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Intelligent Robotics & Machine 3D Vision

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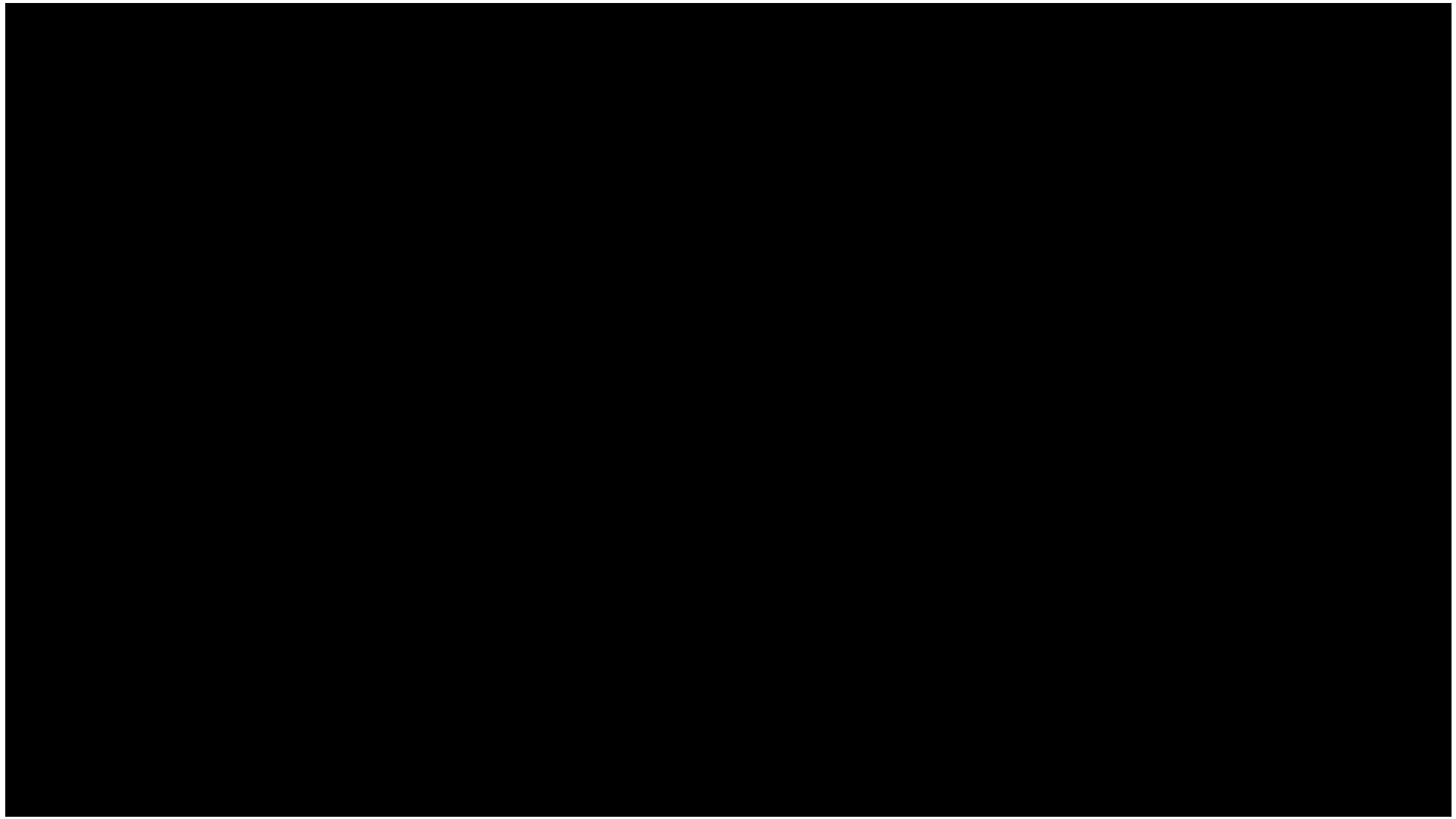
FANUC America Corporation

MANUFACTURING™ TECHNOLOGY SERIES

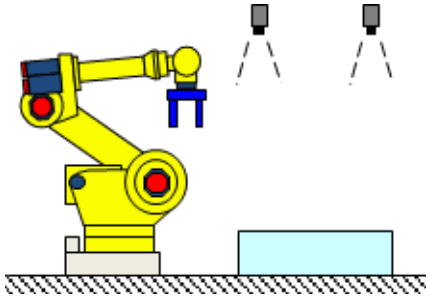
FANUC 3D Video



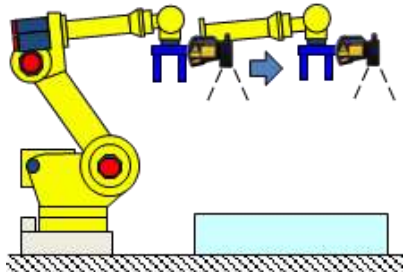
*i*RVision Overview

- *i*RVision is fully integrated into every FANUC controller
- Seamless and immediate interface with the robot
- Automatic 2-way data communications between *i*RVision and robot
- Eliminates the need for 3rd party intermediate software and components

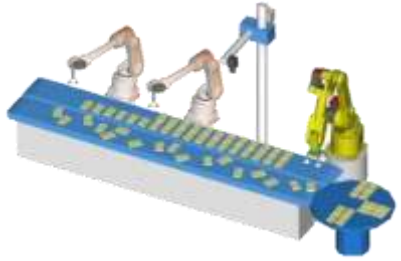
iRVision Overview



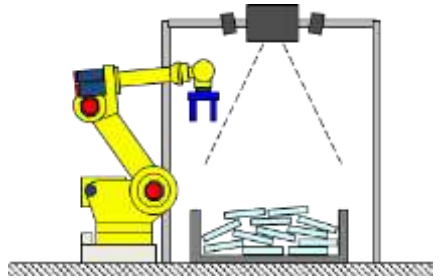
2D Fixed



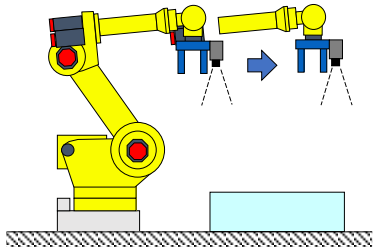
3DL Robot Mounted



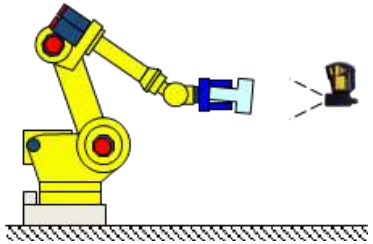
Visual Tracking



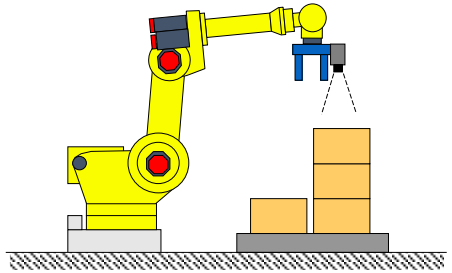
3D Area Sensor
Bin Picking / Depalletzing



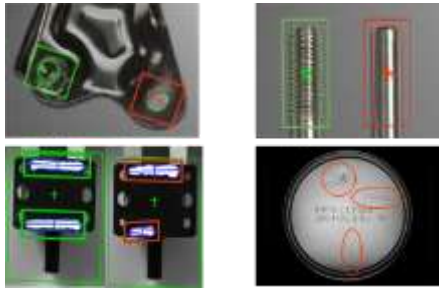
2D Robot Mounted



3DL Fixed



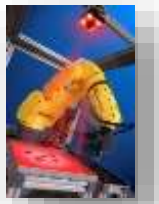
2.5D Depalletizing



Defect Detection

Vision Processes

- Full range of vision processes tailored to inspection, 2D, and 3D guidance applications
- Vision process
  - Streamlined setup of application specific vision tools
  - Allows creation of multiple vision tools and child tools



