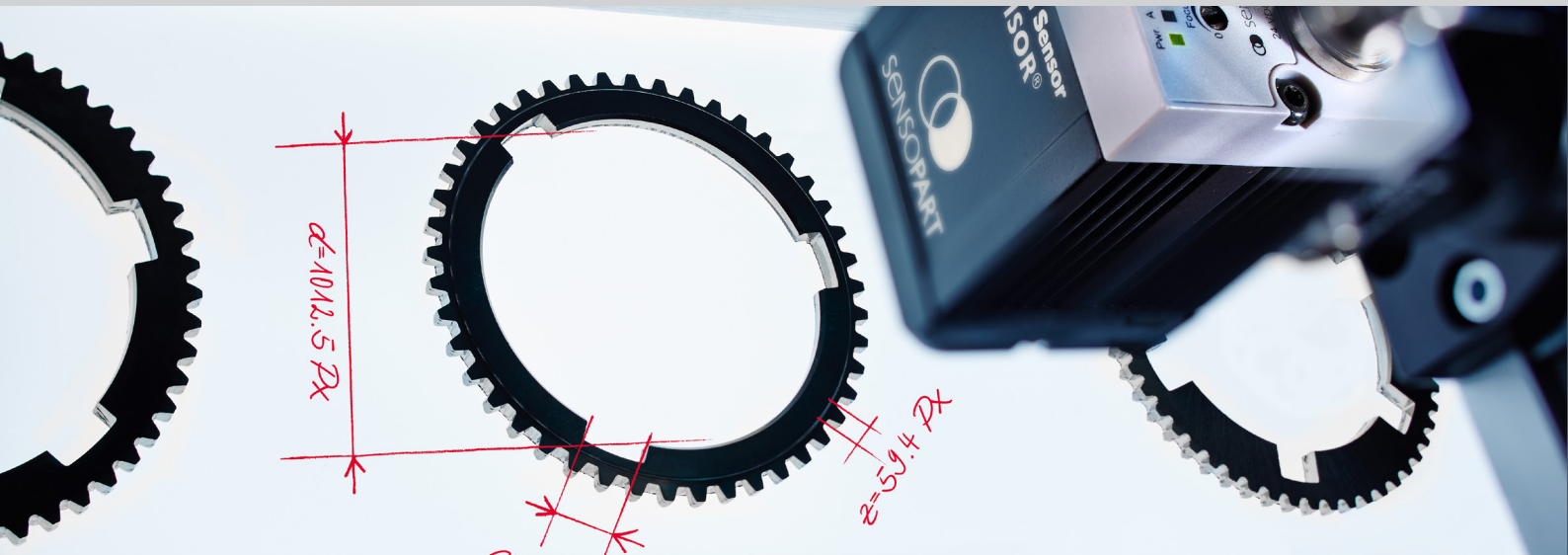# Vision sensor calibration

Real-world engineering units and robot coordinates at a mouse click.

Measurement and inspection in millimeters or inches

Easy conversion of pixels into real-world coordinates.

Component position and distance values are generally required in metric units, such as millimeters or inches, rather than in pixels. Thanks to the VISOR® calibration function, vision sensor coordinates can now effortlessly be converted into real-world engineering units: place the calibration plate into the sensor's field of view, a single mouse click in the configuration program – and it's done!


1. Situation: measurement and inspection of components
The vision sensor outputs the position and dimensions of a component in pixels. These are relative sensor coordinates without reference to the "real world": The measured component dimensions depend partly on the part's distance from the sensor.
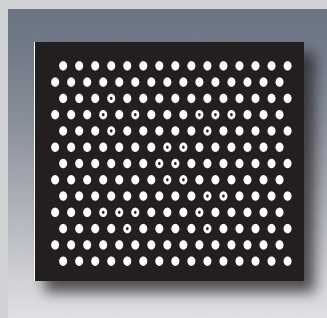

3. The solution: one-click calibration with a calibration plate
The SensoPart calibration plate establishes a relationship between relative sensor coordinates and absolute world coordinates. It is positioned in the sensor's field of view. The calibration function in the VISOR® configuration software now enables the conversion of vision sensor coordinates into real-world coordinates and pixels into inches or millimeters. Any image errors and distortions are also corrected.
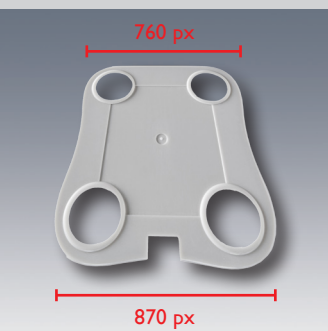
2. The problem: distorted images and measurement in pixels
If the vision sensor is at an angle in relation to the measurement plane, the component also appears distorted: the side furthest from the sensor looks shorter. It is, therefore, not possible to determine the actual size and shape of the part. A significant lens distortion may also occur – depending on the focal width of the lens.
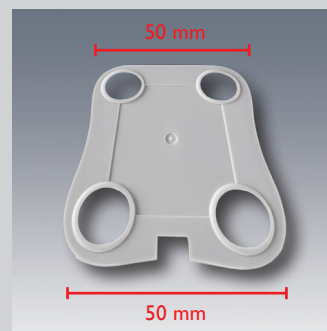

4. The result: measured values in real-world coordinates
After one-time calibration with the aid of a calibration plate, the VISOR® immediately outputs all position and distance values in world coordinates, i.e. inches. All inaccurate values caused by image distortion are now corrected. The position and dimensions of a component can be correctly identified in inches or millimeters even at an angle to the measurement plane.

