Intera 5.1 Vision Guide for Success

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Success with vision-based tasks in Intera relies on task selection, end effector design, and workcell configuration. Tradeoffs exist among pick accuracy, place accuracy, task speed, and environmental conditions.

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Vision Task Considerations

TASK ATTRIBUTE	Ideal	Max Recommended
Part positional tolerance	±4 cm	±13 cm
Part rotational tolerance	±5 deg	±20 deg
Distance from camera to target	20-40 cm	60 cm
Speed of moving parts	15-20 mm/sec	35 mm/sec
Time to reach the part	2-3 sec	4 sec
“Flat” part topology variance	0 cm (flat)	1 cm
Gripper actuation time	0 sec (vacuum)	1 sec

Working With An Error Budget

Using vision in a task is useful when the location and orientation (presentation) of the part is not the same on each cycle or if the part is on a moving conveyor. However, because the part is in a different location each time, there will generally be more variability in how the end effector grips the part compared to tasks where the part location is fixed. The amount of variability depends on the specific configuration of the task and can be predicted using the error budget described in the table below. Use this budget as a guide to help keep variability to a minimum and also to design other parts of the task (such as the place) to tolerate any unavoidable variability (using compliance for example).

The error budget is based on system characterization using a standard of three sigma, so the accuracy of a vision-based pick action is expected to fall within the specified error range 99.6% of the time. The dimensions of the error are expressed in terms of the X-Y plane that the part is resting on. To estimate the error budget, start with the static baseline and add each component that applies.

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Error Budget Table

Component	Constraints	Error	Affected dimensions
Static Baseline	Move < 40 mm, Rotate < 5 deg	±1.5 mm	X and Y
Part Location	Move > 40 mm, up to 130 mm	±0.9 mm	X and Y
Part Rotation	Rotate > 5 deg, up to 20 deg	±1.2 mm	X and Y
Moving Part	Up to 35 mm/s	±0.6 mm/s * action time	Direction of motion
Speed change	Typically about 1.2 mm/s	±1.2 mm/s * action time	Direction of motion

For example, a static part whose location varies up to ±130 mm and rotates up to 20 deg can expect error less than ±3.6 mm in X and Y (1.5 + 0.9 + 1.2 = 3.6). For a moving part up to 35 mm/s whose location varies up to 130 mm but does not rotate more than 5 deg using an action time of 3 seconds can expect less than ±2.4 mm error in X and Y plus an additional error no more than ±5.4 mm in the direction of motion.

Frequently Asked Questions

- My part is not flat and it's picking too early. What should I do?
    - Measure the height of the tallest component and adjust by nudging the position of the _SurfaceFrame by ½ of the height in the +Z direction. Test using a static pick. If the results are not satisfactory, nudge again in increments of ¼ of the tallest component.

- How can I make sure the camera is in the ideal location for setting the surface?
    - After setting the surface initially, use Cartesian View to jog the camera endpoint to the ideal location (x=0mm, y=0mm, z=200mm, x-rot=180deg, y-rot=0deg in surface frame) and then update the surface again

Vision Best Practices Checklist

Surface Training Checklist

- ❑ Camera is approximately 20 cm from Landmark, use the target (box) as a reference to position the Landmark.
- ❑ Camera is nearly to parallel with surface
- ❑ Landmark is in the center of the image
- ❑ Exposure is set so that no part of the Landmark is saturated (completely white)
- ❑ Embedded strobe light is off unless it is needed (e.g. fluorescent light in vicinity)
- ❑ Robot and Landmark are completely stationary (no bumps or vibrations)
- ❑ End effector is properly configured (if using endpoint to set surface)

Object Training Checklist

- ❑ Camera is parallel to work surface
- ❑ Part appears clearly in the image, well lit, and free from glare (adjust exposure/gain/strobe settings)
- ❑ Part is nearly centered in the image
- ❑ Part appears at least 50 pixels in height/width (roughly 1/10 of the image height) but not larger than half the image size
- ❑ Detection pose and pick pose are not close to joint limits
- ❑ Robot kinematic and camera calibration is up-to-date

Workcell Checklist

- ❑ The robot and workcell machinery are rigidly secured to the floor
- ❑ The floor is free from excessive vibrations
- ❑ Lighting is controlled and consistent
- ❑ Conveyor belt has constant speed
- ❑ Ensure nothing blocks the camera's view (wires, hoses, etc.)

Pro-Tips

- ❑ After training the part, immediately train the action pose without moving the part, then add other moves as needed
- ❑ Verify the task with a static pick/place before setting up and configuring the moving pick/place
- ❑ Start with 5 images for a static pick and 12 images for a moving pick then adjust as necessary.
- ❑ For a moving pick, put the close approach pose as close as possible to the action pose (timed move)
- ❑ Make sure the pick motion is linear and smooth, and grips the part cleanly without "nudging" it out of alignment (watch the pick from different angles to confirm)
- ❑ With the camera view open, place the part at various locations and orientations in the image to make sure detection is stable and robust
- ❑ Camera view can be open to verify detector operation and workspace visibility, but should normally be closed while running the task, and especially while evaluating cycle time (allow 30 seconds for camera frame rate to return to normal after closing camera view)

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