2D/3D Guidance

Visual Line Tracking

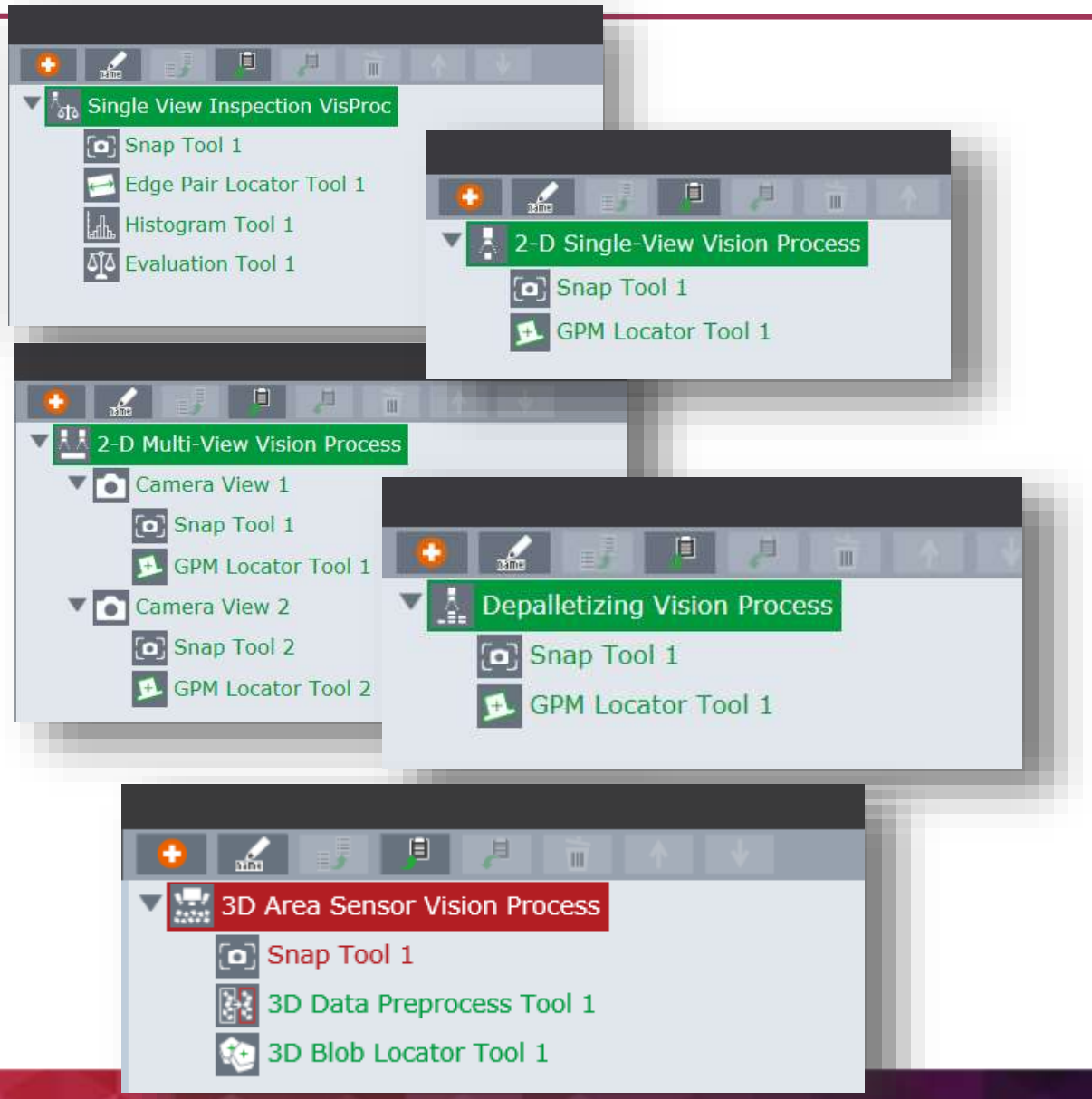
Bin Picking

Color Handling Detection

Inspection

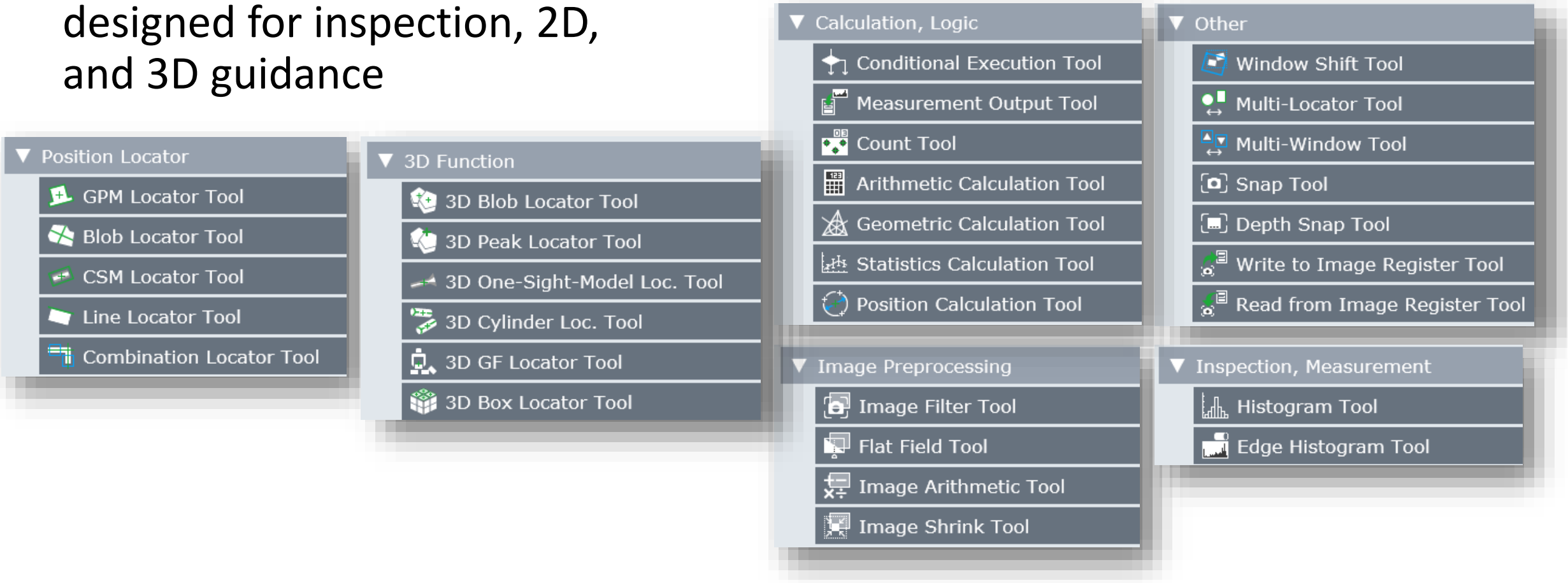
Vision Processes

- The *i*RVision vision process
  - Provides a top down tree-like approach to solving your vision problem
  - Easier to use and understand yet customizable for greater flexibility and reliability
  - Only applicable tools are accessible during development
  - Featuring Inspection, 2D Guidance, and 3D Guidance with many powerful options



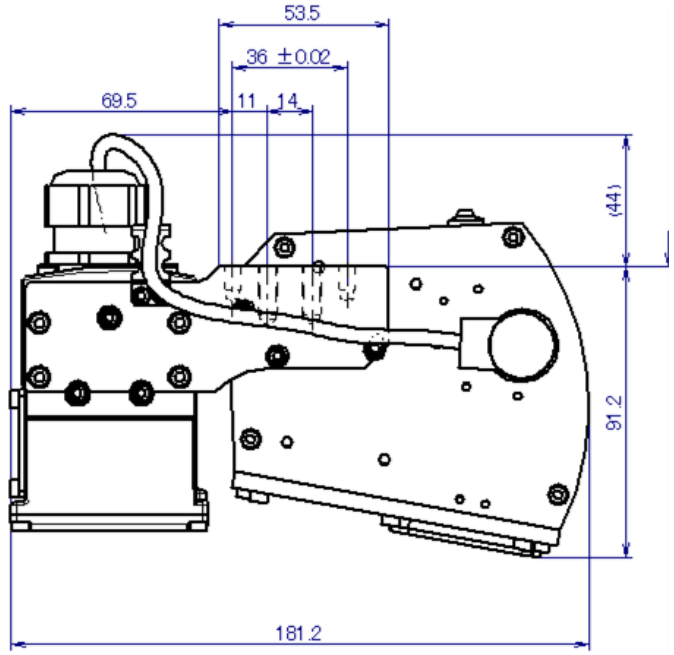
Vision Tools

- Full range of vision tools designed for inspection, 2D, and 3D guidance

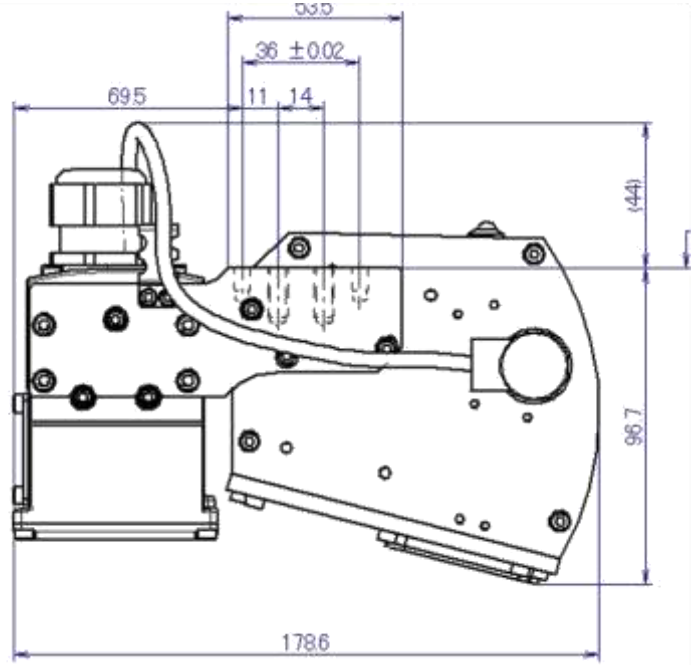


iRVision 3D Laser Sensor 3DL

Lens	12mm		16mm	
Stand-Off	400mm	600mm	400mm	600mm
FOV mm (inch)	250 X 190 (9.8 X 7.5)	363 X 272 (14.3 X 10.7)	187 X 141 (7.4 X 5.5)	363 X 272 (14.3 X 10.7)
Precision	XY: ±0.1mm, Z:±1mm, W&P: ±1°			
Environmental	IP67 equivalent			