Pick & place without programming

Simple conversion of pixels into robot coordinates.

In order to pick up a component, a robot needs to know the part's exact position, particularly in relation to the robot's own coordinate system. Instead of programming the conversion of sensor coordinates into robot coordinates in the control system, which can be a time-consuming process, this can now be done in the VISOR® configuration software in just a few mouse clicks. This represents a significant boost in efficiency when setting up pick & place applications!
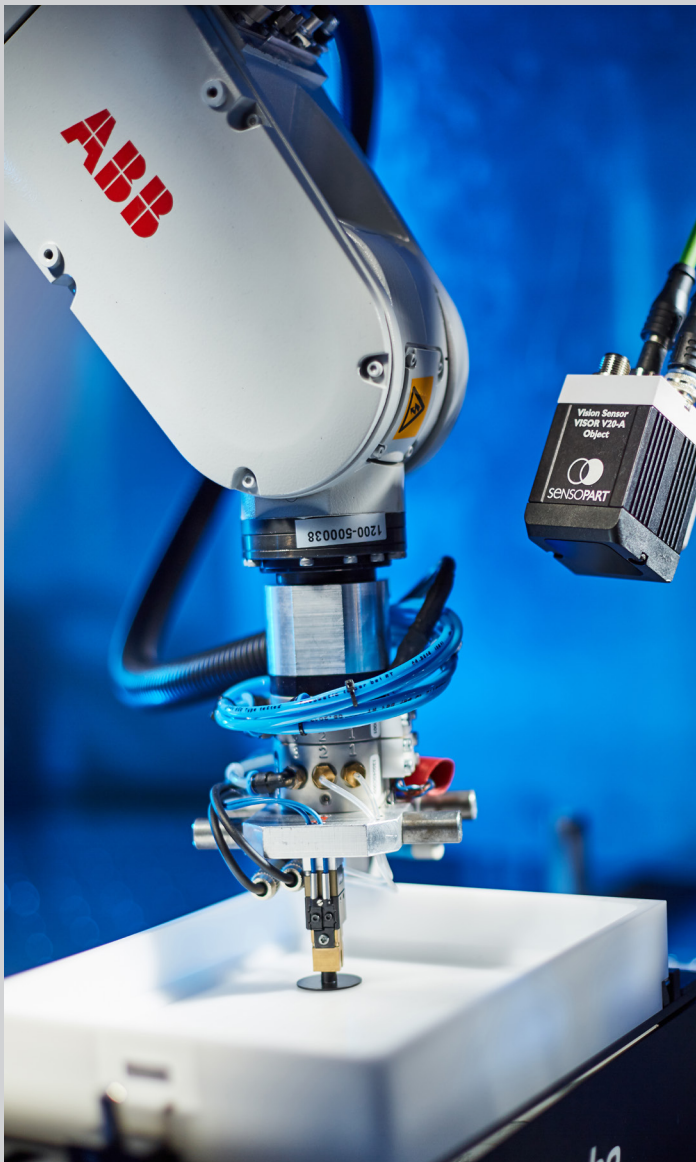
1. The problem: distorted images in sensor coordinates

The robot cannot interpret sensor image pixels, which may also be inaccurate due to a diagonal angle of view and lens distortion.

2. The solution: intelligent calibration with a point pair list

To convert sensor coordinates into robot coordinates, a point pair list is created with at least six corresponding pairs of coordinates. To do this, a suitable calibration part is placed in various positions in the vision sensor's field of view and the respective coordinates are transmitted from the robot control system to the VISOR® configuration software. Thanks to clever user aids, such as the graphic "snap function", calibration is completed in just seconds. The calibration process can even be fully automated through interface commands, e.g. via Ethernet, Ethernet/IP or Profinet. This is particularly useful when recalibrating or modifying applications.

3. The result: exact part position in robot coordinates

Once calibrated, the sensor transmits each part position in absolute robot coordinates, e.g. in relation to the robot base, so that the robot can grip the parts without the need for any further calculations. It is no longer necessary to program the robot control system as the VISOR® now sees the part "through the eyes of the robot".

Image errors, resulting from the sensor's diagonal angle of view in relation to the measurement plane, and possible lens distortions are corrected during calibration. A height offset (Z correction) between the calibration and measurement plane can also be taken into consideration, as well as a gripper offset.

VISOR® Calibration functions at a glance

Z correction
A vertical offset between the calibration and measurement plane can be taken into account during calibration.

Coordinate conversion
Relative sensor coordinates are converted into real-world or robot coordinates using the VISOR® calibration function.

Perspective distortion
Image distortions resulting from the sensor's diagonal angle of view in relation to the measurement plane are automatically corrected during calibration.

Calibration	Cycle time

World X	World Y
20.00 mm	50.00 mm
90.00 mm	40.00 mm
20.00 mm	110.00 mm
110.00 mm	100.00 mm
60.00 mm	80.00 mm

Simple setup
Calibration using a calibration plate or point pair list requires just a few data inputs and mouse clicks.

Gripper offset
A gripper offset can be taken into account with non-rotationally symmetric parts, e.g. those with a handle.

Lens distortions
So-called pincushion distortion can occur with short focal widths. This is automatically corrected through calibration.

Free space check
To ensure that a part can be securely gripped, it is first possible to check whether there is sufficient space for the robotic gripper arm around the part contours.

PROFI NET®
EtherNet/IP™

Automated calibration procedure
Calibration with a point pair list can be fully automated through interface commands, e.g. via EtherNet/IP.