

Cognex OmniView SDK

Programmer's Guide

Omniview 6.0 SR1

September 2011

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5495537, 5602937, 5640200, 5768443, 5825483, 5850466, 5859923, 5949905, 5978080, 5995648, 6002793, 6005978, 6075881, 6137893, 6141033, 6157732, 6167150, 6215915, 6324299, 6381375, 6408109, 6411734, 6421458, 6457032, 6459820, 6490375, 6516092, 6563324, 6658145, 6690842, 6748110, 6751361, 6771808, 6804416, 6836567, 6850646, 6856698, 6959112, 6975764, 6985625, 6993192, 7006712, 7016539, 7043081, 7058225, 7065262, 7088862, 7164796, 7190834, 7242801, 7251366

OMNIVIEW

6215915, 6381375, 6408109, 6421458, 6457032, 6459820, 6594623, 6804416, 6959112, 7383536

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Preface

This manual contains information about using the Cognex OmniView SDK (Software Development Kit) to develop machine vision applications that create two-dimensional images of the surface of unfixtured generalized cylindrical objects.

It includes information on the following topics:

- How to install and configure the OmniView SDK software
- How to write your OmniView SDK application
- How to calibrate your OmniView SDK application
- How to train, locate, and image unfixtured objects

For specific information regarding the classes for building OmniView applications, refer to the OmniView SDK Class Reference, available from the Start menu by choosing **Start->All Programs->Cognex->OmniView->SDK->OmniView SDK Class Reference**.

Style Conventions Used in This Manual

This manual uses the style conventions described in this section for text and software diagrams.

Text Style Conventions

This manual uses the following style conventions for text:

boldface	Used for keywords, function names, class names, structures, enumerations, types, and macros. Also used for user interface elements such as button names, dialog box names, and menu choices.
<i>italic</i>	Used for names of variables, data members, arguments, enumerations, constants, program names, file names. Used for names of books, chapters, and sections. Occasionally used for emphasis.
<code>courier</code>	Used for programming examples and for examples of program output.
bold courier	Used in illustrations of command sessions to show the commands that you would type.
<i><italic></i>	When enclosed in angle brackets, used to indicate keyboard keys such as <i><Tab></i> or <i><Enter></i> .

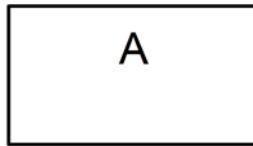
Software Diagramming Conventions

This manual uses the following symbols in class diagrams:

- **Classes** are shown as a box with the class name centered inside the box. For example, a class A with the C++ declaration

```
class A{};
```

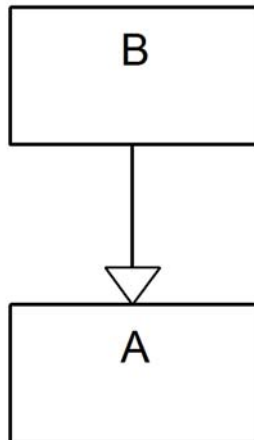
is shown graphically as follows:



- **Inheritance** relationships between classes are shown using solid-line arrows from the derived class to the base class with a large, hollow triangle pointing toward the base class. For example, a class B that inherits from a class A with the declaration

```
class B : public A {};
```

is shown graphically as follows:



These symbols are based on the Unified Modeling Language (UML), a standard graphical notation for object-oriented analysis and design. See the latest *OMG Unified Modeling Language Specification* (available from the Object Management Group at <http://www.omg.org>) for more information.

Cognex Offices

Cognex Corporation serves its customers from the following locations:

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Getting Started with OmniView SDK

1

This chapter contains information you need to know to use the Cognex OmniView SDK product.

- *OmniView SDK Overview* provides an overview of the OmniView SDK product, its intended use, and its components.
- *About this Release* provides specific information about this release of the OmniView, including the system requirements for development and deployment, installation information, and a description of the provided sample code and documentation.
- *OmniView System Design and Configuration* contains an overview of the hardware, mechanical, and optical design requirements for a deployed OmniView system.
- *OmniView SDK Application Design* outlines the structure of a typical OmniView application created using the OmniView SDK product.

OmniView SDK Overview

Cognex OmniView is machine vision software that uses simultaneous multi-camera acquisition to construct a 360° view of a cylindrical container, then registers the unwrapped image to a common starting point so that verification can be defined for relatively fixed regions of interest.

Each unwrapped image (or any of the original images) can be analyzed with Cognex vision tools to verify logos, dates, product codes and more to ensure the container has been manufactured and labeled correctly.

A four-camera system with the cameras spaced at 90° intervals provides the optimum balance between speed and part coverage. The examples shown in this document assume this type of configuration, as shown in Figure 1:

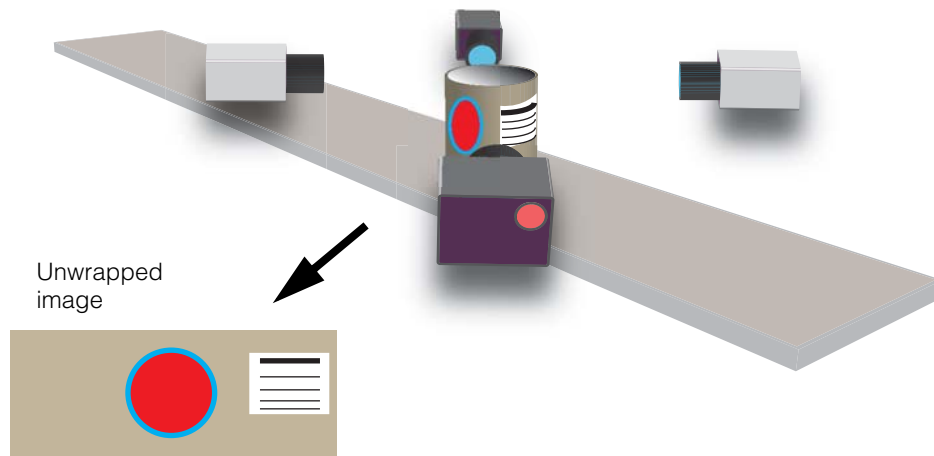


Figure 1. OmniView

OmniView has several advantages over conventional methods for visualizing and inspecting cylindrical objects:

- The parts need only be roughly centered on a production line. No rotational fixturing or precise alignment is required.
- Parts do not need to be halted or rotated to acquire the image. A single exposure from the four cameras acquires all of the information required to create a single image that shows the entire object surface.

OmniView SDK and OmniView ASAP

Cognex supplies the OmniView product in two forms:

- OmniView ASAP provides maximum ease-of-use without programming and for rapid development and deployment. OmniView ASAP allows you to add and interactively configure vision and inspection tools from Cognex VisionPro.
- *OmniView SDK* provides a sophisticated .NET programming interface that provides access to the camera calibration, acquisition, training, fixturing, and unwrapping capabilities of OmniView. OmniView SDK is intended for use in conjunction with Cognex VisionPro.

The SDK includes the Cognex OmniView SDK Library, an online class reference describing all the classes in the Cognex.OmniViewSDK namespace. Access the class reference from the Start menu by choosing

Cognex->OmniView->SDK->OmniView Class Reference.

Each purchase of OmniView includes all of the software required for both the ASAP and SDK products. The two forms, however, can not be used together to produce a single OmniView application. You must choose between the ASAP and SDK before you start development.

Note

For more information on the OmniView ASAP, refer to the *OmniView User's Guide* and *OmniView Getting Started* manual, both of which are supplied on the product DVD.

Product Kit Contents

A complete verification station requires a mix of components supplied by both Cognex and the station manufacturer.

Supplied Hardware and Software Components

Cognex can supply some or all of the following components for each OmniView kit:

Component	Description
GigE Vision Cameras	GigE Vision cameras with a minimum resolution of 1628 x 1236. See the section <i>Supported Cameras</i> on page 15 for a list of supported cameras and camera combinations.
GigE Vision Network Adapters	CGE-NIC4 quad-port adapters and CGE-NIC1-1 single port adapters; one quad-port adapter and one single port adapter for a 5-camera station.

I/O Board	Cognex 8501 PCI Opto-isolated Board for a PCI or PCI-X slot (8 ins, 8 outs) with supported software security mechanism
OmniView Installation DVD	All OmniView software, including VisionPro with its wide array of vision tools.
Calibration plates	Three sizes of aluminum calibration plates laminated with a checkerboard pattern. Calibration plates need to be purchased separately based on the requirements of the application.
Security key	A security key to install on the PC that contains the security mechanism necessary to run Cognex software.

User-Supplied Components

Cognex does not provide the following necessary components for each verification station:

Component	Description
Control Enclosure	The enclosure must house the PC running OmniView software and provide adequate cooling. Based on the user's preference, the display, keyboard, pointer device, and other peripheral equipment can also be integrated into the enclosure.
Display	17" minimum size, 1024x768 resolution A second monitor is necessary when using the 3D animated OmniView Model Viewer feature for demonstration purposes.
Imaging Enclosure Exterior	Cubic enclosure with dimensions based on the range of valid containers, made from stainless steel or engineered plastic such as polycarbonate. It is critical that the side-view cameras remain rigidly mounted relative to each other during the operation of OmniView.
Imaging Enclosure Interior	Users are responsible for rigid mounting of lighting and cameras. Cognex encourages users to review their designs and plans with Cognex before implementation.