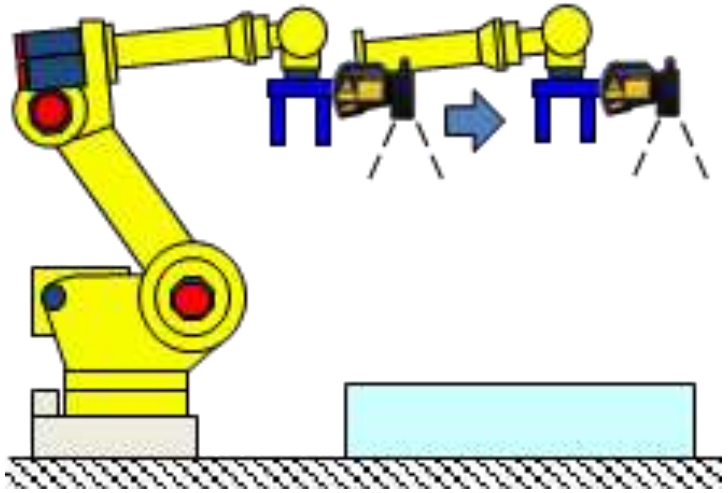
400mm Setup



600mm Setup

iRVision 3DL – Use Case

Long Part Location

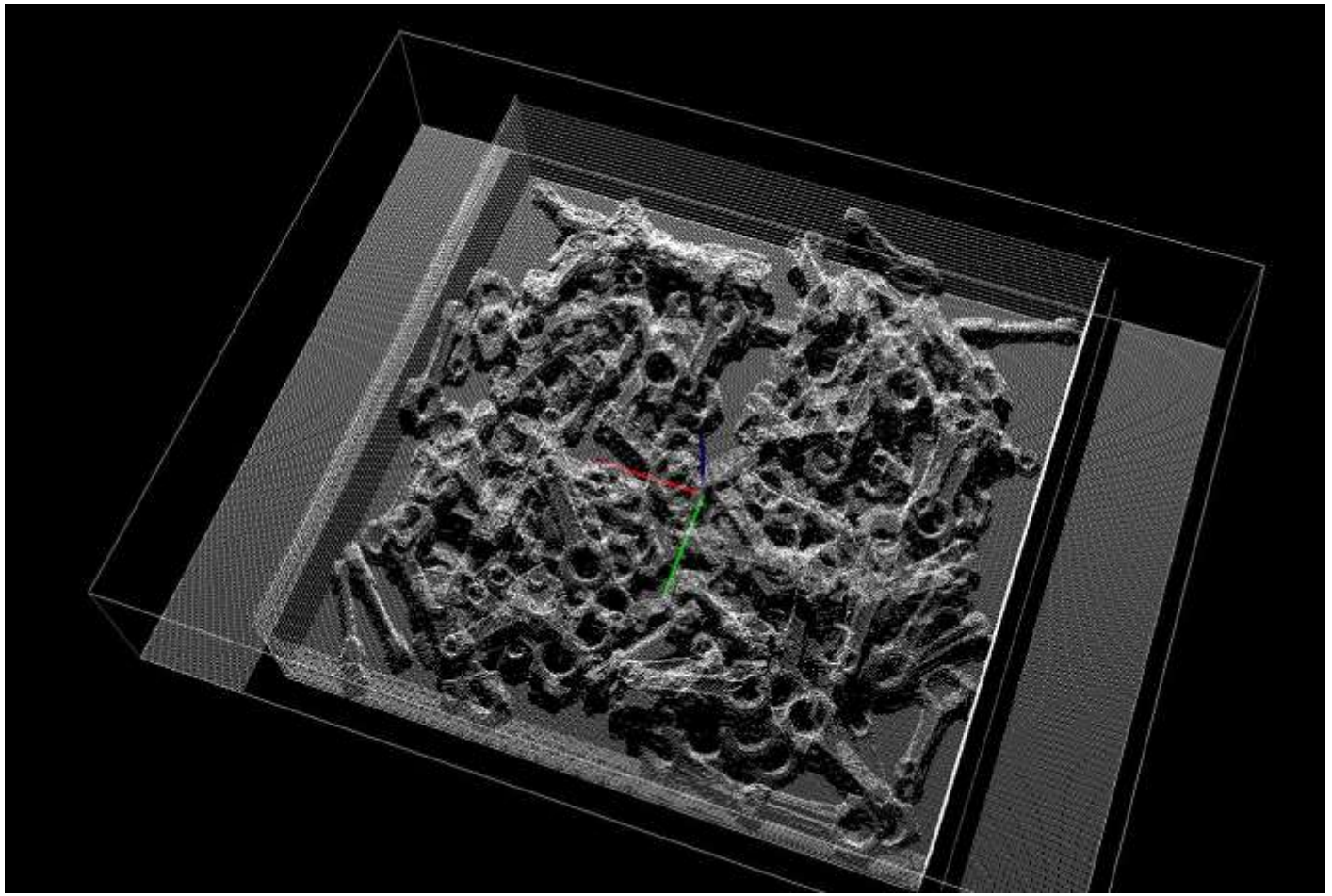


iRVision 3DL – Use Case

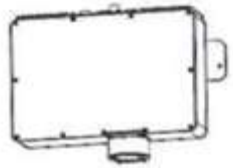
Frame Creation

3 Point
(Origin, X, Y)

*i*RVision 3D Area Sensor 3DA/1300



iRVision 3DA/1300

Type	3DA/1300
Projector Appearance	
Measurement Range[mm] (W x D x H)	400 x 300 x 300 to 1340 x 1000 x 1000
Measurement Time	2 ~ 3 sec. (depending on setup)
Measurement Resolution in Height direction (Z)	Z : +/- 2.3mm (for measurement range 1340 x 1000 x 1000)
Number of 3D Points	Normal Mode 45,000 points (239 x 192) High Speed Mode 45,000 points (119 x 96) High Density Mode 45,000 points (479 x 384)
Number of Sensors	Up to 4 per robot controller
Installation Environment	Ambient Temperature : 0 to 45 degrees C Normally max. 75% RH or less (No dew, nor frost allowed) Short term max. 95% RH or less (within one month) Vibration : 0.5G or less

iRVision 3DA – Use Case

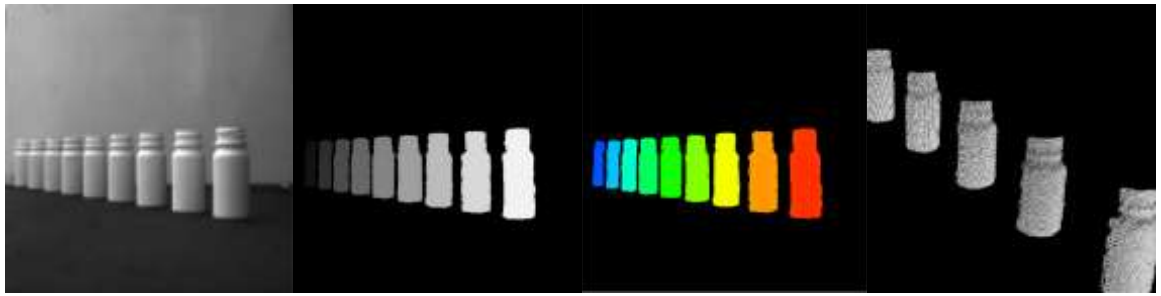
Large Bin Picking

iRVision 3DA – Use Case

Depalletizing

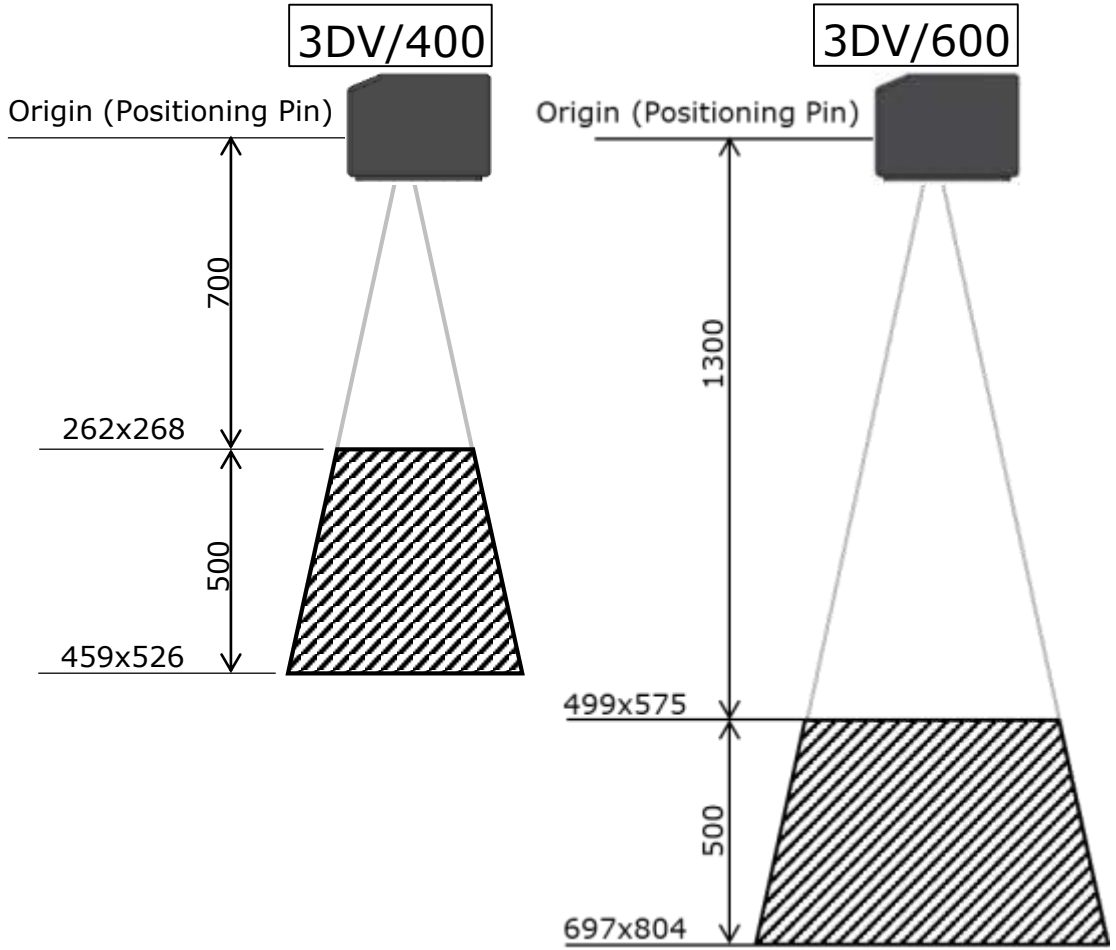
iRVision 3D Vision Sensor 3DV

- Robot or fixed mount
- Single snap 3D imaging
  - Multi-image modes
- Supports snap-in-motion
- 3D Visual Line Tracking
- Single CXV Cable
- Two FOV Sizes 3DV/400 & 3DV/600

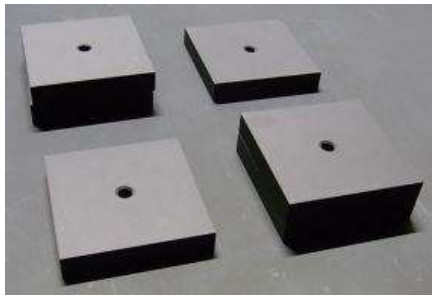


iRVision 3DV

	3DV/400	3DV/600
Acquisition Time	70ms[1] + Exposure Time	
Resolution	950×1104 pixel	
Depth Accuracy	> ±0.5mm[2]	> ±1.6mm[2]
IP Protection	IP67	
Working Temperature	0~45°C	
Life Time	Equal to robot	



