

How to deploy 3D imaging technology into your inspection application

What You'll Learn:

- The benefits of using 3D imaging in inspection applications
- How 3D technology can be used in inspection
- Technology options
- Example of 3D imaging automated solution

Introduction

- Headquarters: Apex, NC (Raleigh)
- Industrial Full Turn-Key System Level Solutions
 - Automated Inspection Systems
 - 3D & 2D Vision, Thermal Imaging, Crack Detection, Acoustic, Leak Detection, X-Ray, etc.
 - Automated Test and Measurement Systems
 - dTRAK: comprehensive client-server manufacturing and test platform
- Smart Machines and Data Analytics: enable the Factory of the Future
 - Smart Machine: high bandwidth data acquisition, transport, and processing
 - Front End- Client
 - Data Analytics: Access, storage, management, analysis, reporting
 - Back End- Server
- Operation in Harsh Environments
 - Temperature, humidity, dirt, dust, etc.
- Maintenance and Support Services
- National Instruments Alliance Partner



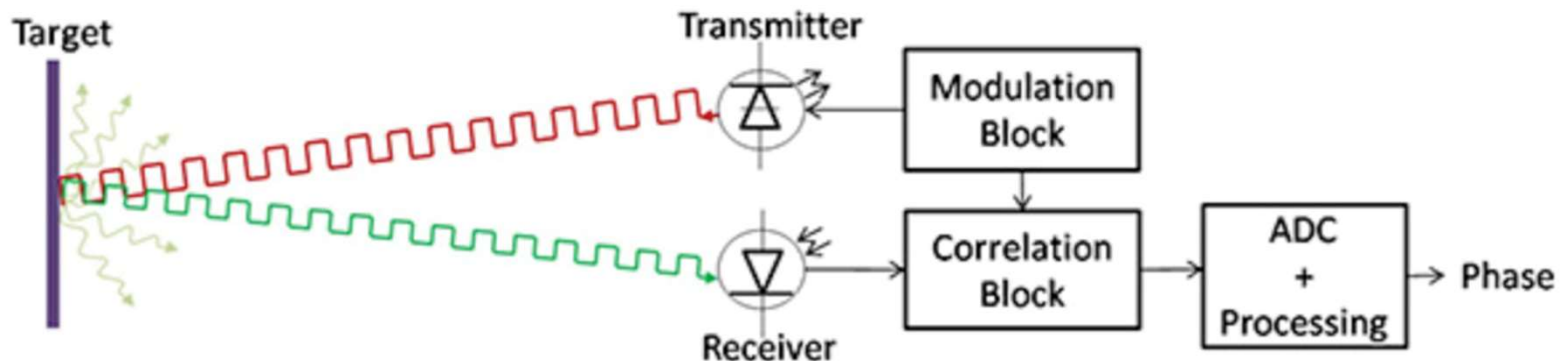
Why 3D Inspection

- Non-contrast applications
 - Lighting limitation
 - Color / background
 - Imprinted Text
- Measurements
 - Height, width, length
 - Volume, depth
- Surface Inspection
 - Features - presence / absence
 - Location - positioning

Types of 3D Inspection

- Time of flight

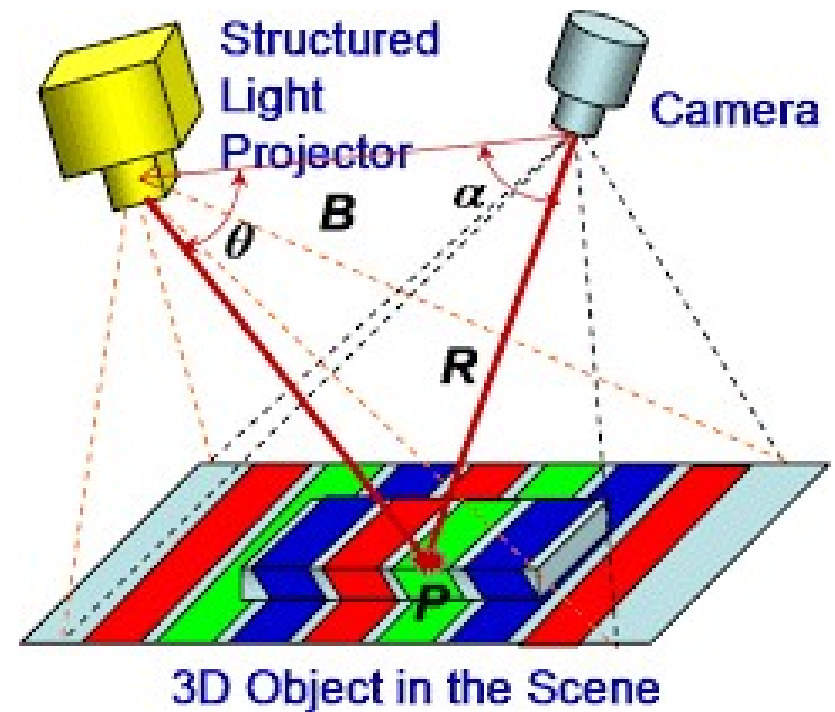
- time-of-flight cameras are a recent innovation and are a type of 3D range-imaging camera that use a collection of techniques to produce a multi-dimensional image showing the distance to points in a scene from a specific point. The subsequent image captured has pixel values which correspond to the distance, where brighter values mean shorter distances. These pixel values can then be translated into physical units of measurement.