Junction Box	Houses +24VDC power supplies and terminal strips, recommend use of fuses on both DC power supplies Stainless steel type recommended (24" x 20" x 12" minimum size)
Keyboard	Standard English keyboard, PS/2 or USB connector
Lighting	Users are responsible for lighting and any custom diffuser elements. Cognex encourages users to review their designs and plans with Cognex before implementation. A "cloudy day" lighting on the surface of the containers being verified is required for best performance.
Part Presence Sensor	A +24VDC device with single-ended signal interface and selectable signal polarity. You must select the sensor appropriate to container size, with a maximum response time of 2ms.
Pointer Device	Minimum 2-button mouse, PS/2 or USB connector
Power Cables	PC. To ensure clean electrical power signaling and orderly shutdown of Windows in the event of electrical power outage, the use of an Uninterruptible Power Supply (UPS) is strongly recommended. Normally OmniView systems deploy with a UPS rated for a minimum of 400 Watts (450VA) to safely cover the PC, monitor, lights, cameras, and DC power supplies.
Power Supplies	+24VDC @ 2A (fused)
Reject Actuator	A +24VDC controllable device (pneumatic valve type is most common)
Shaft Encoder	A +24VDC device with single-ended signal interface; select the proper number of pulses per revolution to achieve a pulse frequency of at least 350 Hz, not to exceed 950 Hz at the peak conveyor speed.
Terminal Block	Cage-clamp style wiring blocks where power supply and trigger connections are terminated

Lenses	Industrial optics such as those available from the Cognex standard product catalog, with locking aperture and focus, matched to the part size and working distance for each particular deployed system
PC	Validated OmniView processing platform from Dell Computer.

About this Release

OmniView 6.0 SR1 SDK is the latest general release of the OmniView SDK product.

PC Requirements

Cognex has tested OmniView on the Dell Precision T5500 in each of the following configurations:

- Intel dual processor Xeon Six Core, 2.66 GHz, 12GB physical memory
- Intel Xeon Quad Core, 2.66 GHz, 6GB physical memory

In addition, your PC must meet the following minimum requirements:

- Windows 7 Professional 64-bit.

This release does not support Microsoft Windows Vista or Windows XP.

- Administrator privileges to install OmniView.
- One full height PCI or PCI-X slot for the I/O board
- For 4-camera stations, one open PCI-Express slot for the GigE Vision network adapters.
- For 5-camera stations, an additional open PCI-Express slot for a 2nd GigE Vision network adapter.

Check with your Cognex sales representative before using a non-validated platform.

Supported Cameras

Cognex has tested OmniView with a specific set of Basler GigE Vision cameras:

Camera Model	Resolution	Mono/Color
Basler Scout scA1600-14gm	1628x1236	Mono
Basler Scout scA1600-14gc	1628x1236	Color
Basler Pilot piA2400-17gm	2448x2050	Mono
Basler Pilot piA2400-17gc	2448x2050	Color
Basler Ace aCa1600-20gm	1628x1236	Mono

Optional 5th Camera

Regardless of which camera type you are using for your four side-view cameras, you can choose a different type of camera for an optional top-view. Specifically, you can choose either of the following cameras for the top-view:

- Basler Scout scA1600-14gm mono
- Basler Scout scA1600-14gc color
- Basler Pilot piA2400-17gc color
- Basler Ace acA1600-20gm mono

You cannot use the Basler Pilot piA2400-17gm mono camera as the optional 5th camera.

See the section *Install the GigE Vision Cameras* on page 17 for details on installing the GigE Vision cameras you will use.

OmniView SDK Installation

Perform the following steps to install the OmniView SDK software.

Save Existing OmniView Jobs

Back up the directory `%omniview_data%` if it exists. Installing this release will overwrite files in this directory. The backup file will allow you to revert to a previous OmniView release if needed.

You may be asked to send a copy of the contents of your `%omniview_data%` directory to Cognex when reporting an issue to Cognex customer support.

Prepare the PC

Turn off the PC and install the Cognex hardware necessary for your vision application:

- Install the Cognex MVS-8501 into an empty PCI or PCI-X slot and attach the I/O breakout module.

Refer to the Cognex 8500 Hardware Reference documentation in the `\doc` directory of the OmniView installation DVD for installation instructions.

- Remove any Cognex security key device if one is installed on your PC, and install the Cognex security key that arrives with the OmniView kit.
- Turn on the PC and download the latest video driver for your video card.

Downloading the latest driver fixes a known display card driver problem. Refer to the manufacturer's web site for details.

- Disable Windows 7 power saving schemes and any C-state settings in the BIOS that allow an idle processor to turn off unused components to save power.

OmniView will not run properly after exiting standby or hibernation since it is a high performance application requiring constant access to its high speed hardware components.

- Disable any virus checking software, any screen savers, and any scheduled tasks on the PC.

Install the GigE Vision Cameras

The `ldoc` directory of the OmniView installation DVD contains the GigE Vision Cameras User's Guide, with specific instructions on installing and using GigE Vision cameras with Cognex software. Perform the following steps to install the GigE Vision hardware:

1. Turn off the PC and install the GigE Vision network adapters.

Refer to the installation instructions for the network adapter for specific installation instructions. Install 1 GigE Vision network adapter for a 4-camera verification station or 2 adapters for a 5-camera verification station.

2. Connect the GigE Vision cameras.

Refer to your camera manufacturer's instructions for details on attaching each camera to a network adapter.

3. Restart the PC.

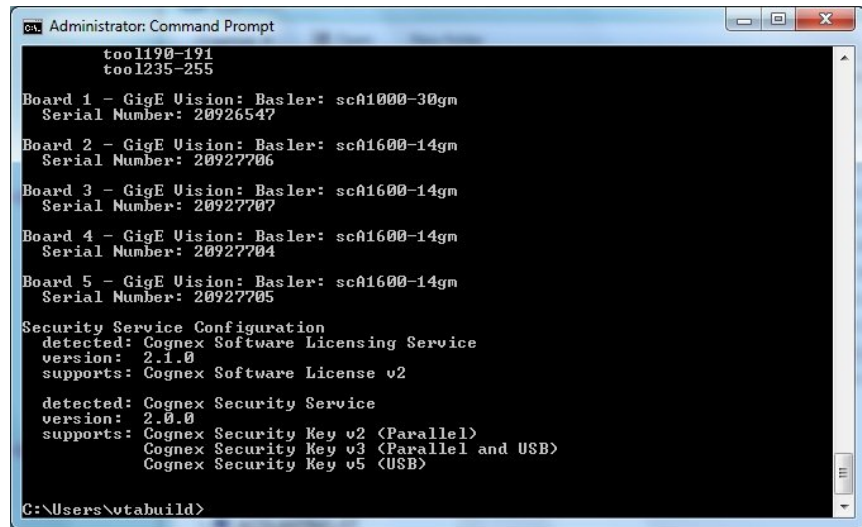
The **Found New Hardware** wizard should launch and allow you to install the drivers for the GigE Vision network adapters automatically. If it does not then install the drivers from the manufacturer's installation media.

4. Turn on the GignE Vision cameras.

Ensure the cameras are available by using the *cogtool* utility. Open a command window and enter the following command:

```
cogtool --print
```

The camera type and serial numbers appear as shown in the following example:



```
Administrator: Command Prompt

tool1190-191
tool1235-255

Board 1 - GigE Vision: Basler: scA1000-30gm
Serial Number: 20926547

Board 2 - GigE Vision: Basler: scA1600-14gm
Serial Number: 20927706

Board 3 - GigE Vision: Basler: scA1600-14gm
Serial Number: 20927707

Board 4 - GigE Vision: Basler: scA1600-14gm
Serial Number: 20927704

Board 5 - GigE Vision: Basler: scA1600-14gm
Serial Number: 20927705

Security Service Configuration
detected: Cognex Software Licensing Service
version: 2.1.0
supports: Cognex Software License v2

detected: Cognex Security Service
version: 2.0.0
supports: Cognex Security Key v2 <Parallel>
          Cognex Security Key v3 <Parallel and USB>
          Cognex Security Key v5 <USB>

C:\Users\utabuild>
```

5. (Optional) Change the User Account Control (UAC) setting to **Never Notify**.

Access the Control Panel from the Start menu. See your Windows documentation for details. Reboot the PC for the UAC to take effect.

Uninstall existing Cognex software

Uninstall any existing Cognex software. Use the Add or Remove Programs feature of the Windows Control Panel to remove any of the following programs if they are present:

- **Cognex OmniView**
- **Cognex Drivers**
- **Cognex VisionPro**

Restart your PC if prompted.

Install the OmniView Application Software

Administrative privileges are required in order to install and run OmniView.

1. Exit all applications and insert the OmniView DVD.

If the installation utility does not start automatically, double-click setup.html on the installation DVD.

If this screen does not appear, double-click on the file *setup.html* in the root directory of the DVD.

2. Click on **Install VisionPro 7.1** and follow the on-screen prompts.

You must install VisionPro in order to use OmniView.

Install the Cognex drivers when prompted to do so.

3. Click on **Install VisionPro 3D 7.1 Rev A Prerelease 2** and follow the on-screen prompts.

%OMNIVIEW_ROOT% refers to where OmniView Application is installed and

%OMNIVIEW_DATA% refers to where it saves and loads data. By default

%OMNIVIEW_ROOT% is *C:\Program Files\Cognex\OmniView*;

%OMNIVIEW_DATA% is *C:\Program Files\Cognex\OmniView\data*.