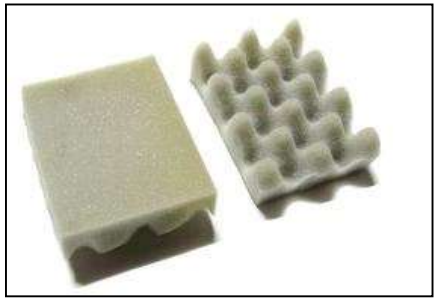
iRVision 3DV



Low Contrast Part Height

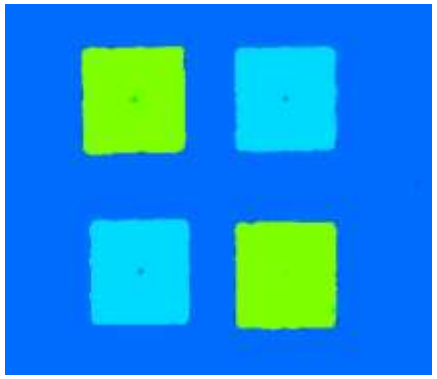
Convex/Concave

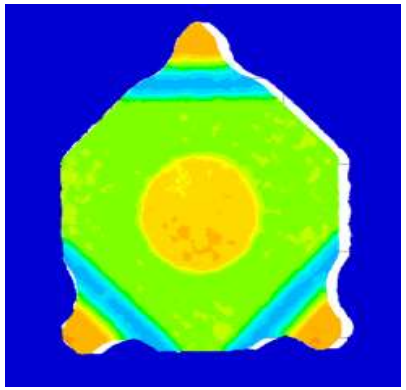
Part Presence

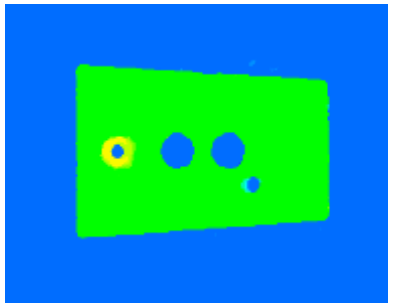


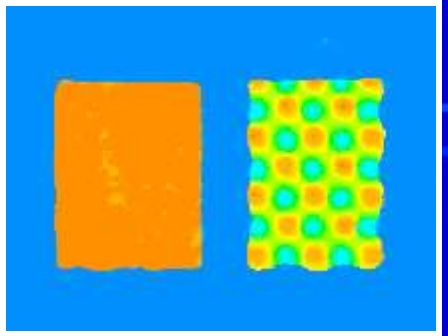
Orientation

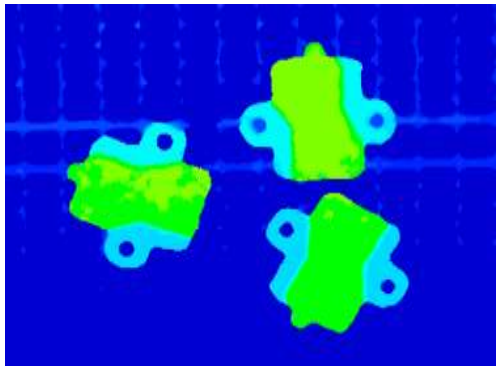
Noisy Background



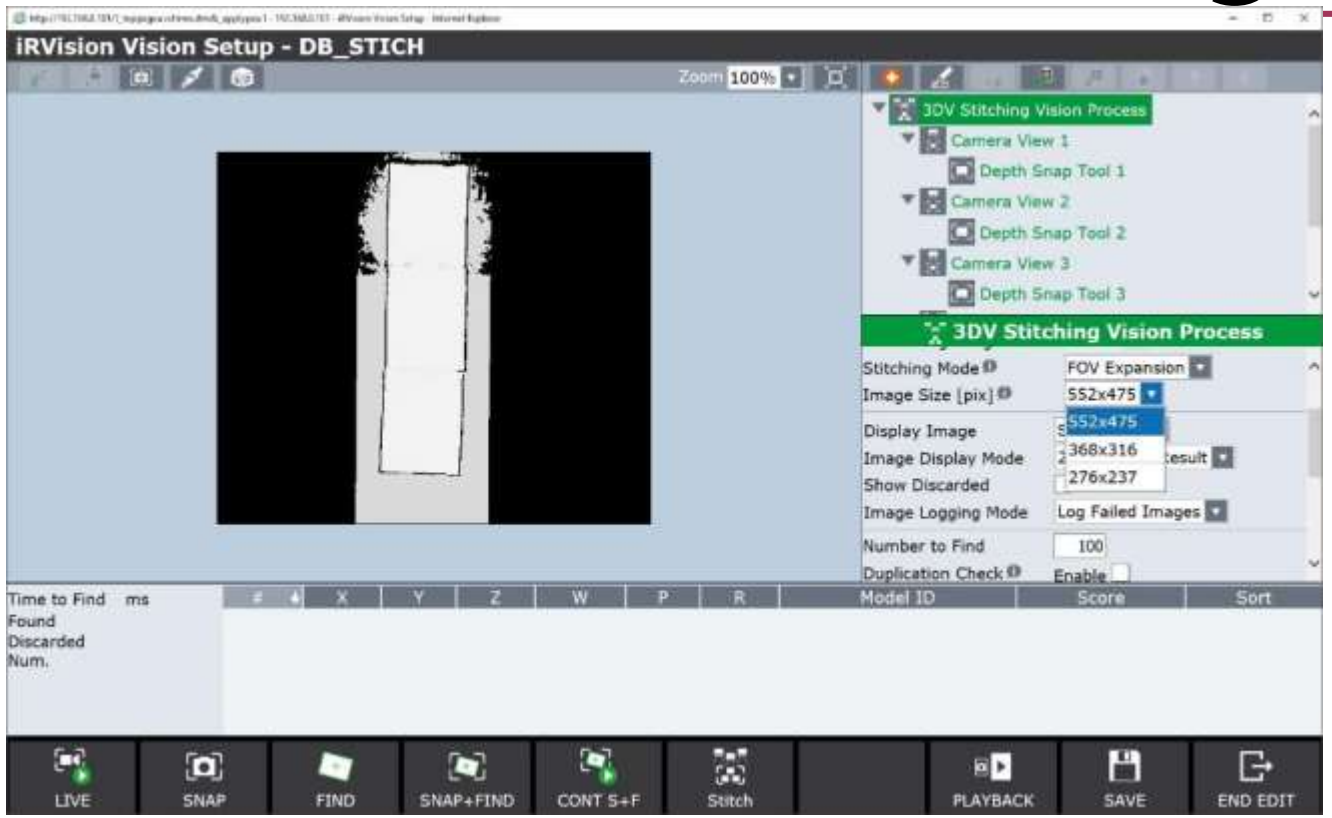




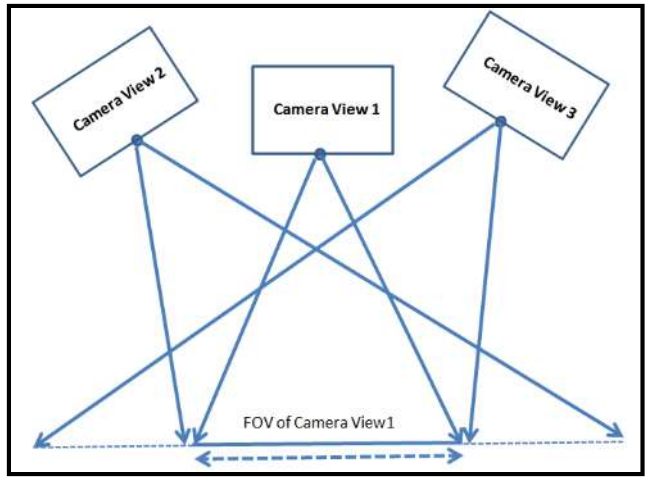




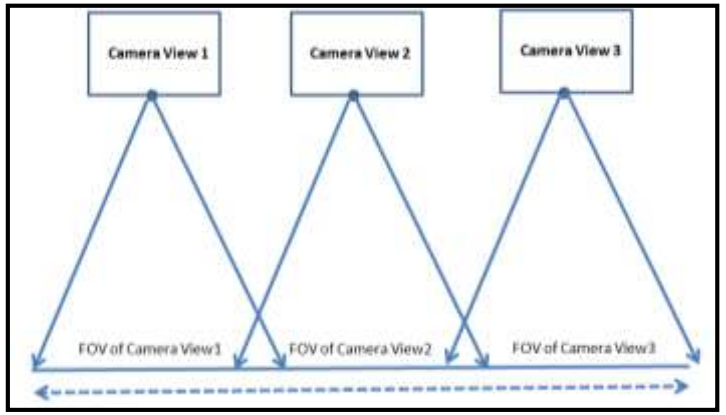
iRVision 3DV Stitching




```
 1:  UFRAME_NUM=3 ;
 2:  UTOOL_NUM=3 ;
 3:L P[1] 500mm/sec FINE    ;
 4:  CALL IRVSTSNAP("Vision Process"='DB_STICH',"Camera View"=1) ;
 5:L P[3] 100mm/sec FINE    ;
 6:  CALL IRVSTSNAP("Vision Process"='DB_STICH',"Camera View"=2) ;
 7:   ;
 8:L P[2] 500mm/sec FINE    ;
 9:  CALL IRVSTSNAP("Vision Process"='DB_STICH',"Camera View"=3) ;
10:   ;
11:  CALL IRVSTRUNFIND("Vision Process"='DB_STICH') ;
12:  VISION GET_OFFSET 'DB_STICH' VR[1] JMP LBL[500] ;
```



FOV Interpolation

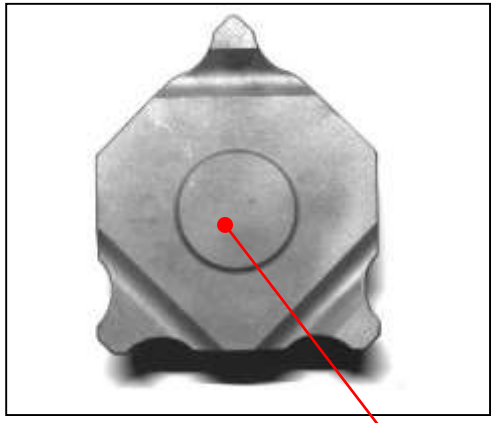


FOV Expansion

iRVision 3DV – Use Case

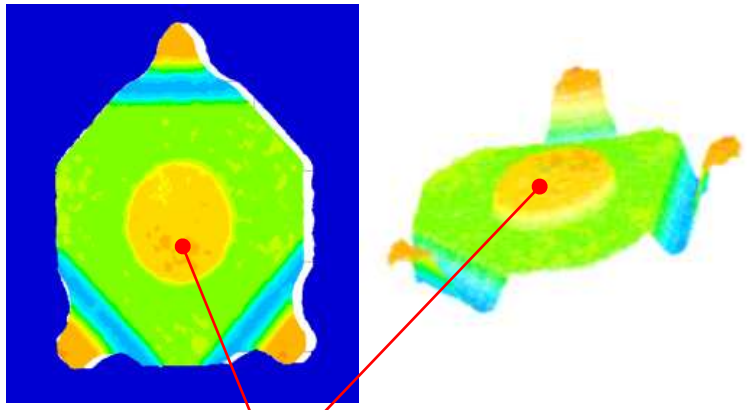
Concave / Convex Check

2D Image



It is hard to distinguish concave / convex

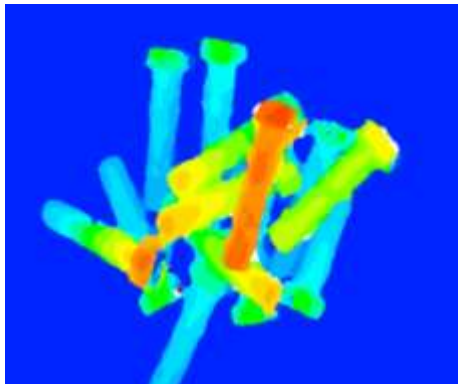
New 3D Sensor



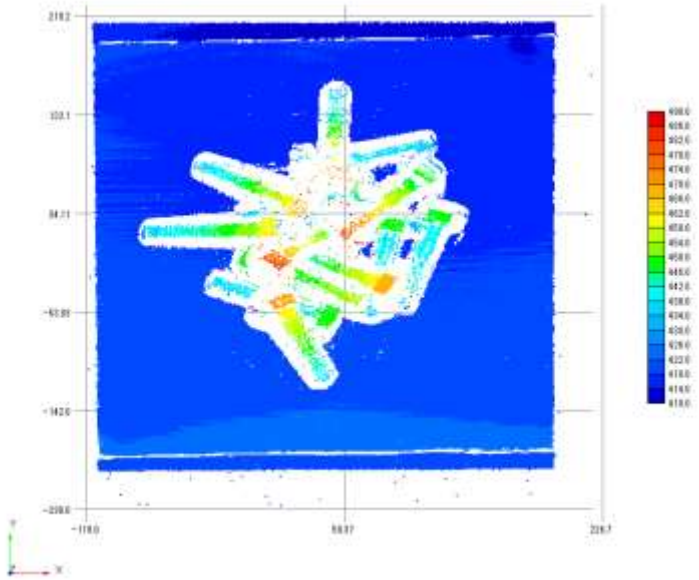
Height difference is clearly visible

*i*RVision 3DV – Use Case

Shiny Bolts



3DV/400 Depth Image

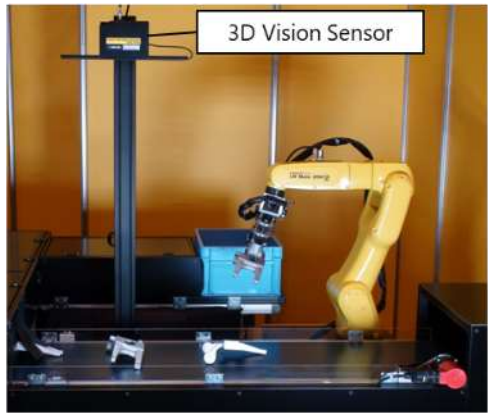


3DA/400

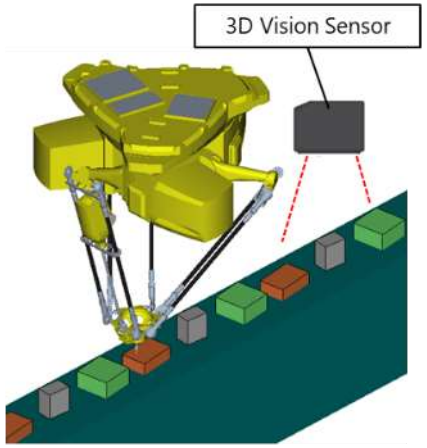
iRVision 3DV – Use Case

iRPickTool 3D Visual Tracking

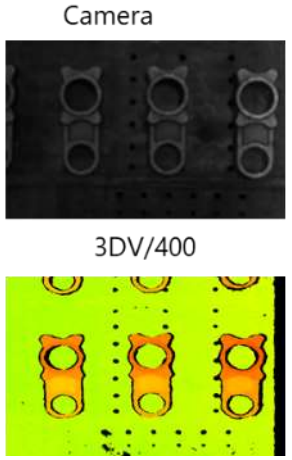
Application Example 1
Track the tilted parts.