Types of 3D Inspection

- **Structured light**

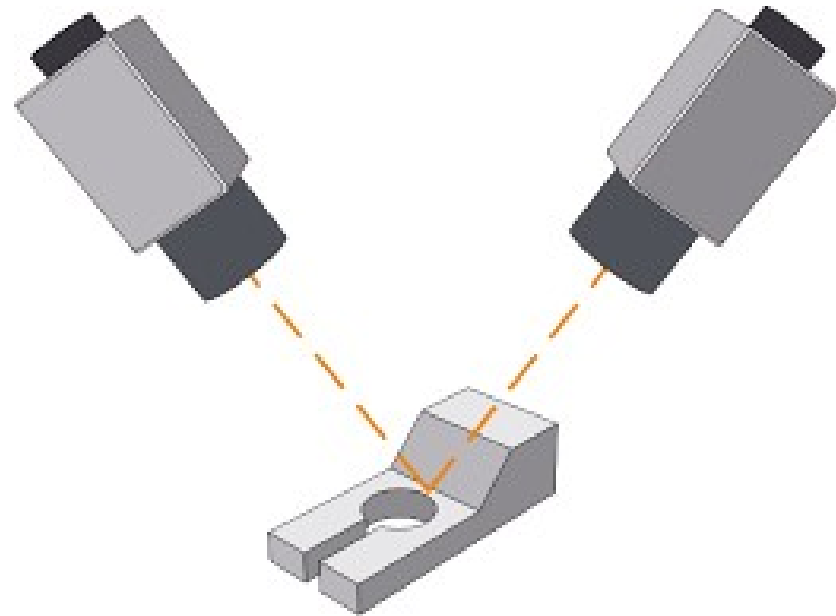
- Structured-light 3D scanners project a pattern of light on the subject and look at the deformation of the pattern on the subject. The pattern is projected onto the subject using either an LCD projector or other stable light source. A camera, offset slightly from the pattern projector, looks at the shape of the pattern and calculates the distance of every point in the field of view.



Types of 3D Inspection

- Stereo

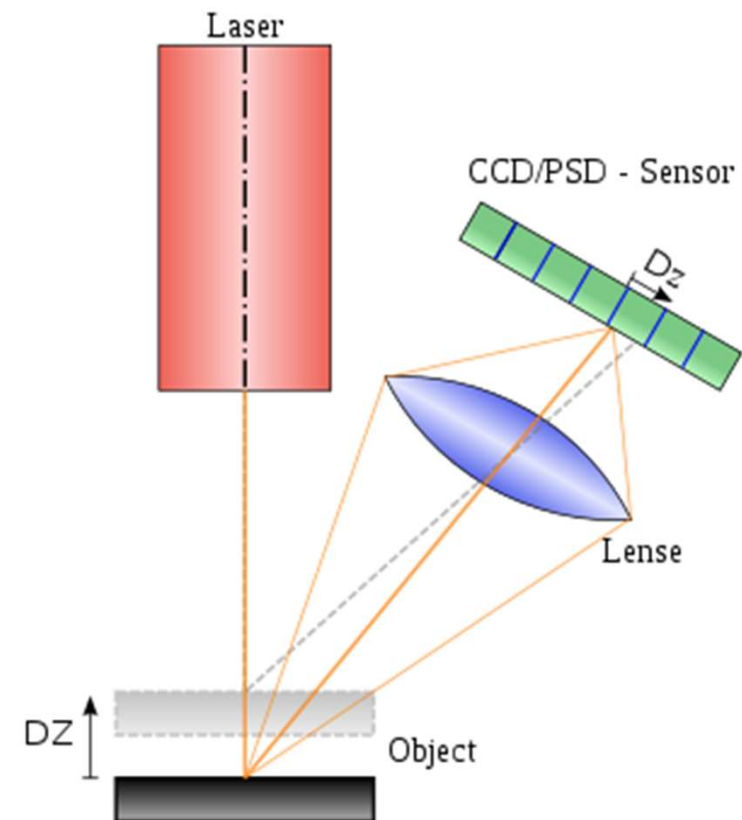
- combines two 2D images taken from different positions and finds correlations between the images to create a depth image. Stereo technology does not depend on a dedicated light source. However, to find correlations the two images need to have sufficient details and the objects sufficient texture or non-uniformity. To obtain better results, one may need to add those details by illuminating the scene with structured lighting.



Types of 3D Inspection

- **Triangulation**

- The measurement principle of laser triangulation is simple: the sensor operates with a laser diode, which projects a visible light spot onto the measurement target. The reflected light is imaged by an optical receiving system onto a position-sensitive element. If the light spot changes its position, this change is imaged on the receiving element and evaluated.