4. Click on **Install OmniView SDK 6.0 SR1** and follow the on-screen prompts.

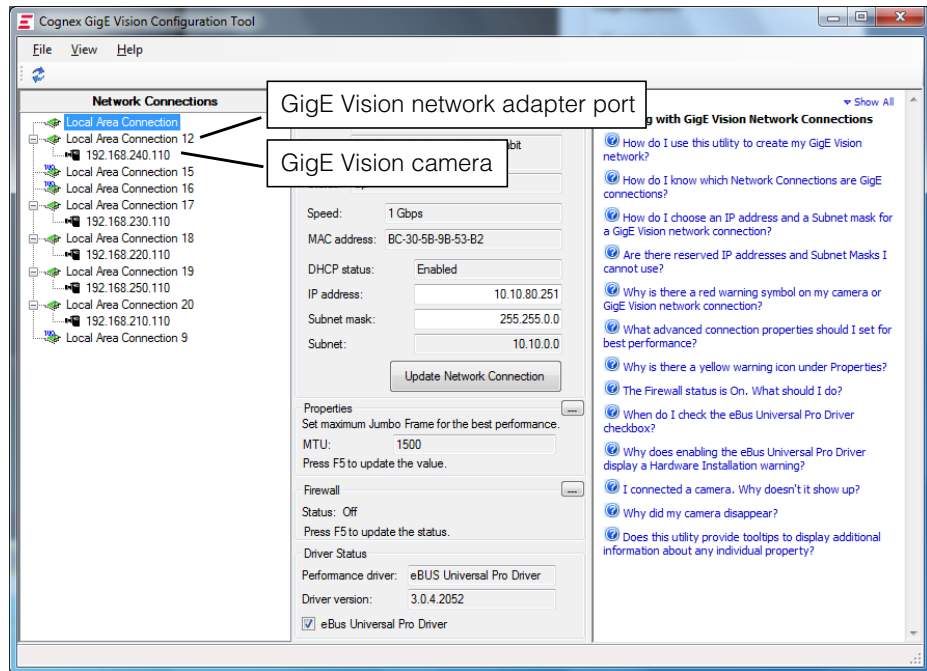
Configure the GigE Vision Equipment

Each GigE Vision network adapter (or each port of a multi-port adapter) must have its own IP address on its own subnet and each camera must have an IP address in the same subnet as its network adapter.

Choose **Cognex->VisionPro->Utilities->GigE Vision Configuration Tool** to launch the GigE Vision Configuration Tool and assign all the IP addresses your GigE Vision equipment requires.

The GigE Vision Configuration Tool displays all the network connections installed on your PC, including GigE Vision network adapters and the GigE Vision cameras attached to them.

For example, the following figure shows a PC where a quad port adapter and a single port adapter have been installed and five cameras have been attached:



An interactive list of Questions and Answers appears on the right side of the utility to guide you in setting IP addresses and configuring other system properties.

If you are not familiar with TCP/IP networking, Cognex recommends you use the following IP addresses:

Adapter	IP Address	Camera IP Address	Subnet Mask
1	192.168.21.200	192.168.21.210	255.255.255.0
2	192.168.22.200	192.168.22.210	255.255.255.0
3	192.168.23.200	192.168.23.210	255.255.255.0
4	192.168.24.200	192.168.24.210	255.255.255.0
5	192.168.25.200	192.168.25.210	255.255.255.0

For each GigE Vision network connection and camera, perform the following steps to configure their IP addresses:

1. Select a **Network Connection** listing corresponding to a GigE Vision network adapter, a single port on a multi-port adapter, or a network switch.
2. Assign an **IP Address** and **Subnet mask** and click **Update Network Connection**.
3. Verify that the **Properties** section does not display a yellow warning icon indicating that you need to modify one or more system properties.
4. Verify that your **Firewall** status is **Off** or that the group policy set by your network administrator disables the Windows Firewall regardless of the local status detected by the utility.
5. Verify that the eBus Universal Pro Driver checkbox is checked.
6. Select the GigE Vision camera listed under the GigE Vision network connection.
7. Assign an IP Address and Subnet mask and click Update Camera Address.
8. Close this utility.
9. Attach the trigger cables from the I/O breakout module to the GigE cameras.

Consult the *GigE Vision Cameras User's Guide* for other helpful information as well as troubleshooting tips.

Prepare the Verification Station

Ensure the following equipment has been installed for the verification station:

- All enclosures, equipment, and cabling
- A complete imaging enclosure with lights and cameras rigidly mounted

If not fully wired already, ensure the system is at least ready for connection.

The mounting hardware for the cameras should be rigid enough so that the relative position among the cameras does not change over time. A common practice is to mount side view cameras on a single aluminum base plate.

Strobe Lights for 5 Camera Stations

Refer to the manufacturer's documentation for your strobe light for information on how to connect it to the cameras in your verification station. If you are using a 5-camera station and all cameras are the same type, the strobe light can be connected to any camera.

Some verification stations use a 5th camera with a different format from the 4 side-view cameras. In these stations the delay between the image acquisition trigger and the start of image integration must be considered so that the strobe light adequately illuminates the container under inspection.

If you are using cameras supported in this release and your verification station uses a different 5th camera than the side-view cameras, perform the following steps:

1. Refer to the following table for the exposure start delay for each supported camera type:

Camera	Exposure Start Delay
Basler Scout scA1600-14gm	58.92 microseconds
Basler Pilot piA2400-17gm	32.06 microseconds
Basler Scout scA1600-14gc	58.92 microseconds
Basler Pilot piA2400-17gc	32.06 microseconds
Basler Ace acA 1600-20gm	45.54 microseconds

2. Connect the trigger signal for the strobe light to one of the cameras with the longest exposure start delay.

If you are using unsupported cameras and your verification station uses a different 5th camera than the side-view cameras, consult your camera specifications and connect the trigger signal for the strobe to the camera with the largest exposure start delay.

Choose a Calibration Plate

Contact your Cognex sales representative for calibration plates, and choose one based on the size of the containers you are inspecting:

Plate Size	Diameter of Container	Description
Small	1" or less	1/16" grid square size (1/16" - 0.0625 inches = 1.5875 millimeters)
Medium	1" to 3"	1/8" grid square size (1/8" = 0.125 inches = 3.175 millimeters)
Larger	3" or greater	1/4" grid square size (1/4" = 0.250 inches = 6.35 millimeters)

Uninstalling OmniView

Use the Windows Control Panel to uninstall OmniView.

OmniView retains the environment variable `%OMNIVIEW_DATA%`, which points to the directory holding archived configuration files such as all job files and the file *config.xml*. In most cases, you may want to retain the existing data when reinstalling or upgrading OmniView. In these cases, Cognex recommends you make a backup of the `%OMNIVIEW_DATA%` directory before reinstalling or upgrading.

To completely delete the OmniView installation, delete the directory referenced by `%OMNIVIEW_DATA%` and then delete the environment variable itself.

Changing or Removing GigE Vision Equipment

Any time you replace a GigE Vision camera, you must use the GigE Vision Configuration Tool to set the camera's IP address. See the *GigE Vision Cameras User's Guide* for more information.

Any time you replace or add a GigE Vision network adapter, you must configure the network connections with the correct IP address and subnet mask.

OmniView System Design and Configuration

This section provides some basic information concerning the electrical, mechanical, and optical configuration for OmniView SDK applications. For additional information, please contact your Cognex representative.

Mechanical and Optical Configuration

When used in a typical four-camera configuration, Cognex recommends the following general optical and mechanical system configuration:

- The four cameras must be mounted in a single plane, all aimed at a central point, arranged at 90° intervals from each other.
- The camera order should be counter-clockwise when viewed from above the cameras (this order will cause OmniView to automatically generate a 3D physical coordinate space with the Z-axis pointing up).
- The plane defined by the cameras' optical centers must be mounted parallel to the plane upon which the parts travel (typically a conveyor).
- At the point where the images are acquired, the part must be contained within an enclosure with a minimum number of visible background features.
- The enclosure must provide mounting for strobed illumination that provides even, diffuse lighting for the object being inspected.
- An optional fifth camera, typically used to inspect the top of the part, can be used.

Figure 2 displays the recommended configuration.

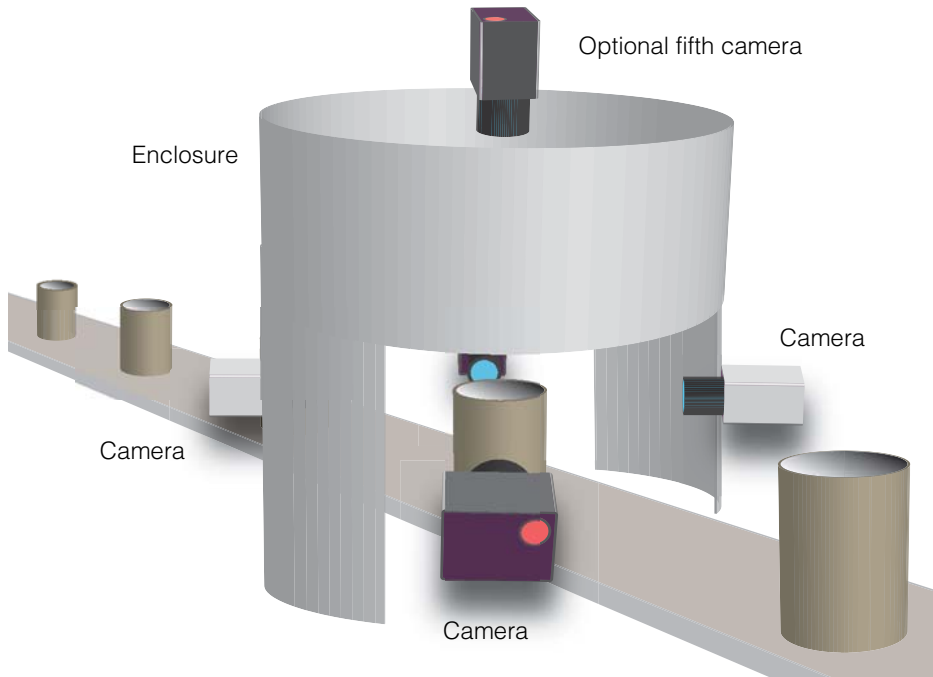


Figure 2. Basic mechanical configuration

Optical Considerations

Each of the four cameras must be of the same type, and each camera should be equipped with the same lens focal length and type. You should select a focal lens that provides approximately 75% coverage of the part being inspected at the typical working distance.