Application Example 2
Track the various height parts.



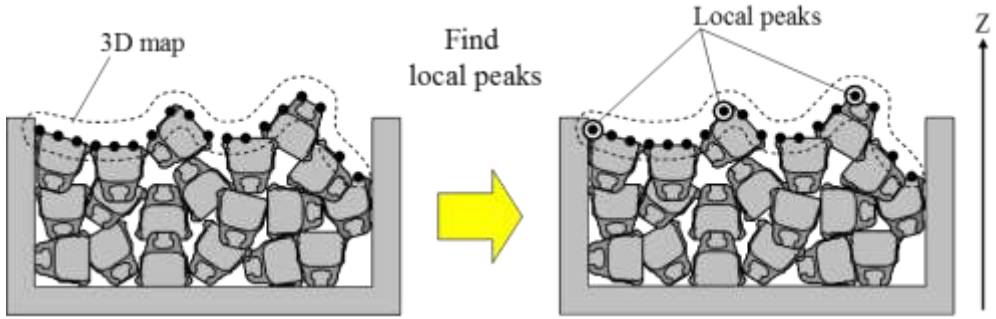
Application Example 3
Track the parts in unclear scene.

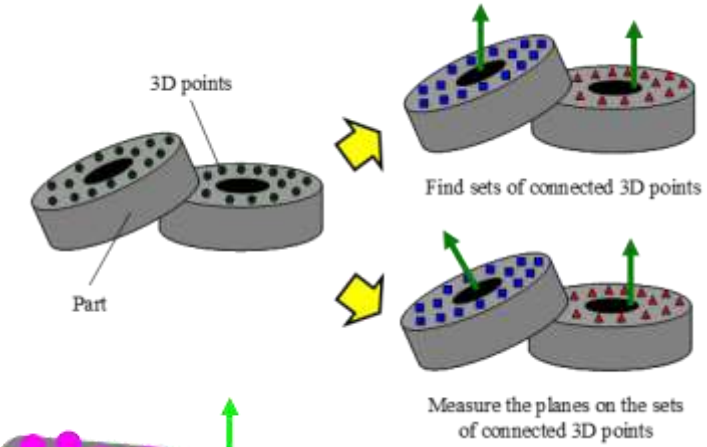


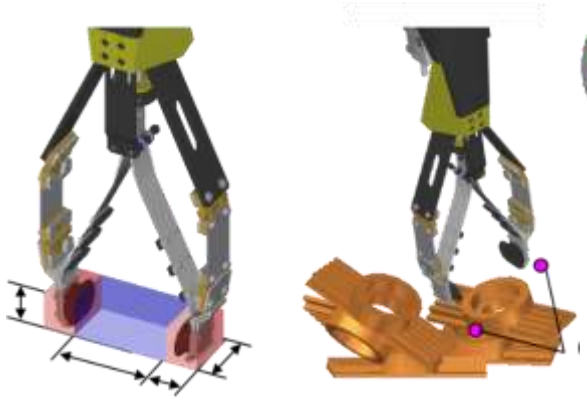
- <500mm/sec conveyor speed has been tested with good results.
- Any 3DV tracking application should be reviewed by FANUC

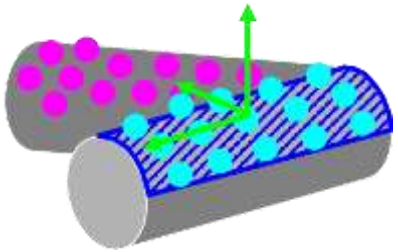
iRvision 3D Location Algorithms

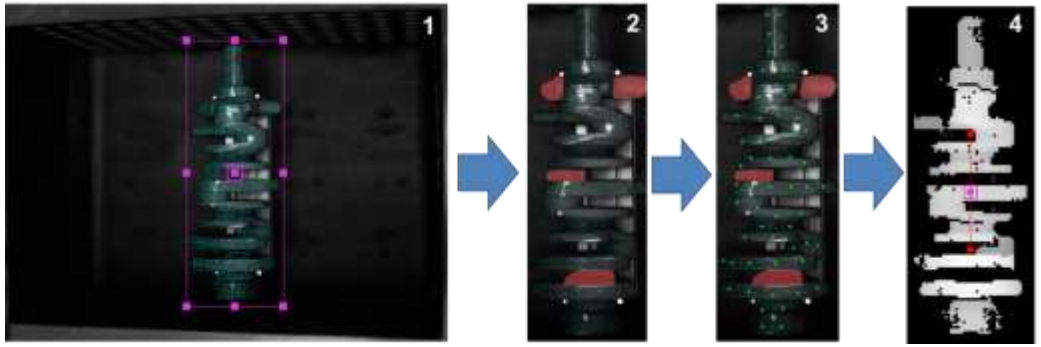
- Peak
- Area Blob
- Cylinder
- Curved Surface
- Gripper Finger
- Box Locator
- Model Matching