Time of Flight Approach

- Technology
 - Area Cameras
 - IR pulsed light source
- Pros:
 - Simplicity – no moving parts
 - Speed – measures an area with one snap
 - Large measurement range
- Cons:
 - Multiple path reflections
 - X-Y resolution
 - Fast movements

Structured Light Approach

- Technology
 - Area Camera
 - Dual cameras in stereo configuration
 - LED pattern generator
- Pros:
 - Coverage Area – typically larger than other technologies
 - High resolution capability
- Cons:
 - Environment – objects reflective properties
 - Background light

Stereo Approach

- Technology
 - 2 Area Cameras
 - Ambient or Structured Light
- Pros:
 - Speed – high frequency acquisition
 - Large coverage area
 - Suitable for outdoor applications
- Cons:
 - Poor height resolution
 - Limited depth of focus of camera

Triangulation Approach

- Technology
 - Line Scan Camera
 - Controlled Motion
- Pros:
 - Speed – high frequency acquisition
 - Coverage area only limited by motion
 - High resolution capability
- Cons:
 - Coordinated motion required to acquire image
 - Configuration is optimized to the object – variations cause issues
 - Shadow effects possible

Technology Considerations

- Motion
 - Yes: Triangulation
 - No: TOF / Structured Light
- Ambient Light
 - Yes: Triangulation
 - No: TOF / Structured Light
- Reflective Surface
 - Yes: Triangulation / Structured Light
 - No: TOF
- Large Field of View
 - Yes: TOF / Structured Light
 - No: Triangulation

Illumination Considerations

- Geometry
 - The 3-D spatial relationship among sample, light and camera.
- Structure, or Pattern
 - The shape of the light projected onto the sample
- Wavelength, or Color
 - How the light is differentially reflected or absorbed by the sample and its immediate background
- Filters
 - Differentially blocking and passing wavelengths and/or light directions

Automated Inspection Application

Connector Inspection System

Connector Inspection System

- Customer
 - Fortune 500 Connector Manufacturer in the automotive industry
- Requirements
 - Develop automated inspection and packaging system for a 60 pin header assembly that will
 - Integrate into the manufacturing line
 - remove foreign debris
 - electrical test – hipot and continuity
 - Inspect – pin height, true position
 - barcode
 - package parts in trays
 - 4 second TAKT time