Electrical Configuration

A field wiring diagram is available from the Start menu with **Start->Cognex->OmniView->Wiring Reference**, or as the file *800-5712-3R.pdf* in your *Cognex\OmniView\doc* installation directory.

Default Discrete Inputs

The following default inputs are required to run an OmniView vision application:

- Part Presence Sensor (+24VDC single-ended signal, default falling-edge polarity).
- Shaft Encoder (+24VDC single-ended signal, range 350 -2500Hz).

Default Discrete Outputs

The following default outputs are produced by an OmniView vision application:

- Camera Trigger Output (+5VDC single-ended signal, falling-edge polarity).
- Light Trigger Output (+5VDC single-ended signal, rising-edge polarity).
- Reject Control Output (+24VDC, single-ended signal, rising-edge polarity).

OmniView SDK Application Design

This section provides an overview of the structure of a representative OmniView SDK application. OmniView applications typically are composed of the following areas:

- Image acquisition

As described in the section *OmniView SDK Overview* on page 10, OmniView requires that four images of the part being inspected from four different cameras be acquired simultaneously as the part is centered between the four cameras. Use the VisionPro **CogFrameGrabberGigEs** and the **ICogFrameGrabber** interface to acquire images.

- Camera calibration

You must calibrate OmniView for the cameras and verification station you are using. Once calibrated, you can begin to create a 3D Model of the container being inspected. You must perform a successful calibration as you prepare your verification station for initial usage.

It can become necessary to perform the calibration process again later. In fact, you must recalibrate your vision application whenever you change an existing camera in your verification station, refocus a lens, change an aperture setting or when recommended by the calibration validation option.

Three-dimensional camera calibration is described in the chapter *OmniView SDK Calibration* on page 39.

- 3D model creation

In order to successfully establish the 3D location of the container being inspected, OmniView must have information about its size and shape. Use the OmniView SDK to create a contour describing the edges of the container. OmniView uses this 3D model for each inspection.

- 3D part alignment

For each inspection, 3D part alignment uses the 3D model, the acquired images, and the camera calibration information to determine the precise location and orientation of the part being inspected in three-dimensional physical space.

- Image unwrap

The image produced by the unwrap tool is an undistorted representation of the cylindrical surface of the part.

- Unwrapped image registration

You can specify a registration point to use so that all unwrapped images have the same starting point.

- Downstream vision tool processing

Once OmniView has created the unwrapped image, you can use any VisionPro vision tool or image processing tool to analyze, measure, or inspect image features.

Each of these areas is discussed in detail in the next chapter, *OmniView SDK Application Overview*.



OmniView SDK Application Overview

2

- This chapter provides an overview of how your application is structured:
 - Image acquisition
 - Camera calibration
 - 3D model creation
 - 3D part alignment
 - Image unwrap and registration
 - Downstream vision tool processing

Image Acquisition

For each inspection, your application needs to acquire four images of the part from four cameras at the same time. A set of simultaneously acquired images is referred to as a *viewset*. You should organize your image acquisition code with the following guidelines in mind:

- The four images that make up a given viewset should be referred to through a single object or data structure.
- The order of the images in a viewset, and which camera acquires the first image in the viewset, must be the same for all viewsets.
- Your application should provide support for persisting viewsets to a CDB file or other archive mechanism.
- Your image acquisition code should acquire the images that make up a viewset at the same time. You can choose to either create a trigger bus from a single trigger, or you can configure your system to use master-slave acquisition.

For more information, see the *VisionPro User's Guide* and the topic *Acquiring Images with GigE Vision Cameras*.

The following table summarizes the es and interfaces you can use to acquire and persist image viewsets.

API	Library	Description
ICogAcqFifo	VisionPro	Interface for controlling an acquisition FIFO.
CogImageFile	VisionPro	The CogImageFile supports generic access to image files using any of the registered image file providers. If you know the image file format ahead of time or if you need specific image file functionality, you can use the appropriate image file provider interface, rather than CogImageFile .

Sample Code

For examples of acquiring images from GigE Vision cameras and image-database files, refer to the VisionPro sample code.

Camera Calibration

OmniView SDK depends on successfully performing 3D camera calibration on each of the four cameras used to acquire part images. OmniView calibration uses VisionPro 3D calibration tools in conjunction with some custom calibration software designed specifically for OmniView.

You perform the calibration process once as you prepare your verification station for use. Once calibrated, you can proceed to other setup tasks such as creating a 3D model of your container.

As you design the camera calibration phase of your system, keep the following guidelines in mind:

- You must specify the grid pitch (the spacing of calibration plate vertices) precisely.
- The calibrated 3D space uses the same units that are specified for the grid pitch. All future measurements must be specified in the same units.

OmniView calibration requires that you acquire a collection of viewsets, where each viewset includes a specifically positioned calibration plate. Although the VisionPro 3D calibration tools can work directly with images, it is much more efficient to develop your application to extract and correspond the calibration plate features and provide timely feedback; this approach is illustrated in the OmniView sample code.

Note

Cognex recommends that you archive all calibration plate images to a CDB file as you acquire them. This will enable you to experiment with different calibration parameters using a consistent set of feature data.

In addition, Cognex strongly recommends that immediately after calibration you acquire an additional collection of viewsets for use as a set of baseline images for calibration validation. You can use the VisionPro 3D **Cog3D Camera Calibration Validator** to validate that your camera calibration is still valid once your system is in production.

3D camera calibration and 3D camera calibration validation are both described in the chapter *3D Vision Overview* in the *Cognex 3D-Locate Developer's Guide* provided with VisionPro 3D. OmniView calibration is described in additional detail in the chapter *OmniView SDK Calibration* on page 39 of this document.

Class Summary

The following table summarizes the classes that you will use to perform calibration.

Class	Library	Notes/Inputs/Outputs
Cog3DCheckerboardFeatureExtractor	VisionPro 3D	Extracts the calibration features from an image of a Cognex checkerboard calibration plate.
Cog3DCrspFeaturesCollection	VisionPro 3D	Class that encapsulates the feature correspondence and calibration plate pose information for a given viewset
Cog3DCameraCalibrator	VisionPro 3D	Class for executing 3D camera calibration for one or multiple cameras
Cog3DCameraCalibration	VisionPro 3D	Class for holding intrinsic and extrinsic camera calibration parameters for one camera
Cog3DCameraCalibrationResult	VisionPro 3D	Class for holding the calibration result
CogOmniViewCameraCalibrations	OmniView SDK	This class holds the OmniView 3D camera calibration data. It contains a set of Cog3DCameraCalibration objects, one for each of the cameras to be used by the OmniView 3D alignment and image unwrapping classes.

Sample Code

The OmniView SDK installation utility installs a calibration sample application CameraCalibrations in the directory
`%OMNIVIEW_ROOT%\samples\SDK\Programming\CameraCalibrations`.

The sample application steps through collecting and testing (feature detection to confirm good images) of calibration plate images. The sample application includes an image-database file of calibration plate images corresponding to the correct plate presentations which are directly loaded at the appropriate time.

3D Model Creation

In order to successfully establish the 3D location of the container being inspected, OmniView must have information about its size and shape. You must provide a single contour that describes one side of the object, and use the OmniView SDK to construct a 3D model by revolving the 2D contour about the positive Y-axis.

Creating a 3D Model is done once for each type of container you plan to inspect. You must specify a single contour specified in the physical coordinate system defined during camera calibration.

You can create a graphical user interface to allow the user to create a 3D model interactively using a part image, or you can write an application that generates contours based on CAD or other numerical data.

Class Summary

The following table summarizes the classes that you will use to create a 3D model:

Class	Library	Notes/Inputs/Outputs
CogOmniViewShape	OmniView SDK	Contains the methods to create an OmniView 3D shape used to perform image alignment and unwrapping. All points and units referenced by this class are in physical world units unless otherwise specified. Currently, only the surface of revolution shape is supported by OmniView SDK.

Sample Code

The OmniView SDK installation utility installs a shape training sample application ShapeTraining in the directory
`%OMNIVIEW_ROOT%\samples\SDK\Programming\ShapeTraining`.

The shape training simple sample code uses the OmniView calibration generated by the calibration simple sample code, and returns a shape that illustrates the final shape that was fitted to the bottle. The final shape displays as a result graphic.

The sample comes with an image-database of four images (one per camera) of a part.

3D Training and Alignment

Given the following inputs, OmniView can locate the object being inspected in a three-dimensional space:

- A 3D model of the part
- A viewset of images where each image contains the part
- A valid OmniView calibration object

Successful alignment requires that the model be trained before it can be aligned. 3D model training requires:

- A valid model
- A valid OmniView calibration object

Note No image pixels are required for training: Only the model geometry and the calibration.

The results of a 3D part alignment (the 3D pose of the object) are required to successfully generate the unwrapped image, and they may also be useful for your application.

Note The returned pose does not specify the z-rotation for the part; you can obtain this information using the align unwrap tool, described in the section *Image Unwrap and Alignment* on page 36.

Class Summary

The following table summarizes the classes that you will use to align a 3D model.

