the system is in production how hard will it be to adjust the vision?
- If I need support who do I call?

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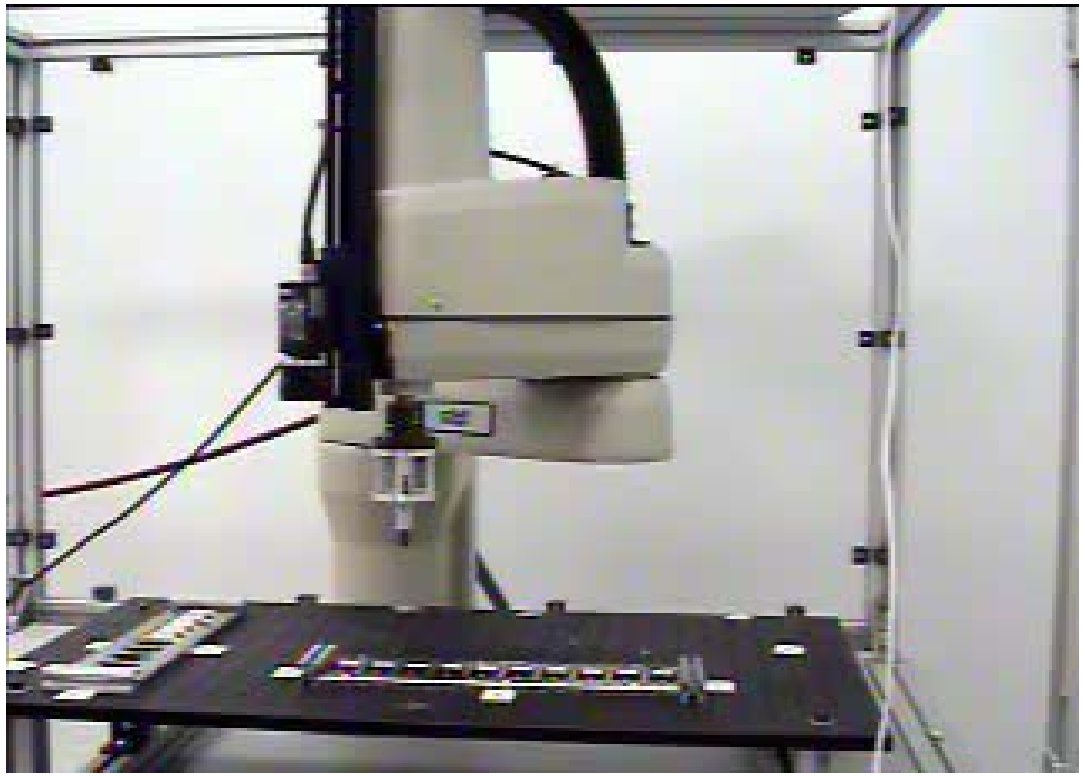
Why Vision Guidance – Isn't it harder

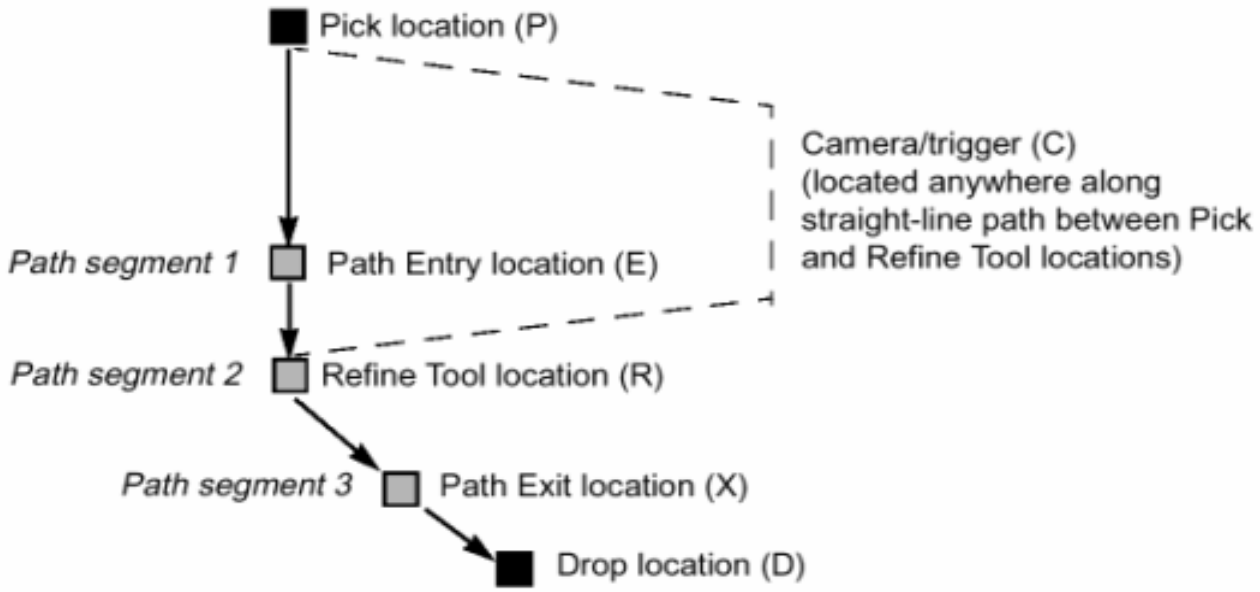
- Vision guided applications don't require tight fixtures or trays for parts entering the system
- Pre-orientation of parts is not required
- Quality improves because parts can be inspected prior to and/or during assembly instead of after assembly
- Changes in part geometry only require a simple re-teaching of vision instead of a change in tooling
- Eliminate Assembly tolerance stack-up
- Accuracy of robot mechanism become close to its repeatability
- Flexibility…Flexibility…Flexibility

Example – Traditional Vision Guidance



Vision on-the-fly

"Vision on the fly" is a feature that allows the vision system to take a picture while the robot is moving the part through the camera's field-of-view. Once the picture is acquired, the robot proceeds to a tool refinement location, stops at that location while a tool refinement is performed, and then proceeds to the place (drop) location.



Components for Vision-On-the Fly Technology

- **Vision On-The-Fly**
  - Vision guidance without stopping the robot for image acquisition
  - Latching robot encoders simultaneously with image acquisition
- **Sub-Pixel resolution for improved accuracy**
  - Object finder/Circle Finder etc
- **High Performance Robot**
  - 17 Bit High Resolution Absolute encoders
  - Low-inertia harmonic drives
  - 8 kHz servo update rate for improved path following and control
  - +/-0.015mm Repeatability
- **Tight integration Integrated Motion and Vision**
  - Upward/Arm mounted camera calibration

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Process

- Part Pick up from Cassette/Feeder
- Start Moving towards the destination
- Vision task waits till screw is in the field of view of camera
  - Acquire image and latch encoder simultaneously
  - Calculate robot tool offsets using vision image
- Approach final location
  - Use vision offsets and accurately position robot over the placement location
- Place part

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Other Applications & Videos

- Disk Install using “Vision-On-The-Fly”

•HSA Install

•Ramp,Latch,Clamp,Cover Install

•HGA Assembly

Integrated Vision – What is it?

- Built into the Hardware
  - The motion interface and vision interface reside in the same box

- Tightly coupled to the Operating System
  - Vision commands can be issued from a monitor prompt for debugging
- Has built in extensions in the programming language
- Built in methods to calibrate the vision to the robot for various configurations
  - Robot Mounted Camera calibration
  - Fixed mounted Camera calibration
  - Upward Looking Camera calibration
  - Camera only calibration