

**3D-Locate™ is a set of 3D vision software tools that open new possibilities for vision-guided pick-and-place, assembly, and inspection applications.**

Cognex 3D-Locate delivers accurate, real-time 3D position information that makes it possible for automation equipment to work with a wide variety of parts, including items that are stacked or tilted. Cognex 3D-Locate improves vision performance for a wide range of applications where 2D tools alone are not enough.

3D-Locate can be deployed in:

- Single camera applications that need more information than a 2D or 2.5D approach can offer
- Robot-mounted single or stereo camera guidance systems
- Work cells with multiple fixed-mount cameras to eliminate mechanical fixturing
- Alongside conveyor lines for tracking and sorting applications

3D-Locate can also be combined with other Cognex vision tools, such as barcode and 2D Data Matrix reading, gauging, and color verification.



## Calibration—Critical to Success

Calibration is an often overlooked key to the success of any 3D vision project. High-precision Cognex calibration tools adjust for optical distortion and camera position and accurately synchronize cameras with robot end effectors—a key element in the success of any 3D application.

3D-Locate includes the following types of calibration:

- Camera intrinsic calibration. Correction for lens distortion and image sensor alignment.
- Camera extrinsic calibration. Calibration to determine relative camera position and orientation.
- Hand-Eye (Robot-Camera). Calibration to determine the relationship between the camera and robot coordinate systems. Hand-eye calibration can be done with respect to the robot base or to the end effector (gripper).

3D-Locate also offers a calibration wizard to simplify image acquisition, calibration parameter setup, calibration, and validation. The wizard can be used in the lab, or deployed on the factory floor.

### 3D-Locate Calibration Validation

Slight changes in camera position caused by vibration or accidental bumping by factory personnel can cause cameras to slip out of calibration. This can cause subtle robot guidance problems. To minimize this, 3D-Locate includes a calibration validation feature. Validation is a quick test that can confirm whether or not all cameras are still correctly calibrated, and identify any cameras that have shifted. This greatly simplifies troubleshooting. It can also be used for preventative maintenance, for example during shift or production change-overs.

### How Does 3D Calibration Work?

Calibration works by acquiring a series of images of a calibration plate at different locations and orientations. Cognex 3D-Locate calibration offers true multi-camera calibration that calibrates all cameras simultaneously, rather than independently. Cognex uses calibration

plates designed with checkerboard patterns. This produces much more accurate results than grid-of-dots approaches, which are much more susceptible to distortion when viewed from an angle, or with inconsistent factory floor lighting that cause thresholding problems.

Use Cognex calibration plates, with hundreds of features, to produce uniform, repeatable calibration over the entire camera field of view. Calibration works even if the plate is partially outside the field of view of any camera. Each Cognex calibration plate is marked with a machine-readable 2D Data Matrix code that contains the calibration plate properties such as grid count, pitch and size. This simplifies setup and reduces the opportunities for an operator to enter incorrect data.

### PatMax® Feature Detection

The second 3D-Locate step is to detect features of a part. Cognex's industry-leading alignment tools, such as PatMax, SearchMax™, and PatFlex find multiple 2D features on the part's surface. 3D-Locate combines them to determine the precise three dimensional position and orientation of the object.

- PatMax. Extremely accurate and robust geometric pattern finding. PatMax tolerates non-uniform lighting and handles rotation, scale and tilt. You can train PatMax from existing images or CAD data. PatMax can recognize patterns even when the object



is partially covered or outside of the field of view, which is essential in many real-world applications.

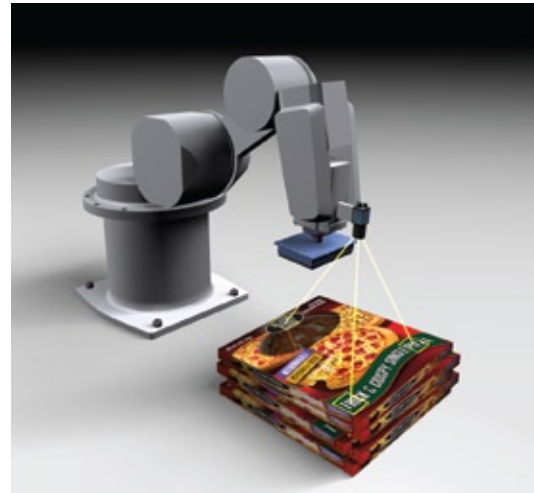
- SearchMax. A color search tool from Cognex that can distinguish objects by color. This is extremely helpful in food, bottling, and packaging applications. SearchMax can also find patterns in monochrome images based on intensity (brightness).
- PatFlex. Designed to align patterns on wrinkled or deformed packages. PatFlex is perfect for applications handling plastic bags or similar products.