Class	Library	Notes/Inputs/Outputs
CogOmniViewAligner	OmniView SDK	This class encapsulates the process of performing OmniView 3D alignment.
CogOmniViewPoseDOFRange	OmniView SDK	This class encapsulates the uncertainties for the degrees of freedom (DOFs) that are used as input for OmniView 3D alignment

Class	Library	Notes/Inputs/Outputs
CogOmniViewAlignerTrainParams	OmniView SDK	This class encapsulates the training-time parameters for OmniView 3D alignment
CogOmniViewAlignerRunParams	OmniView SDK	This class encapsulates the run parameters for OmniView 3D alignment

Sample Code

The OmniView SDK installation utility installs a sample application `AlignAndUnwrap` that calls the alignment and unwrap tools. It uses the calibration and the trained shape from the preceding simple sample code. The sample application is stored in the directory `%OMNIVIEW_ROOT%\samples\SDK\Programming\ShapeTraining`.

Image Unwrap and Alignment

Given the following inputs, OmniView can construct an unwrapped image that corresponds to the surface of the part:

- A 3D model of the part
- A viewset of images where each image contains the part
- A valid OmniView calibration object
- The 3D pose of the part.

The image produced by the unwrap tool is an undistorted representation of the cylindrical surface of the part.

Because the part may be presented to OmniView at any rotational angle, and because the 3D rotation component of the returned pose is ambiguous, the start of unwrap for the image will vary from part to part, as shown in Figure 3.

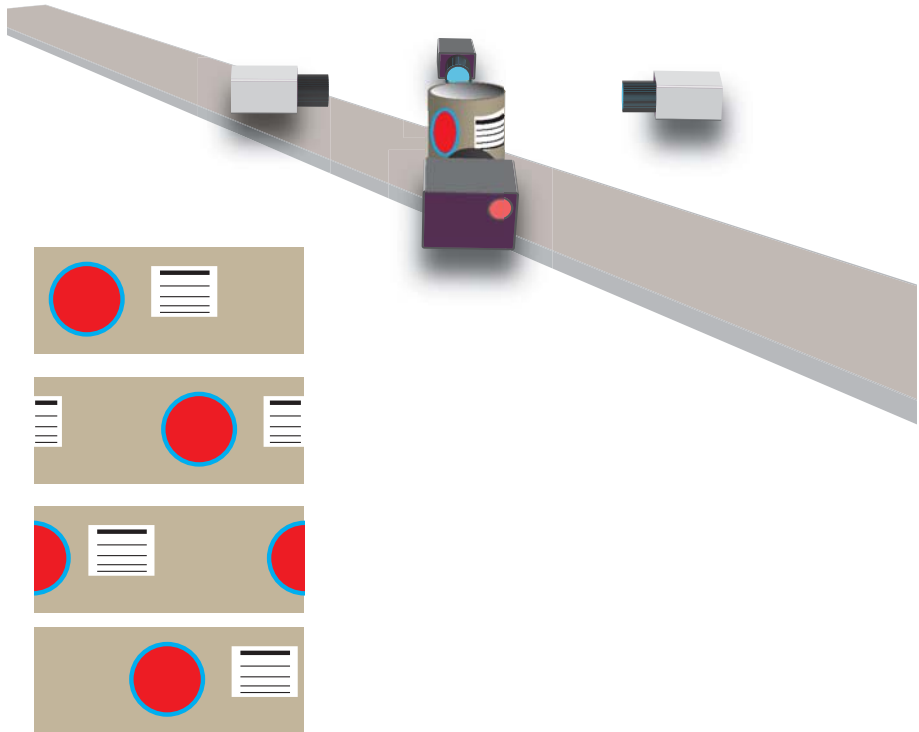


Figure 3. *Unwrapped, unregistered images*

To use the unwrap align tool, you first create an unwrapped image of a good part. You then identify the offset to be used as the start of the unwrapping process, as shown in Figure 4.

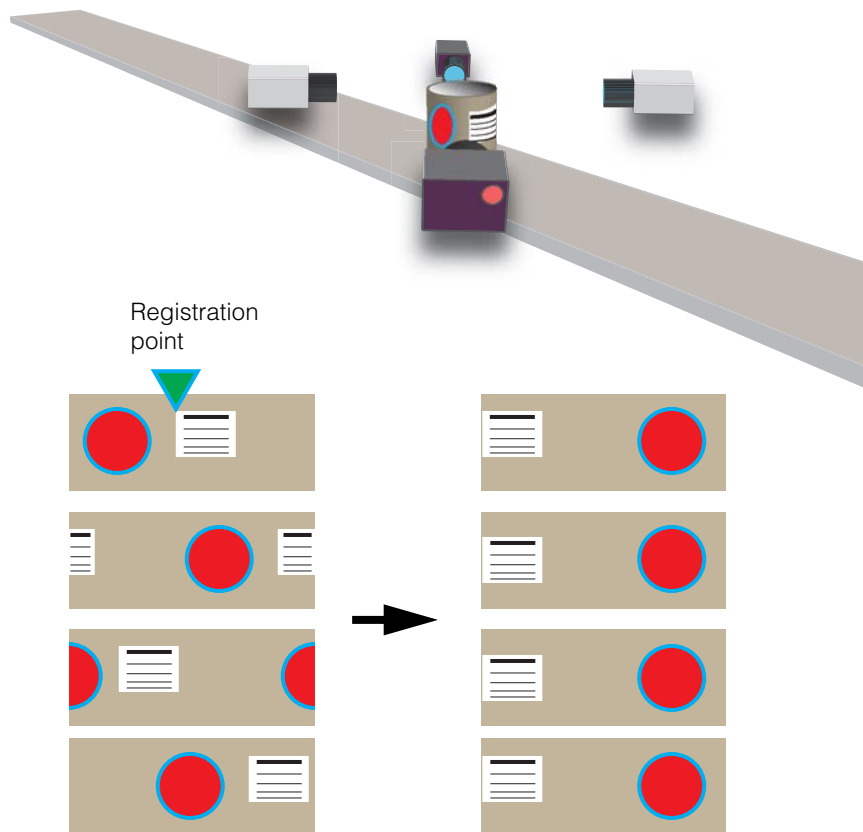


Figure 4. Registration

You can specify that OmniView generate an unwrapped image that represents more than 360 degrees of rotation, which can be useful in applications where one or more features you want to inspect can break across the end and start of the image regardless of where you choose to identify the offset.

For containers featuring few features or features that repeat and therefore introduce a risk that the unwrapping will not happen reliably, you can add sub-align regions in addition to the offset to ensure a consistent unwrapped image each time.

Class Summary

The following table summarizes the Omniview SDK classes that you will use to perform image unwrap and unwrapped image alignment.

Class	Notes/Inputs/Outputs
CogOmniViewUnwrapper	This class encapsulates the process of performing OmniView image unwrapping
CogOmniViewUnwrapperTrain Params	This class encapsulates the unwrapper training parameters. This parameter class contains one or more unwrap regions.
CogOmniViewUnwrapperRunParams	This class encapsulates the run parameters for OmniView 3D image unwrapping
CogOmniViewUnwrapAligner	This class encapsulates the process of registering the unwrapped image to a common starting point
CogOmniViewUnwrapAlignerTrainParams	This class encapsulates the unwrap alignment training parameters
CogOmniViewUnwrapAlignerRunParams	This class encapsulates the run parameters for OmniView start of unwrap alignment class
CogOmniViewUnwrapRegion	This class encapsulates the parameters for an unwrap region. An unwrap region defines the portion of a shape to be unwrapped.

Sample Code

The OmniView SDK installation utility installs a sample application AlignAndUnwrap that calls the alignment and unwrap tools. It uses the calibration and the trained shape from the preceding simple sample code. The sample application is stored in the directory `%OMNIVIEW_ROOT%\samples\SDK\Programming\ShapeTraining`.



OmniView SDK

Calibration

3

- This chapter describes how to calibrate an OmniView system, which requires you to perform the following tasks:
 - Acquire multiple viewsets of a calibration plate at specific positions
 - Provide these viewsets to the CVL 3D camera calibration function
 - Provide the resulting 3D camera calibration objects to the OmniView calibration function.

Acquiring Calibration Plate Images

To calibrate the system, you should acquire 21 4-image viewsets. Each viewset is made up of four images from the four OmniView cameras, taken at the same time and showing a calibration plate.

Note The OmniView cameras must be rigidly mounted with respect to each other. To obtain valid unwrapped images, the maximum apparent movement of any camera with respect to any other camera must be less than one pixel at the nominal part pose.

Note The OmniView cameras must not be moved or have their optical characteristics (lens, focus setting, or aperture setting) altered after calibration. For more information on calibration, see the *3D-Locate Developer's Guide* supplied with CVL.

Calibration Plates

To calibrate the OmniView system, you must use a calibration plate with the following characteristics:

- Conforms to the Cognex standards for Checkerboard calibration plates, as described in the CVL documentation.
- Has an origin fiducial mark defining a right-handed coordinate system.
- Is sized so that the plate fills each camera's field of view.
- Has a pitch (checkerboard size) so that each plate has an apparent size of between 20 and 50 pixels in the acquired images.

Cognex Corporation can provide high-accuracy, low-cost calibration plates in a range of sizes. Contact your Cognex representative for information on ordering these plates.

Note You must use the same physical units throughout the calibration and operation of OmniView.

Acquiring Image Viewsets

The four OmniView cameras are arranged at 90° intervals surrounding the expected location of the part. An arbitrary camera is designated camera 0, and the remaining cameras are numbered sequentially, as shown in Figure 5.