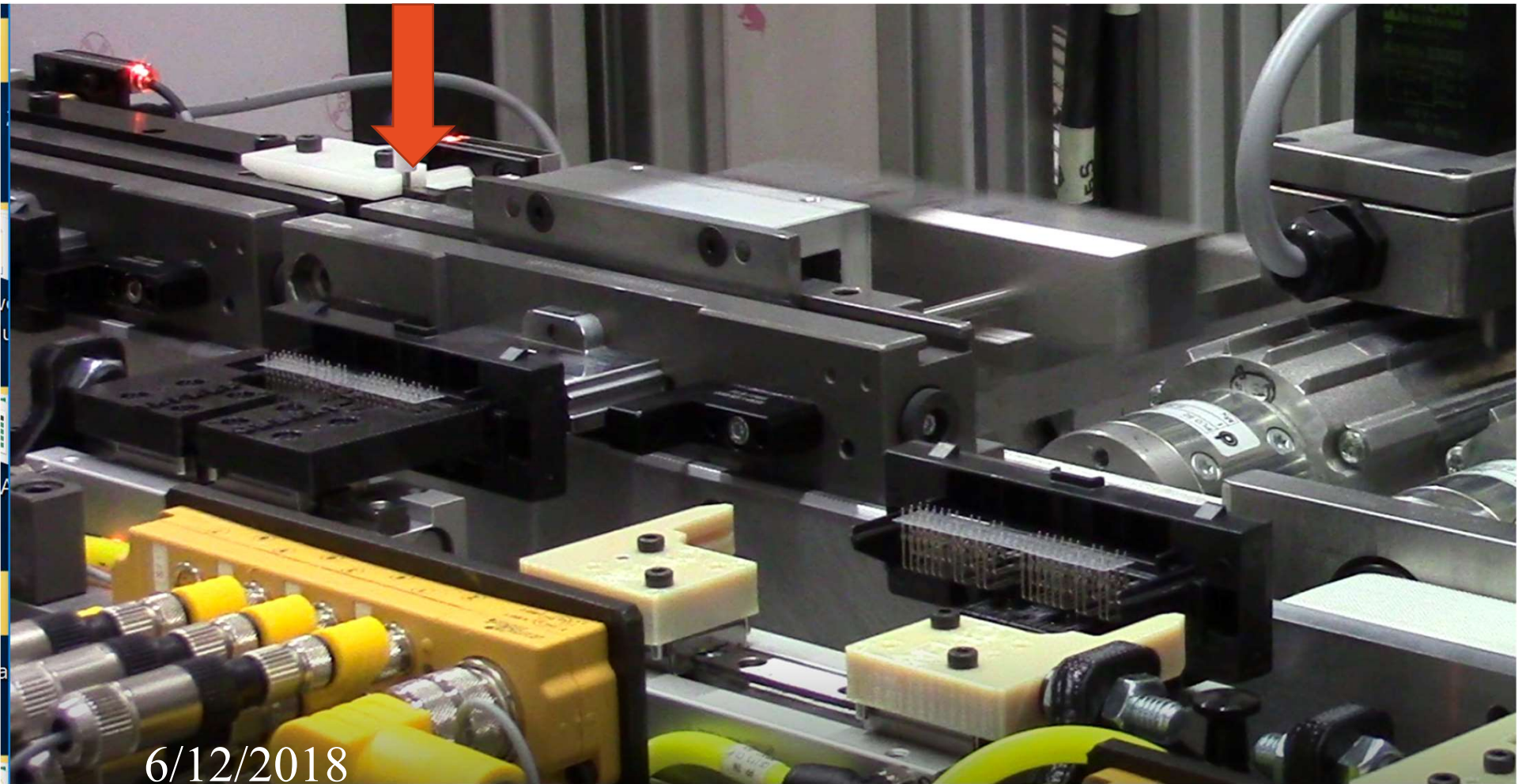
Automated Inspection Application

- Challenge
 - Part handoff from up stream system
 - Electrical interface to 60 pin header assembly
 - 3D inspection of part assembly
 - 2D barcode parts