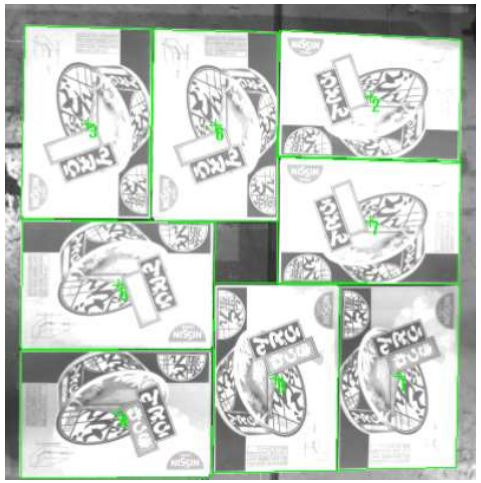






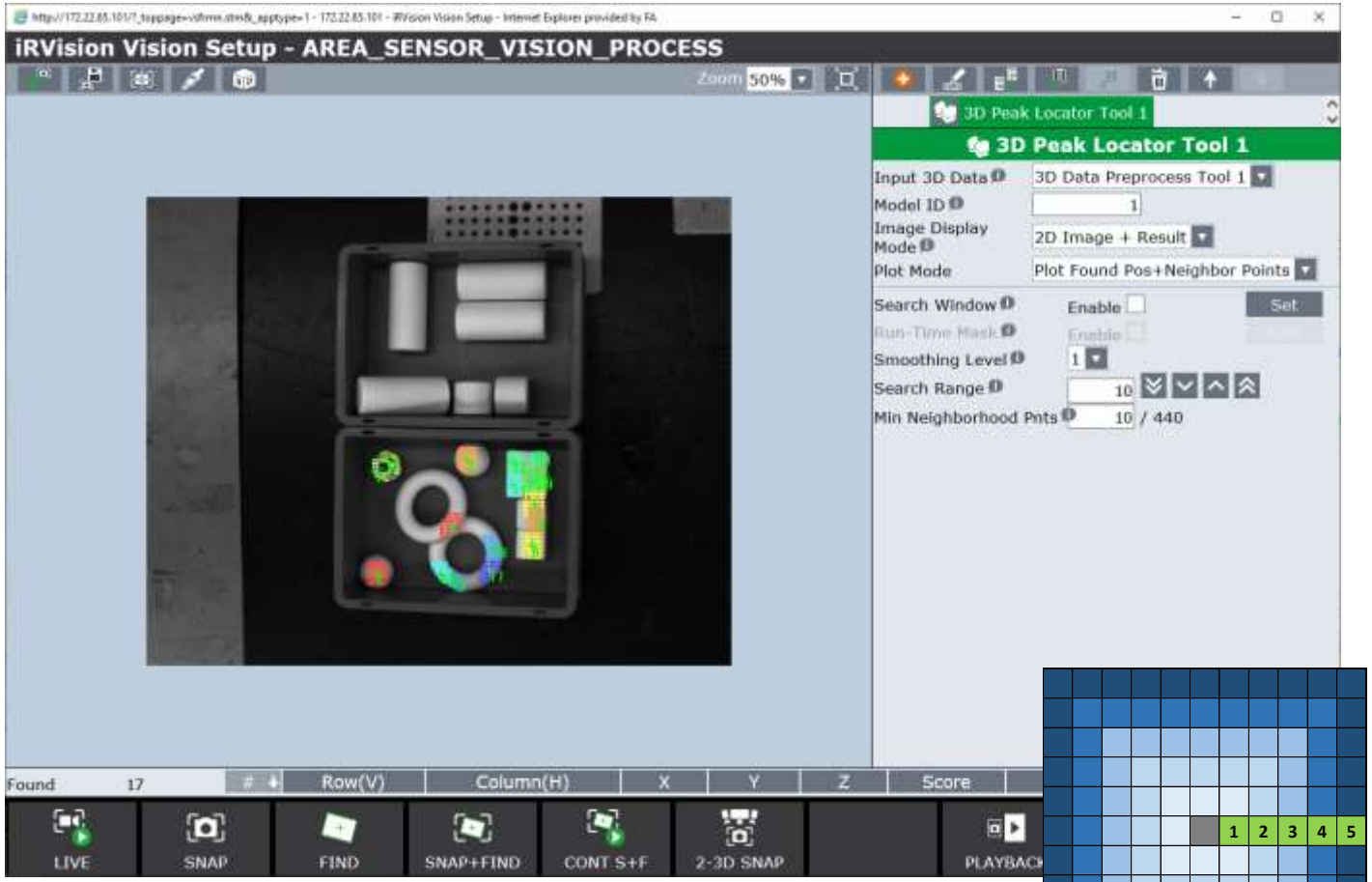






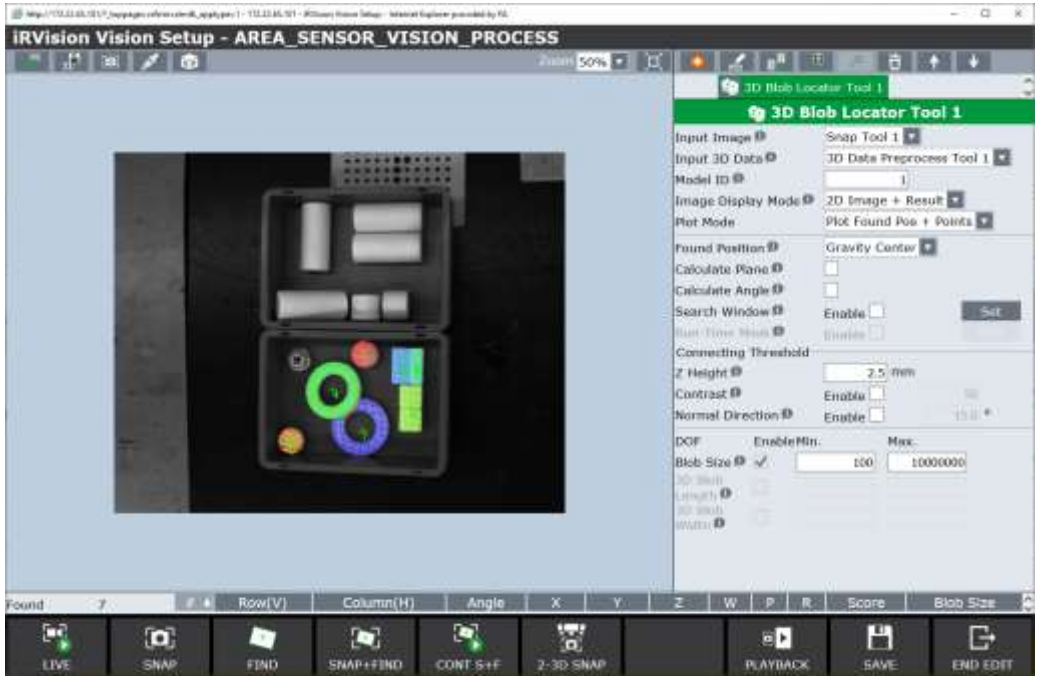
Peak

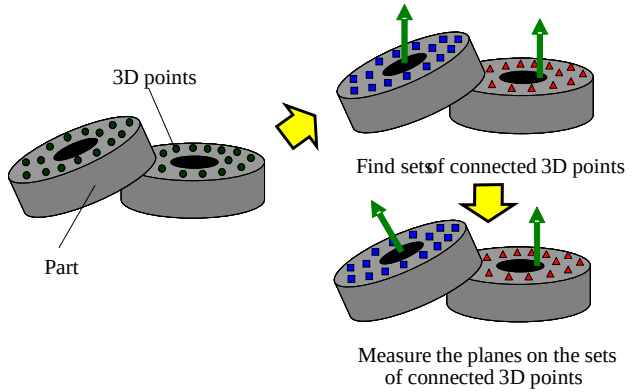
- Only provides X, Y, Z
- Local peaks
- Good for general part detection



Blob

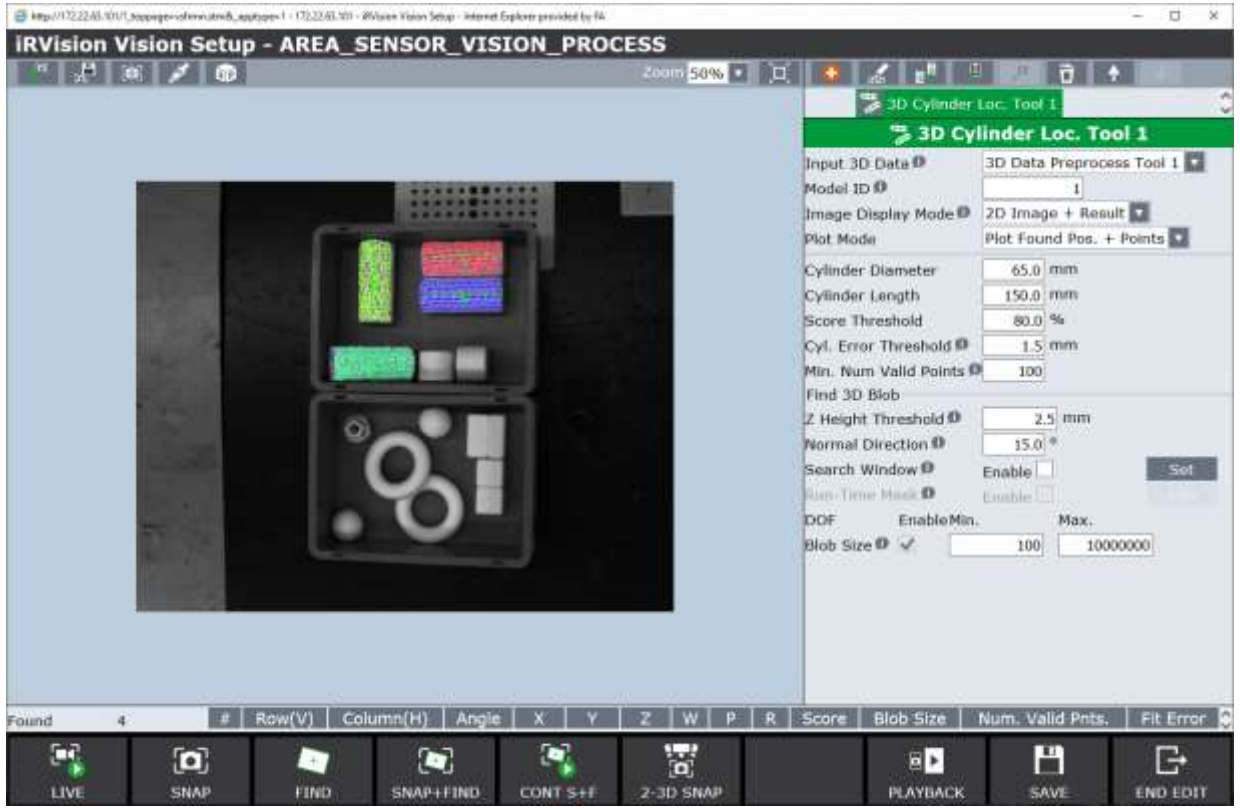
- Highly versatile tool
- Find continuous surface
  - Separation methods:
    - Z Height (Default – cannot be disabled)
    - Contrast
    - Normal Direction
  - Orientation definition
    - Plane fit (adds W, P)
    - Angle calculation (adds R)
  - Found Position
    - Gravity Center (X, Y, Z) (Default)
    - Minimum Rectangle (forces plane and angle)
    - Dense Pos
    - Hole Pos (Hole Posture) (no angle)
    - Hole Pos (Part Posture)

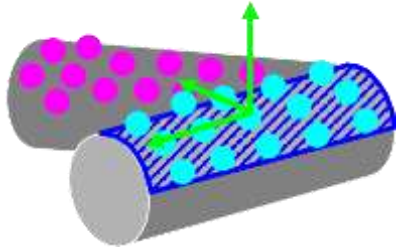




Cylinder

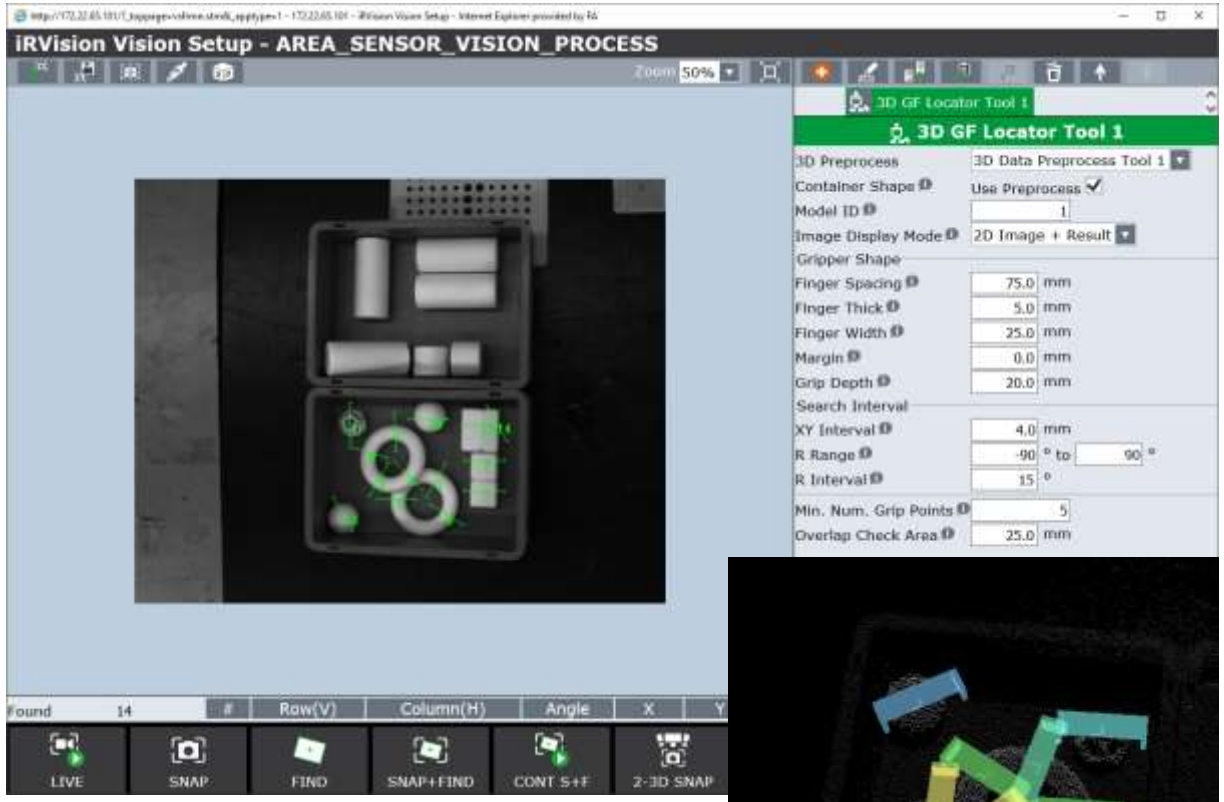
- Locates cylinders
- X, Y, Z, W, P, R
- Based on blob tool
- Define Cylinder Diameter and Length





Gripper Finger

- No part criteria specified!
- Dimensions for two finger parallel gripper
- X, Y, Z, R
- High flexibility – no orientation