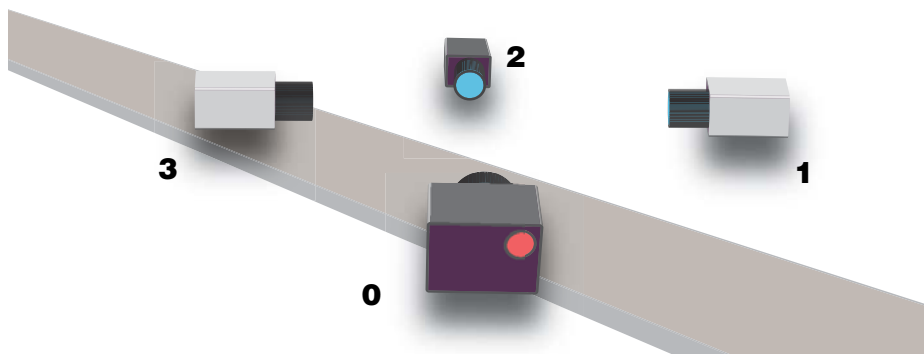
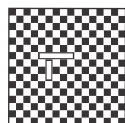


Figure 5. OmniView camera numbering

For each of the four cameras, you must acquire a viewset of images from all four cameras, for each of the five plate poses shown in Figure 6.



Normal to camera



Rotated toward right-hand neighbor camera



Rotated toward left-hand neighbor camera



Top tilted toward camera



Bottom tilted toward camera

Figure 6. Required plate poses, as seen from camera

Because of the required arrangement of the cameras, many of the images that make up the viewsets will not show any plate features. This does not affect the calibration result. Figure 7 shows how the first viewset from the first camera is acquired, along with the resulting images.

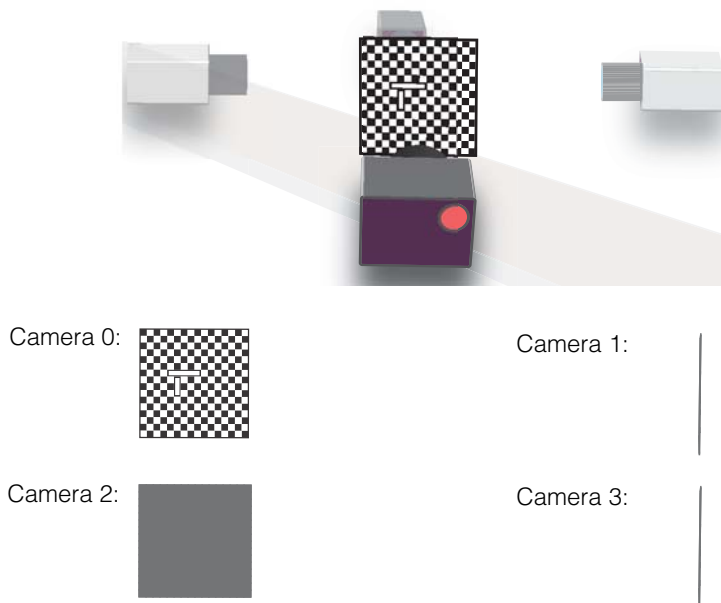


Figure 7. Viewset 0: (Camera 0, plate pose 0)

Figure 8 shows all five viewsets (one for each plate pose) acquired at camera position 0.

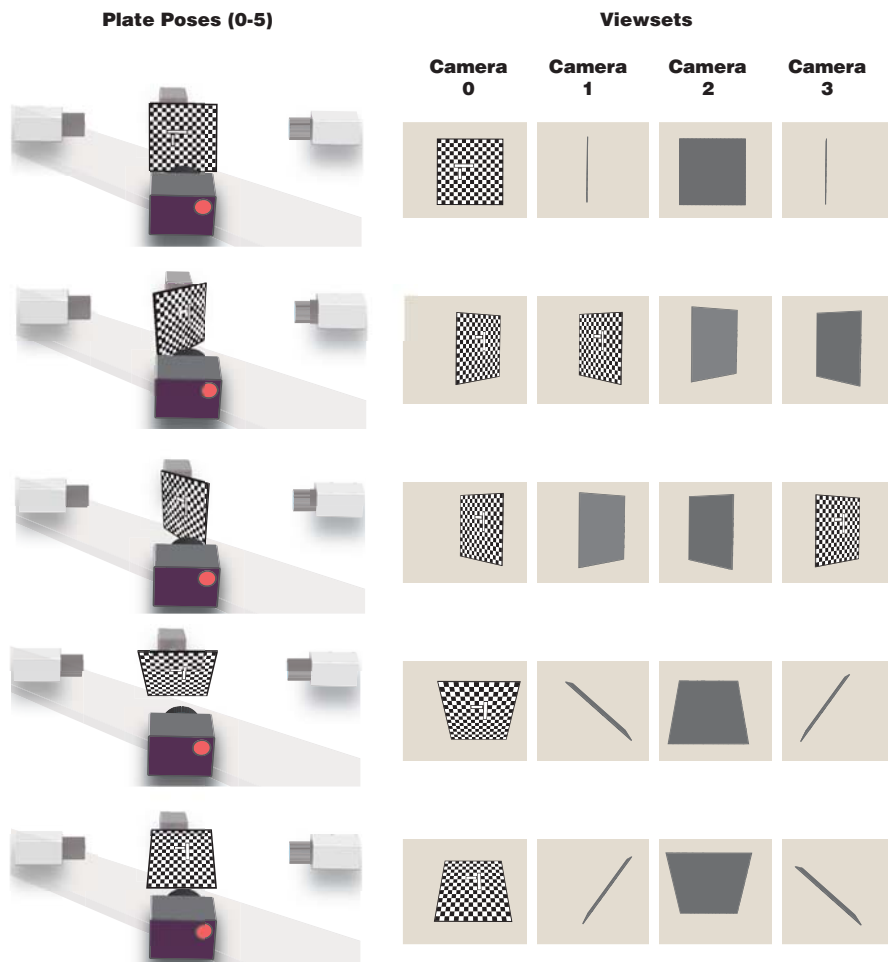


Figure 8. Viewsets 0-4 (camera position 0)

In Figure 8, each row of acquired images is a viewset. Each viewset contains four images from the four cameras showing the same calibration plate at the same time. To perform OmniView calibration, you must acquire the five viewsets shown in Figure 8 at each of the four camera positions.

Viewsets 5-9, 10-14, and 15-19, at camera positions 1, 2, and 3, are acquired in exactly the same way as the first 5 viewsets.

Note

Each successive camera position's viewsets includes images that are redundant to images from the previous camera position. You can omit these images, but including the redundant images improves the accuracy of the calibration.

Defining the Origin of Physical 3D Space

After acquiring the viewsets listed above, each of which has a pose type of *Cog3DCalibrationPlatePoseTypeConstants.PoseTilted*, you must acquire one additional viewset. This final viewset has a pose type of *Cog3DCalibrationPlatePoseTypeConstants.PoseDefineWorldCoord*, and the origin defined by the calibration plate is used as the origin of the 3D physical space in which OmniView returns part poses. Figure 9 shows how the calibration plate fiducial defines the origin in three dimensions.

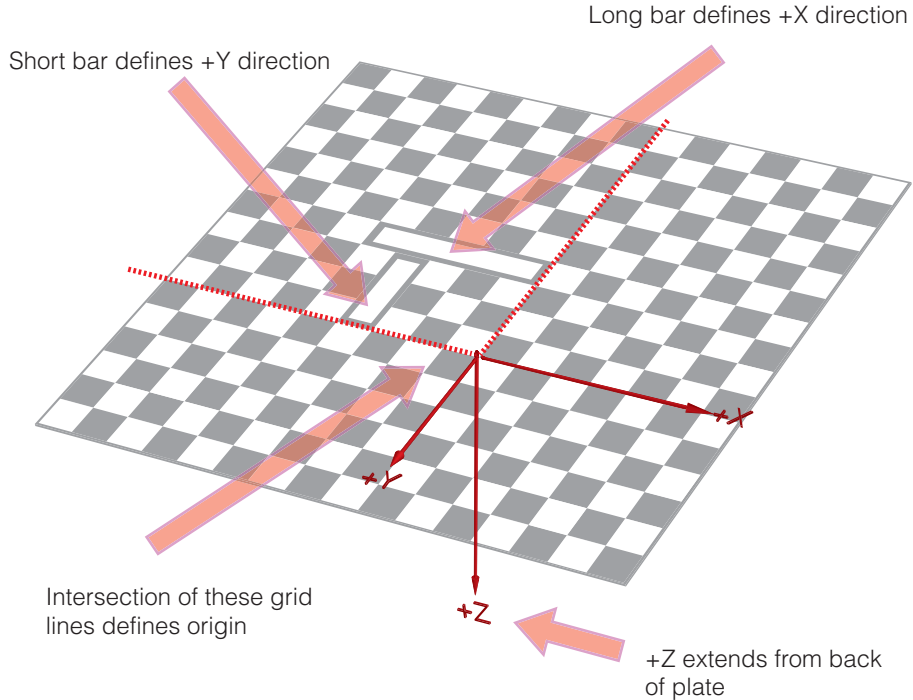


Figure 9. Calibration plate fiducial definition

Note

In addition to positioning the plate so that the origin is where you would like to place the origin of 3D physical space, the plate should be visible to two cameras.

Auto-Adjusted Physical Space Origin

OmniView SDK by default automatically readjusts the origin of calibrated 3D physical space. Unless specified otherwise, the origin of 3D physical space has its origin at the center of a region defined by the four cameras' positions, with the X- and Y-axes aligned to orientation of the cameras, as shown in Figure 10. The positive Z-direction is determined by the handedness of the camera ordering. For cameras arranged in the counterclockwise order (as shown in this document, the Z-axis points up).