 - Packaging parts in trays and stacking trays

Automated Inspection Application

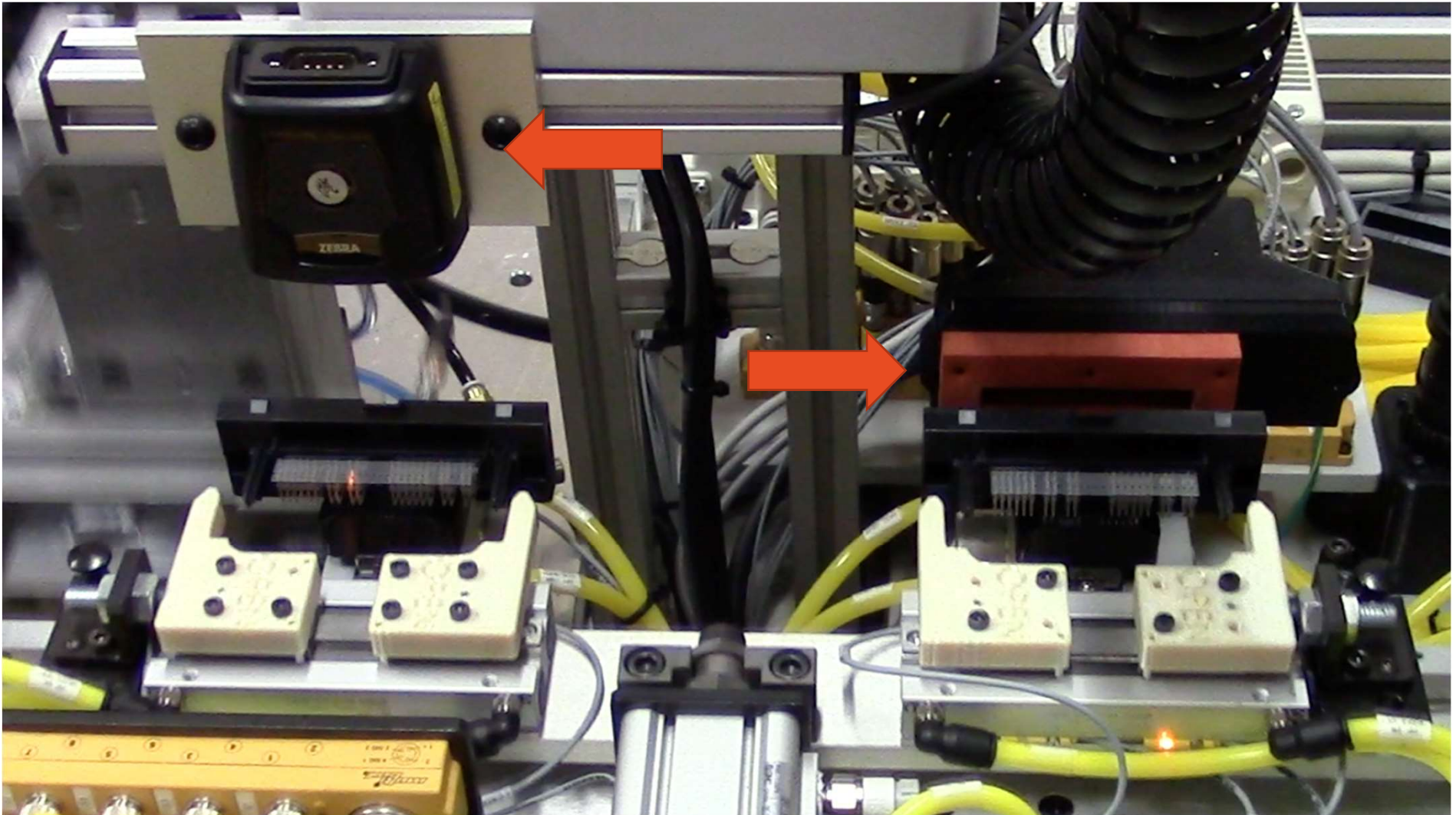
- Solution
 - Create multi-station system to accommodate the TAKT time constraints and all functional requirements