### 3D Pose Determination

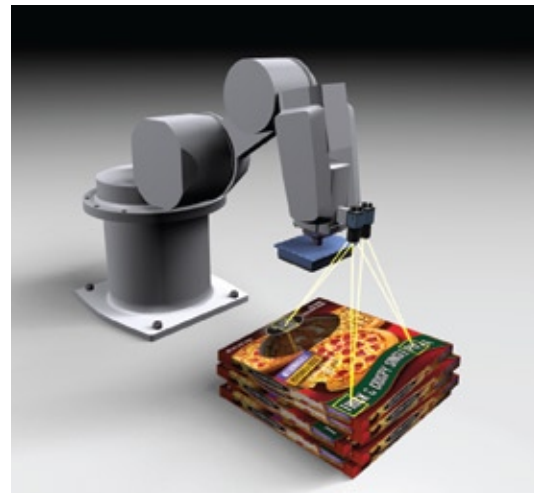
The final step of 3D-Locate is determining the pose of the part. 3D-Locate takes 2D features and triangulates where the part is. There are many ways to use 3D-Locate, including:

- Multi-Camera 3D Triangulation. Multi-camera triangulation involves multiple, widely separated cameras. It is the most accurate type of usage because the system triangulates on individual features from widely different angles. It is also very robust because it works well even if one or more features is not found by all of the cameras.
- Two Camera Short Baseline 3D. Short baseline 3D involves cameras that are mounted almost parallel (i.e., stereo) to each other. This greatly simplifies training, because the cameras can share the same 2D feature models. Stereo 3D is especially well-suited to robot guided applications.
- Multi-Camera Mixed Applications. 3D-Locate also works using a combination of fixed and robot mounted cameras. This provides the accuracy and short working distance of robot-guided vision, while the fixed cameras can provide initial guidance and contribute to more accurate overall measurements.
- Single Camera 3D. Although single camera 3D is less accurate than multi-camera 3D, 3D-Locate can run in single camera mode and provide better tilt and scale information than a traditional 2D or 2.5D solution. It can run with a camera fixed above a work cell or mounted on a robot.

### Single Camera 3D



### Two Camera Short Baseline 3D

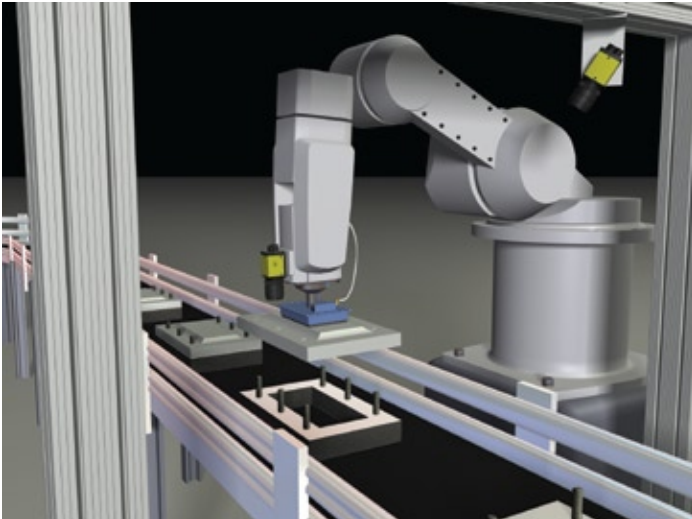


### Multi-Camera 3D Triangulation



# Applications

Precision robot assembly



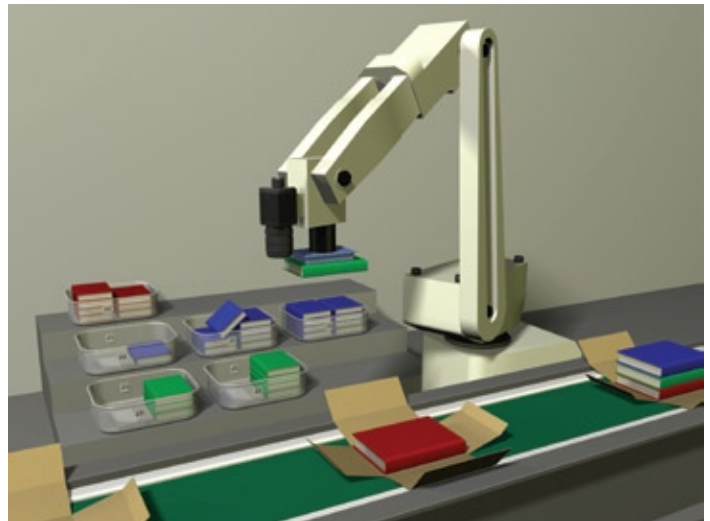
Palletizing/depalletizing



Fixed mount packaging



Pick and pack



# COGNEX

Companies around the world rely on Cognex vision to optimize quality and drive down costs.

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