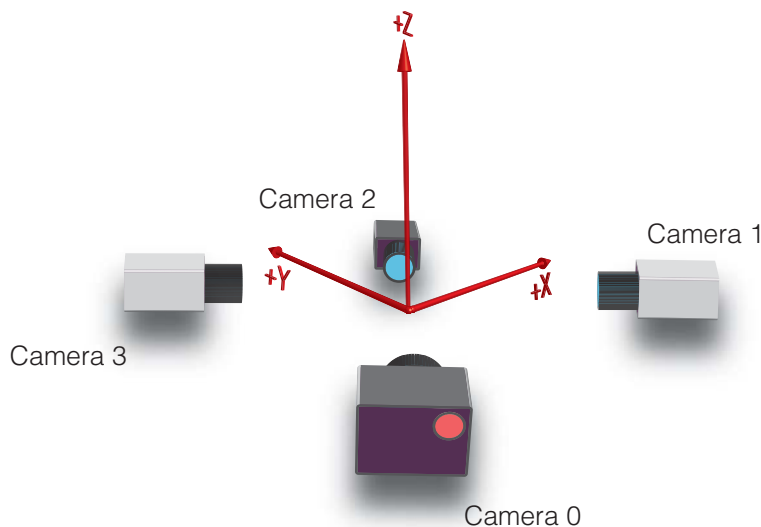


Figure 10. Computed 3D coordinate system.

■ An OmniView model allows you to create an accurate mathematical representation of the part that you are inspecting.

You can create a model by tracing the edges of the part as seen in a set of images acquired from calibrated OmniView cameras, or you can use the dimensions of the part to create the model directly. This chapter describes both techniques.

Note

Creating an accurate model of the part that you are inspecting is an essential prerequisite for the successful creation and deployment of an OmniView application.

OmniView Models

An OmniView model is a mathematical description of the 3D surface of the object that you are inspecting with OmniView.

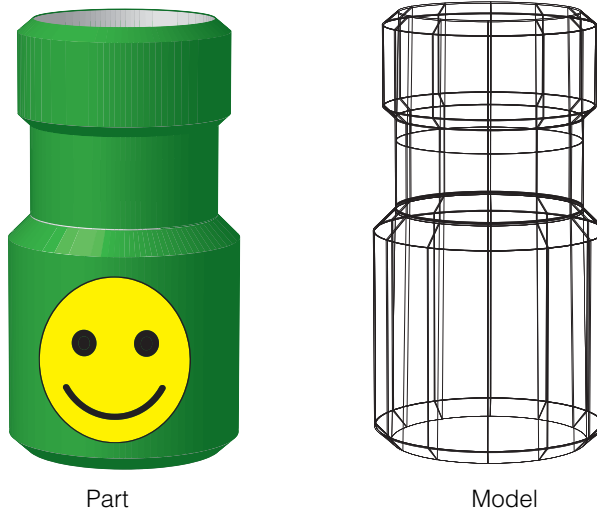


Figure 11. OmniView Model

The particular internal representation used to describe the object surface is not exposed by the OmniView programming interface. Instead, OmniView provides a high-level interface that lets you define a model, along with other tools that let you locate the model in 3D space and create a 2D image that represents the surface of the part.

OmniView uses the model in two ways. By attempting to match the part silhouettes found in images from calibrated cameras with the ideal part silhouette, it can compute the 3D pose of the model in 3D physical space. OmniView also uses the model information to map the image data from the cylindrical 3D model surface to an unwrapped 2D image.

Model Coordinate Space

Each OmniView model has an associated coordinate space. OmniView model coordinates form a 3-dimensional right-handed space. The Z-axis of model coordinate space defines the axis of rotation for the model. The rotation of the X- and Y-axis about the Z-axis are undefined. The origin of the coordinate space is at the midpoint between the top and bottom of the model.

Figure 12 shows the model coordinate system.

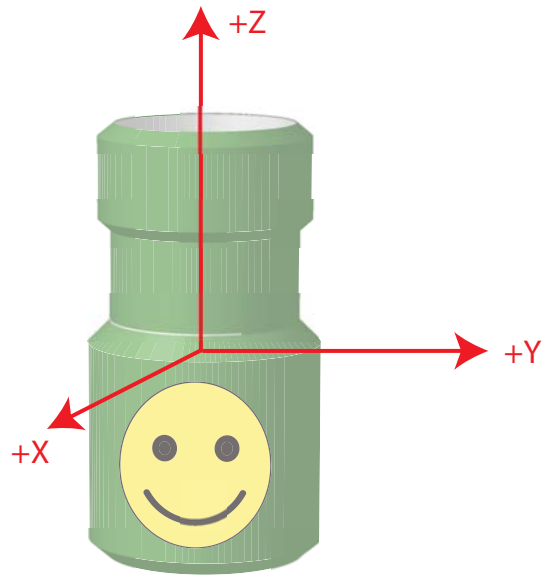


Figure 12. Model coordinate system

How to Specify a Model

OmniView provides two methods for creating a model:

- You can provide a set of contour pairs in image space, where each pair reflects the edges of the object as viewed in an image from a calibrated camera. You must provide a separate contour pair for each calibrated camera, and the images used to create the contours must have been acquired simultaneously.
- You can provide a single contour defining the outer edge of the model in physical units.

Contour Pair Sets (Image-based Training)

You can create an OmniView model by providing a set of contour pairs, where each contour pair is created by tracing the apparent edges of the part in an acquired image. In order to create the model, you must first calibrate your system, then acquire simultaneous images of the part from all of the OmniView cameras. Create contour pairs that accurately describe the apparent edges of the part in each image and supply them to OmniView, along with the OmniView calibration object associated with the cameras from which the images were acquired, to create the model.

Figure 13 shows how to create a model using image-based contour pairs.

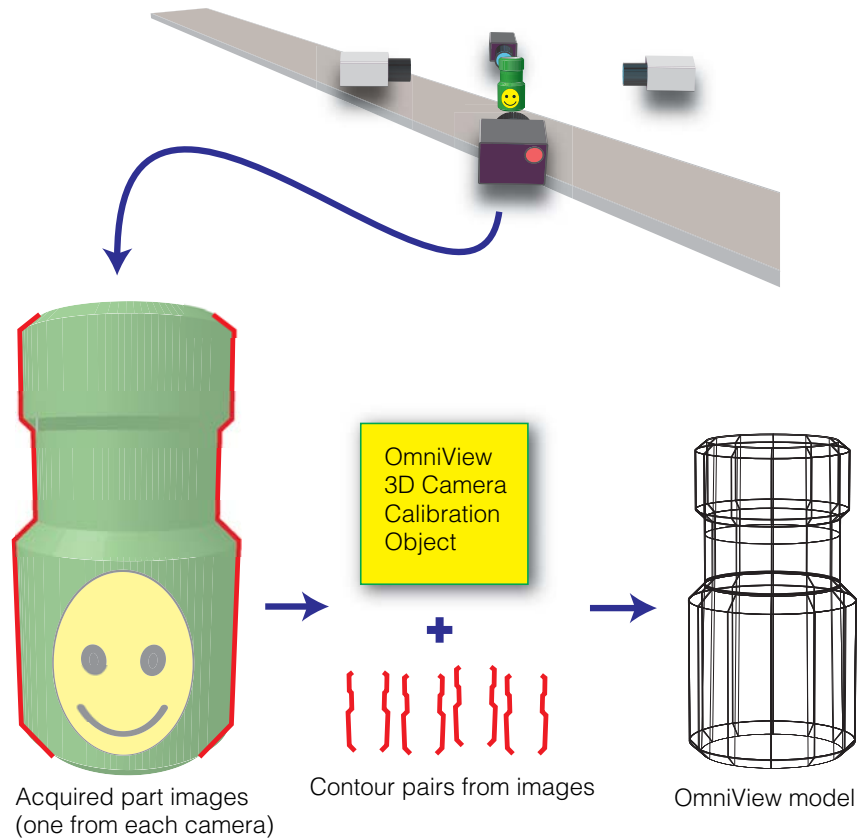


Figure 13. Creating an OmniView model from multiple contour pairs

- Note** The contours that you create must accurately reflect the *apparent* part boundary in the image; do not attempt to straighten or idealize the contour to reflect the actual shape of the part. Also, in cases where perspective distortion in the image creates occlusions of the edge, do not reflect those occlusions in the contour.
- Note** The contour point locations are expressed in the raw 2D image spaces of the acquired images.

Rotated Spline (CAD Based)

If you are able to generate an accurate numerical description of the shape of your part, such as from CAD data, you can also create an OmniView model directly. Simply create a single 2D spline that defines the shape of the edge of the part. OmniView will create a model by rotating the 2D spline about the Y-axis, as shown in Figure 14.

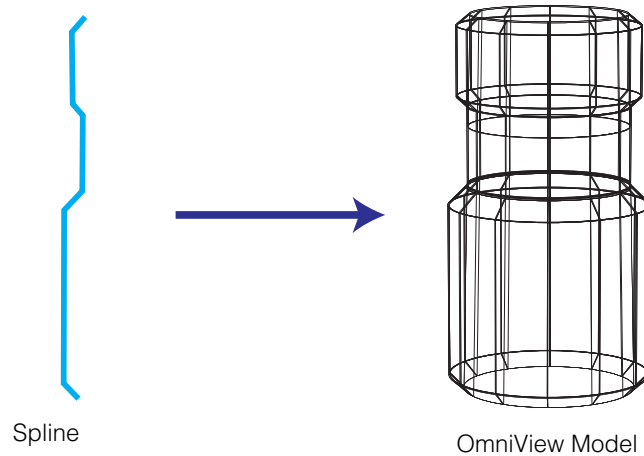


Figure 14. Creating an OmniView model from a 2D spline

Note

The 2D coordinate space defined by the spline must use the same units as 3D calibrated physical space (inches or mm). The Y-axis of the 2D spline coordinate space corresponds to the Z-axis of the model, but the origin of the model coordinate space is re-centered to lie at the vertical center of the model.