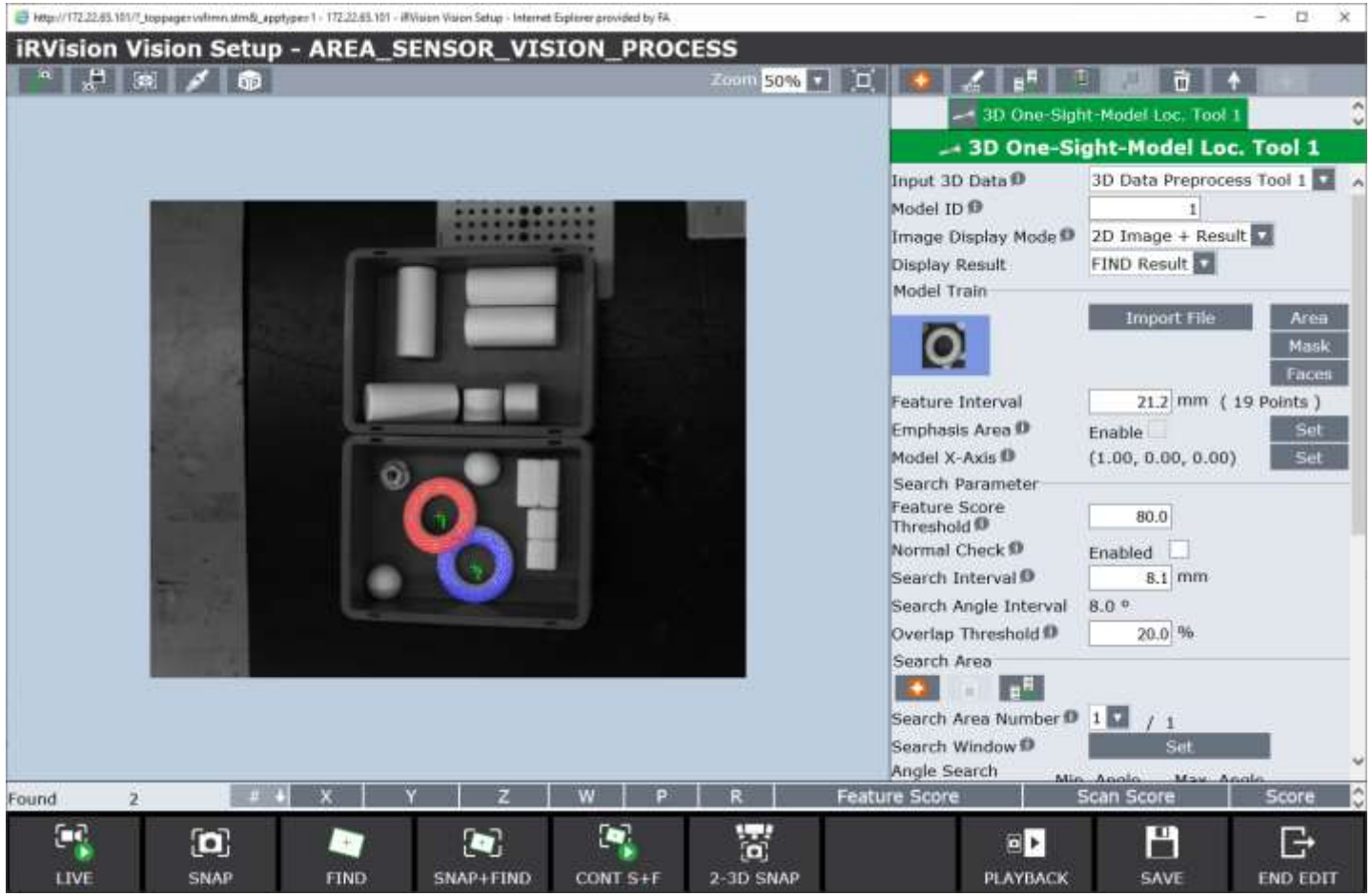


Box

- Uniform load box depalletizing
- Requires box dimensions
- Requires 2D image with good contrast
- Locates boxes on top layer only
- X, Y, Z, W, P, R

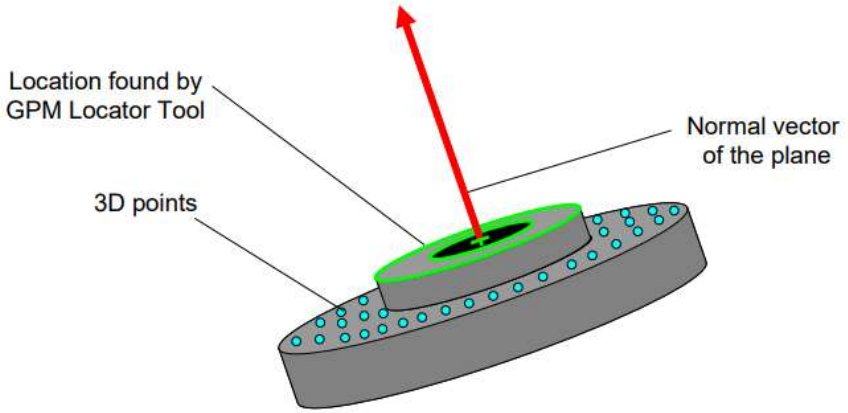
One Sight Model

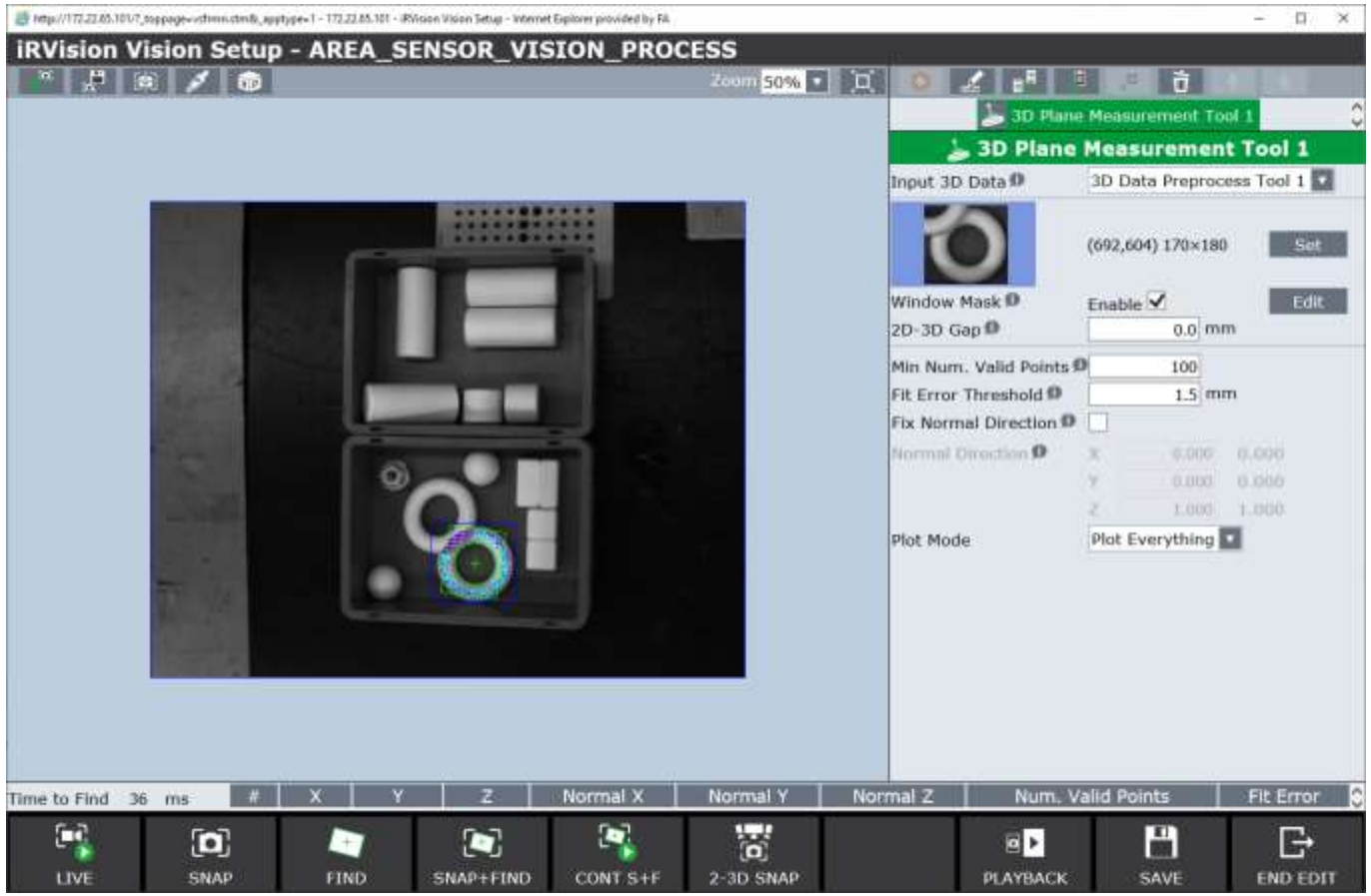
- Train 3D model of part from sensor or CAD
- Locate model in 3D
- X, Y, Z, W, P, R
- Needs a tool per side



Plane

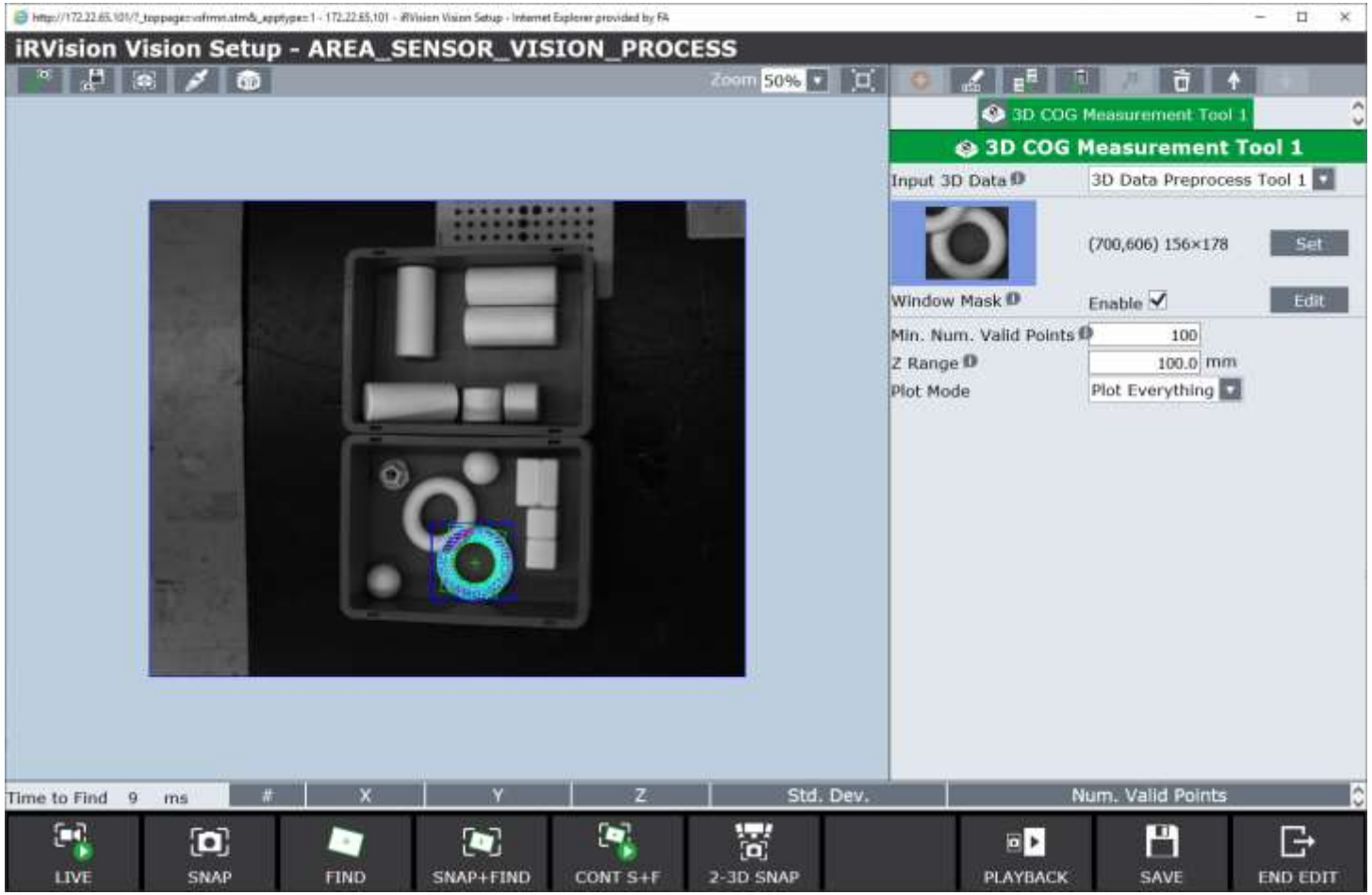
- Finds a plane based on 2D GPM or CSM Locator
- Adds Z, W, P
- Choose to fix normal direction
- 2D-3D gap