Input Material Handling

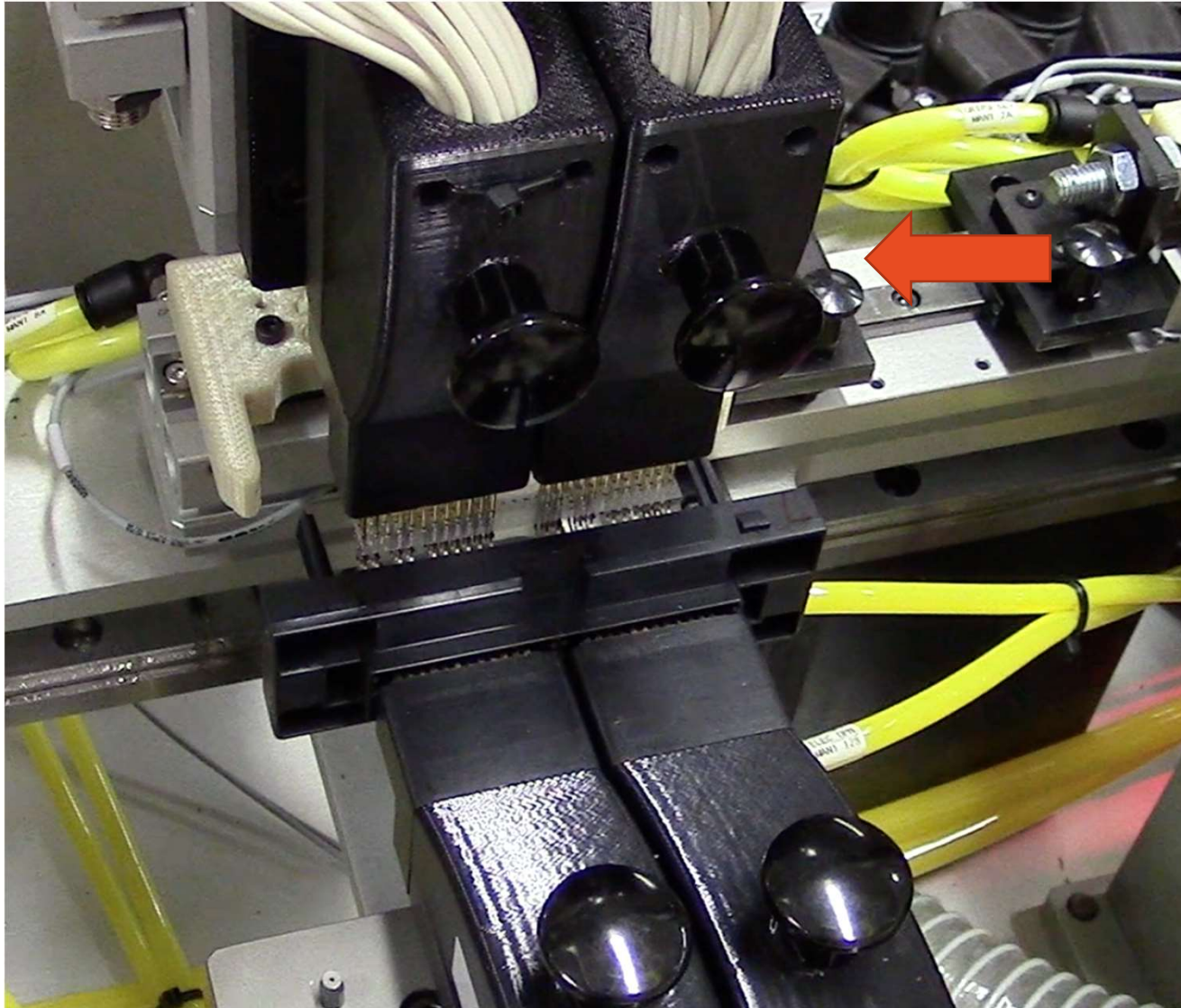


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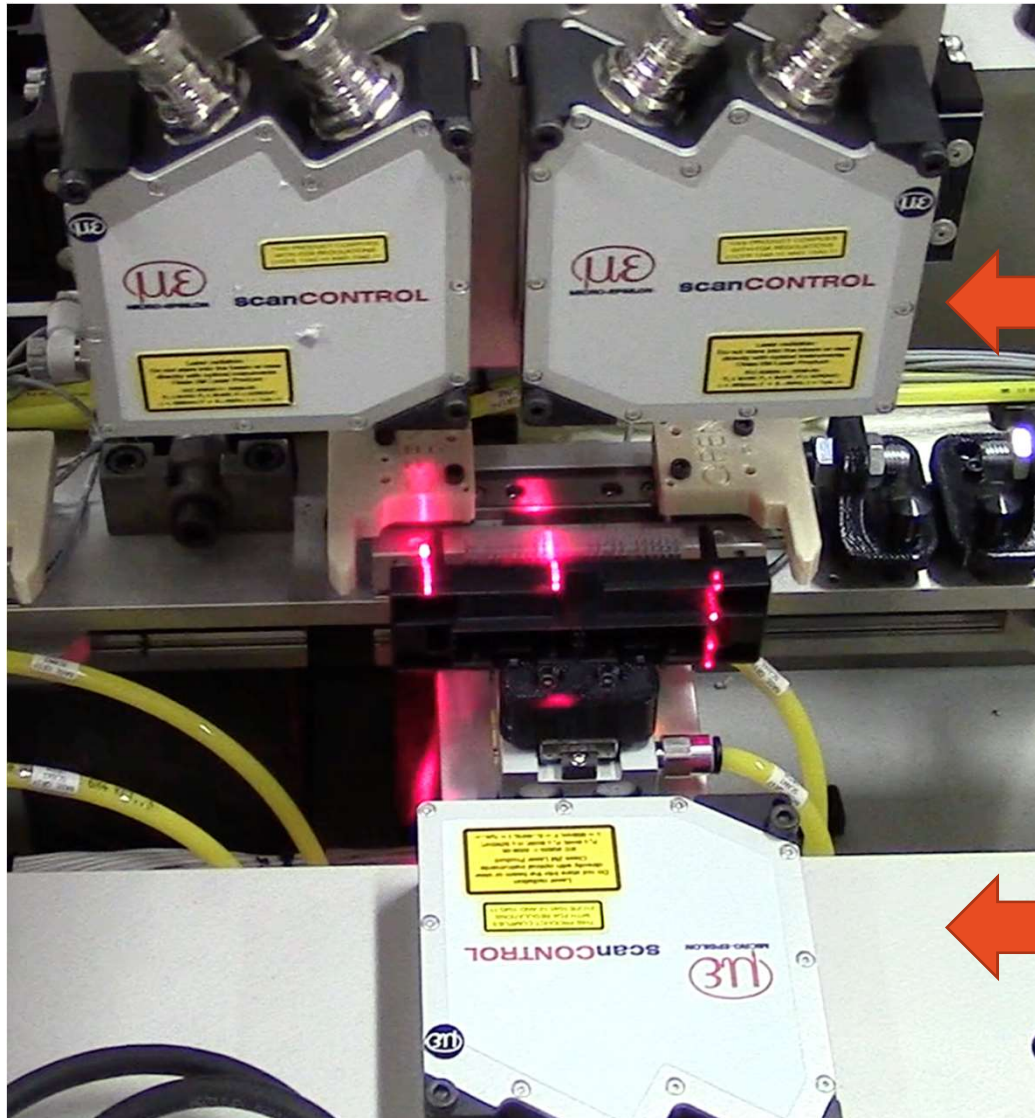
Cleaning Station