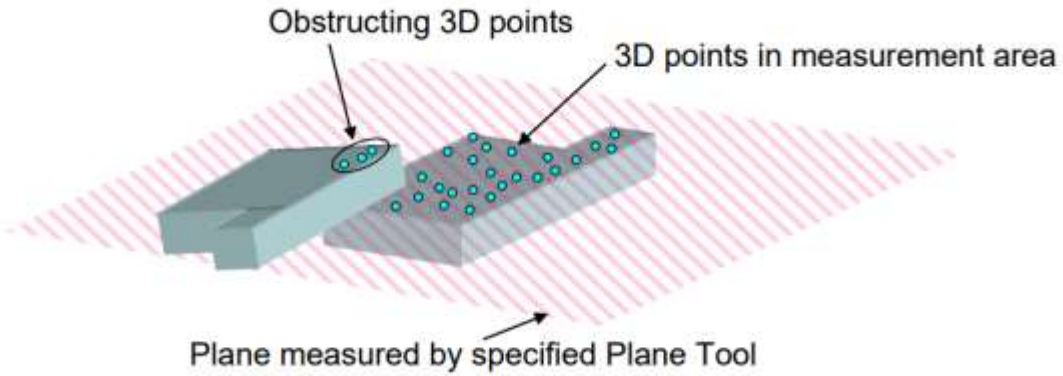
Center of Gravity

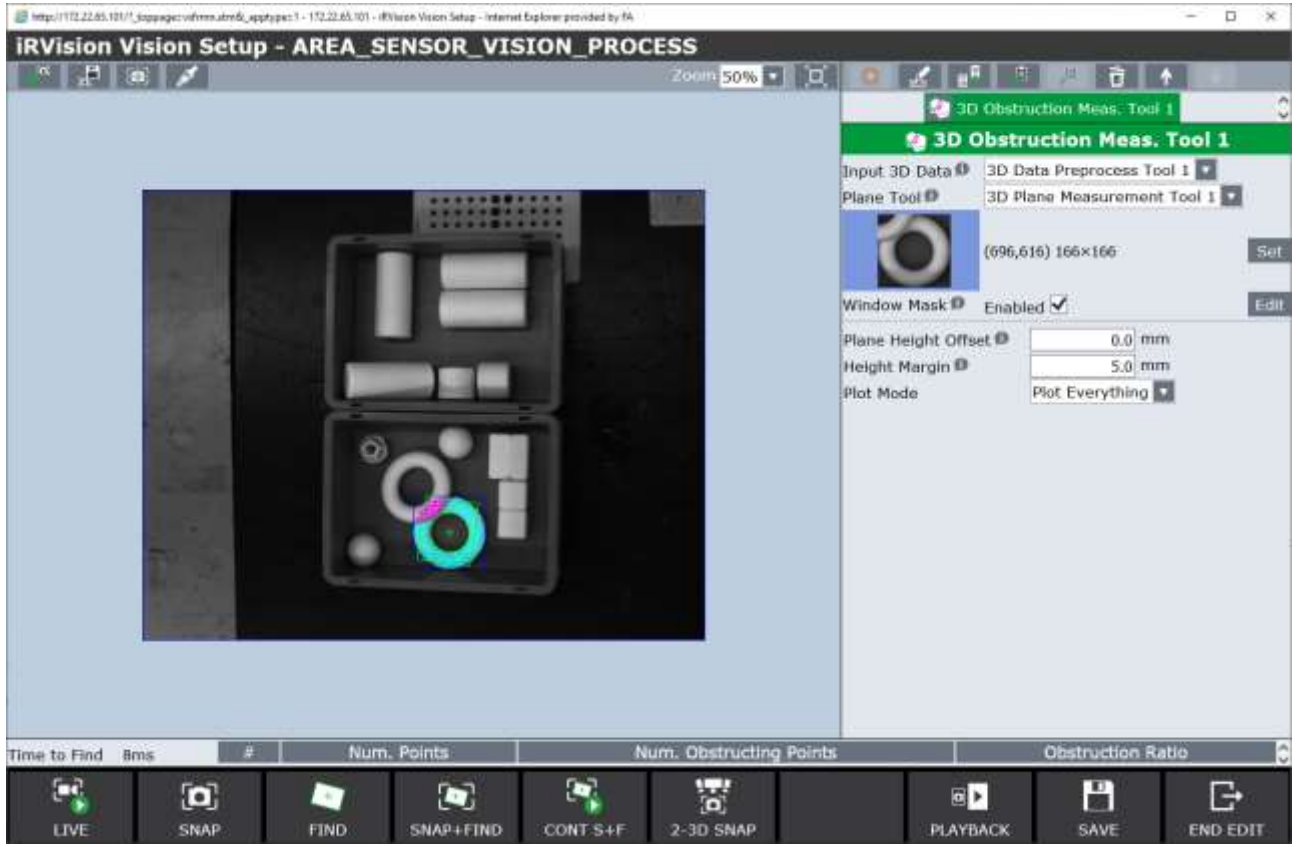
- Finds CoG for 2D GPM and CSM
- Adds Z



Obstruction Measurement

- Checks for obstruction relative to plane
- Requires plane to run
- Only provides data
- Requires Conditional Execution Tool





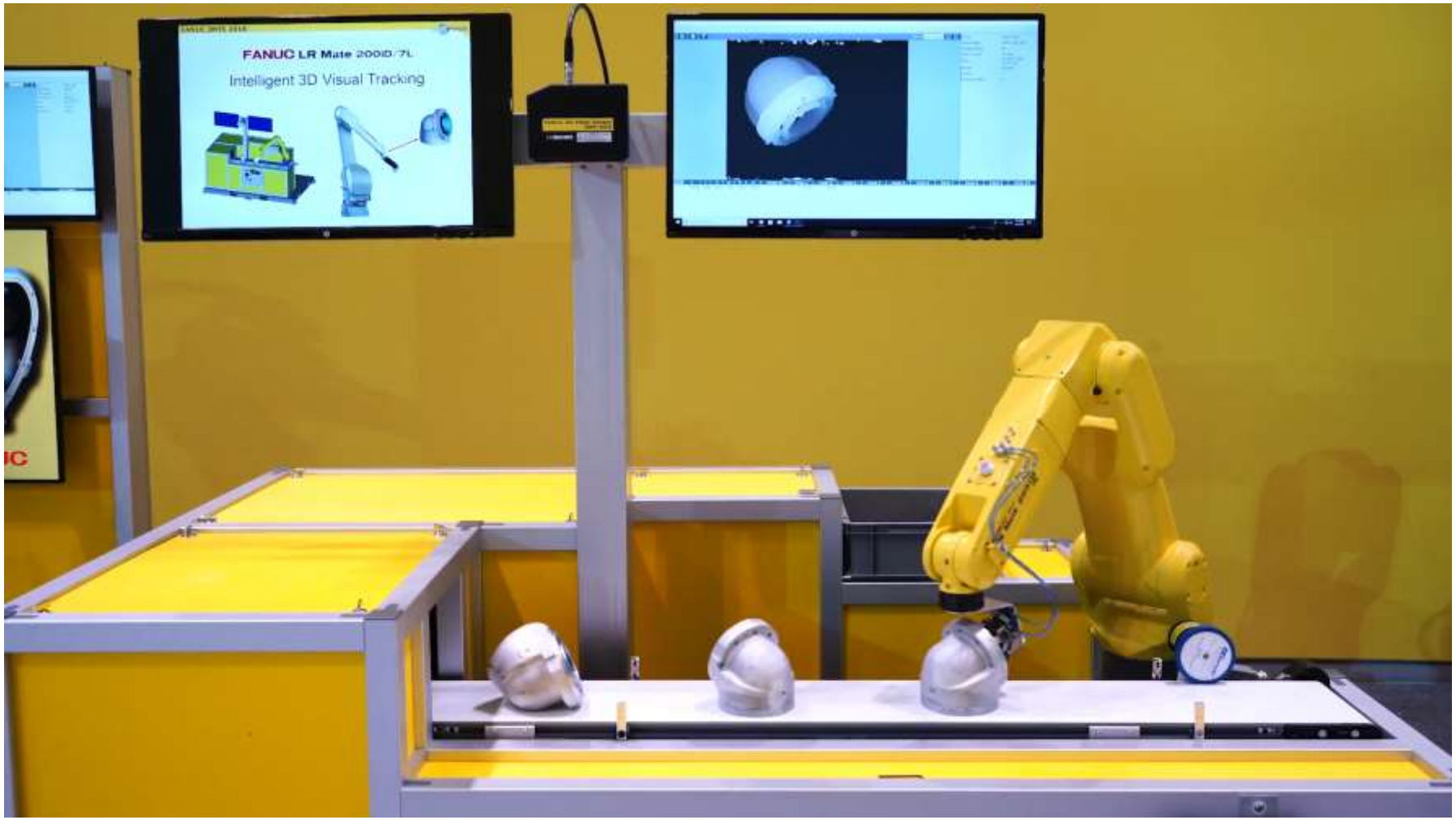
3DL Video

3DA Video

3DA Video

3DV Video

3DV Video



*i*RVision Summary

- Ease of integration
- Application-based processes
- Advanced processes and tools
- Service and support worldwide
- Single source

Questions

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