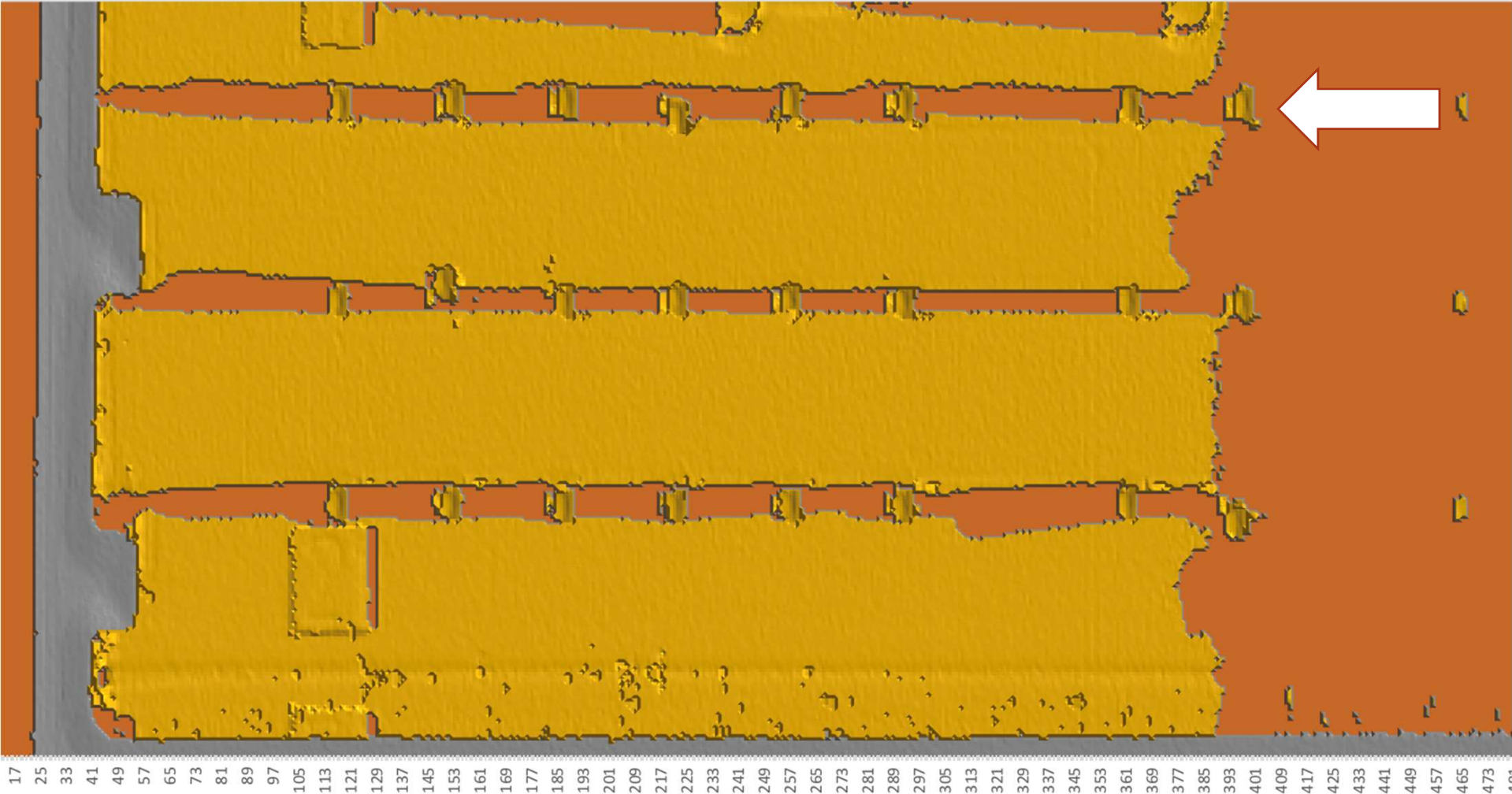
Electrical Test



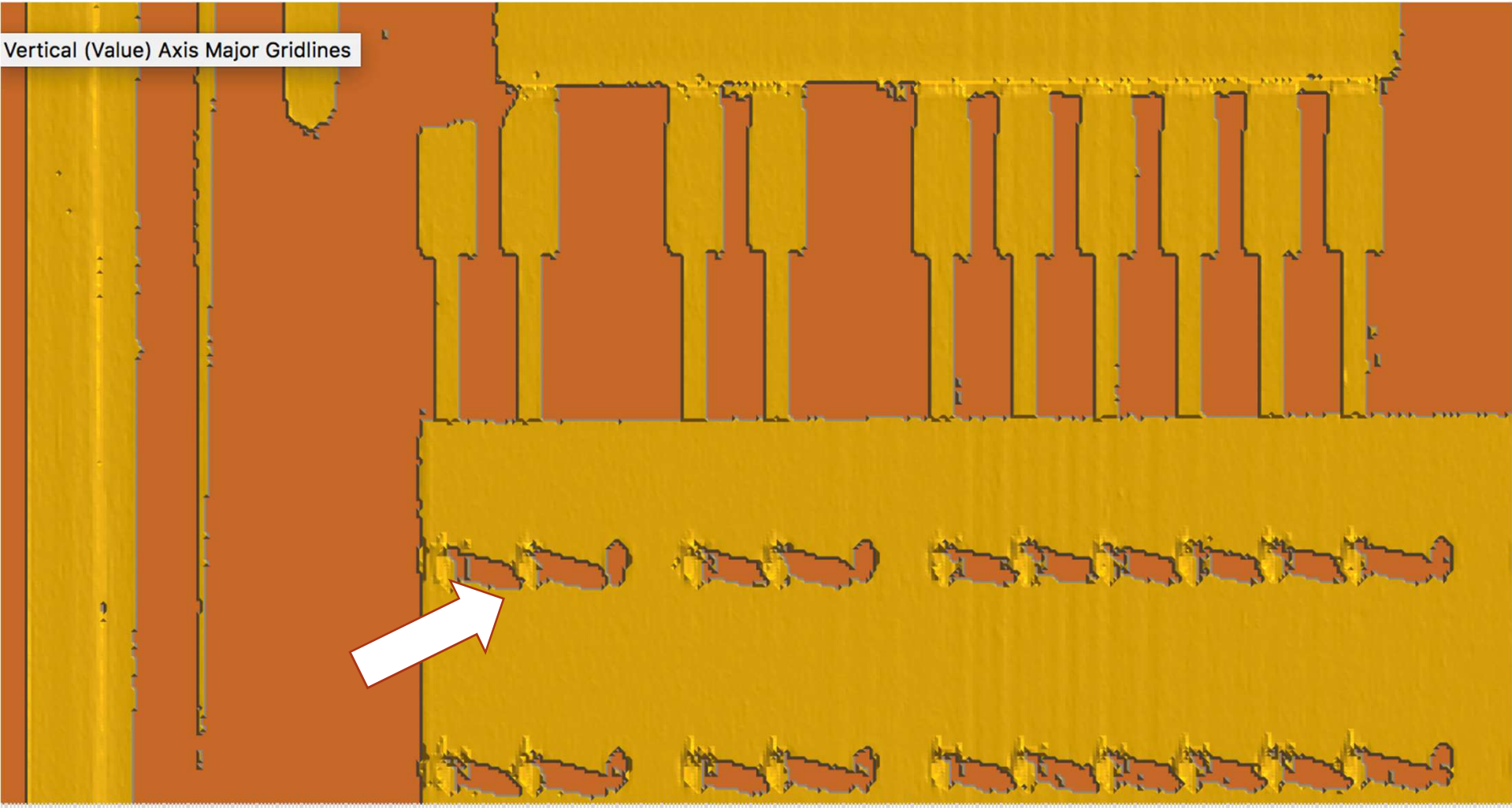
Inspection



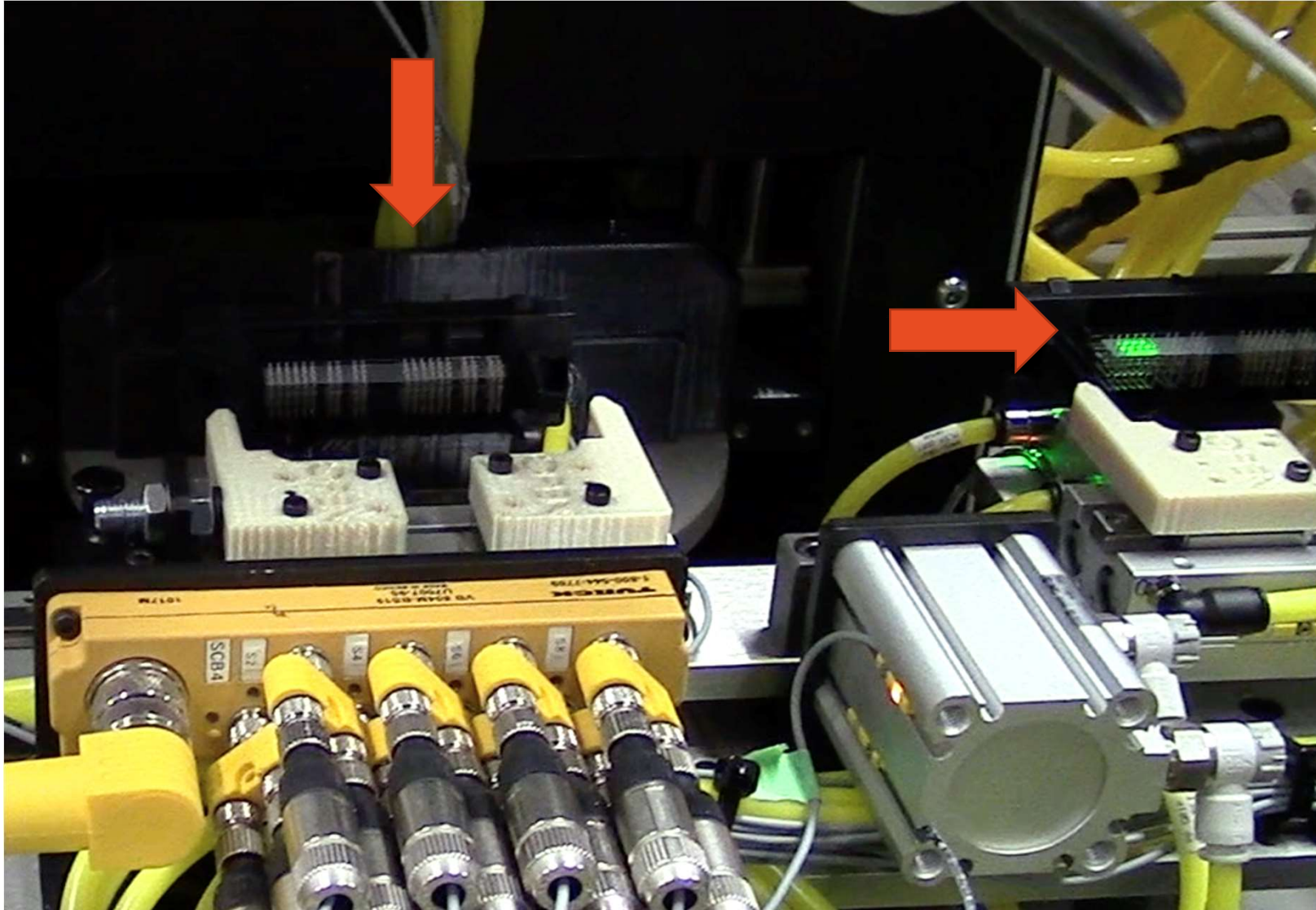
Inspection



Inspection



2D Barcode



Packaging



Summary

- Several 3D Inspection options
 - Structured light
 - Triangulation Laser
 - Time of Flight
- Advantages
 - Robust technologies can overcome inspection challenges
 - Color / background
 - Lighting limitations
 - Ability to detect surface features
 - Provides ability to collect measurement data
- Important to select the correct technology for the application, object, environment.

Thank you!

For more information:

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