- The OmniView 3D Part Alignment tool determines the 3D pose of a part in 3D physical space based on the appearance of the part in multiple 2D images from calibrated OmniView cameras.

In order to align your part, you must

- Have an accurate 3D model of the part
- Have a calibrated multi-camera OmniView system
- Acquire simultaneous images from each OmniView camera of the part

Accurate 3D part alignment allows your application to determine the position and orientation of objects under inspection and it allows OmniView to create accurate unwrapped images of your part surface.

How does 3D Part Alignment Work?

OmniView 3D part alignment is based on Cognex's 3D-Locate technology. Calibrated 3D cameras provide for an accurate mapping between 3D points in physical space and the corresponding projected 2D point in the raw image space of an image from a calibrated camera. If the same 3D point can be seen in images from multiple cameras, 3D-Locate can determine the 3D point *from* the 2D points.

OmniView 3D part alignment extends this technology by mapping the 2D edge locations in the images acquired from the calibrated cameras to 3D splines in 3D physical space, then determining the 3D model pose that most accurately fits the 2D edge locations.

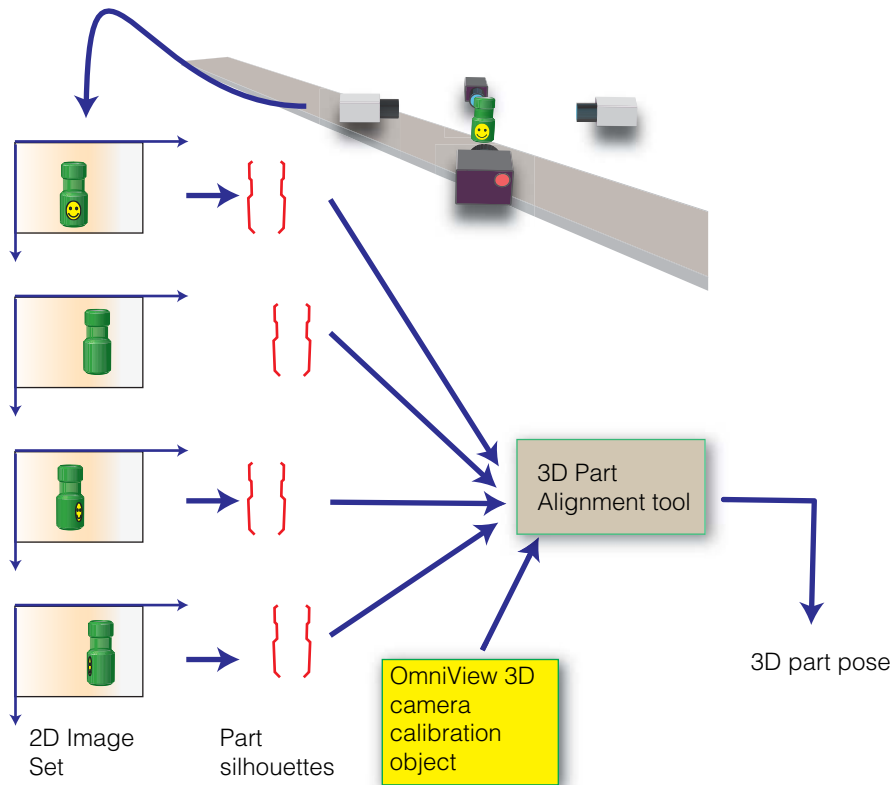


Figure 15. OmniView 3D Part Alignment tool

The OmniView 3D Part Alignment tool performs a search for the best-fit 3D pose for the trained model in the 3D search space that you specify.

Like other Cognex alignment technologies, the OmniView 3D Part Alignment tool must be trained before it is run.

3D Search Score

At run time, the OmniView 3D Part Alignment tool computes a *search score* for each model instance that it finds in the 3D search space. The score, which can range from 0.0 (no match) to 1.0 (a perfect match) depends on the degree to which the part silhouette edges detected in the 2D images correspond to the part silhouette edges that are predicted by projecting the edges defined by the 3D model through the camera calibration object onto raw 2D image space.

Figure 16 shows how the match score is computed.

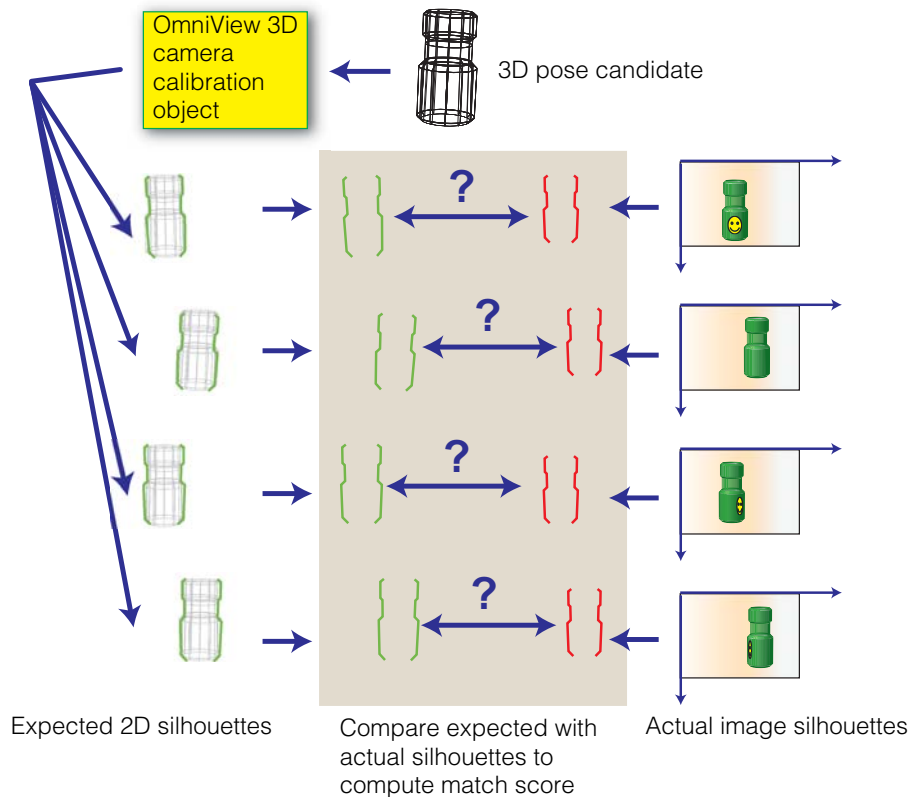


Figure 16. OmniView 3D Part Alignment tool match score

Training the OmniView 3D Part Alignment Tool

To train the OmniView 3D Part Alignment tool, you must provide the inputs listed below.

Input	Description	How Supplied
OmniView 3D Model	The 3D geometric description of the surface of the part that you are inspecting. See the chapter <i>OmniView 3D Models</i> on page 47 for information on creating this model.	Argument to Execute() function.
OmniView Camera Calibration Object	A valid camera calibration object created using the cameras that will be used at run time.	Argument to Execute() function.
Nominal Part Pose	The 3D pose in 3D physical coordinate space where you expect the part to be.	Member of training parameters object.
Search Space	The range of possible locations within 3D physical space to search. You can specify the amount of translation in the X-, Y-, and Z-direction (in 3D physical units) as well as the amount of tilt with respect to the Z-axis.	Member of training parameters object.
Grain Limits and Factors	Information about the feature size and sampling rate for the alignment tool to use. For more information, see the section <i>Grain Limits and Grain Factors</i> on page 57.	Member of training parameters object.

Input	Description	How Supplied
Don't Care Regions	You can specify that the tool ignore certain portions (Z-ranges) of the model. Specifying don't care regions lets you train models that are not radially symmetric at all points in the Z-direction or whose appearance may vary depending on rotation, or for shape features with poor contrast in the viewset.	Member of training parameters object.
Outside Region Threshold	You can specify that the tool not reduce the match score when the specified fraction of run-time features are outside of the cameras' fields of view.	Member of training parameters object.

Table 1. Training time inputs

- Note** Training the OmniView 3D Part Alignment tool may take several minutes, depending on the size of the search space. For an overly large search space, training may fail altogether. Specify a search space that is large enough to encompass expected movement, but no larger than necessary.
- Note** If your model contains limited features in the Z-direction (such as a cylindrical object), avoid specifying any uncertainty in the Z-direction.

Grain Limits and Grain Factors

At training time, you need to specify the *grain limits* that the tool uses to train the model. The grain limits specify the range of feature sizes that the tool will use to locate the object. The grain limits are specified in model coordinate system units.

By default, the tool automatically computes grain limits that are appropriate for the model that you supply. In some cases, for parts that are small in comparison with the field of view, you may be able to improve alignment robustness by reducing the coarse grain limit, although this will cause the tool to run more slowly.

For more information on grain limits, see the information on PatMax in the *VisionPro User's Guide* of the online documentation.

In addition to grain limits, the tool also allows you to specify *grain factors*. The grain factors control the sampling rate used to encode model features at training time. You can reduce the sampling rate to increase performance.

Running the OmniView 3D Part Alignment Tool

To run the OmniView 3D Part Alignment tool, you must provide the inputs listed below.

Input	Description	How Supplied
Image Set	A set of images of the part. The images must have been simultaneously acquired from calibrated OmniView cameras. The cameras must be those used to create the calibration object used for training, and the cameras intrinsic and extrinsic parameters must be unchanged from calibration.	Argument to run() function.
Accept Threshold	The minimum score a model instance must receive to be considered a valid instance. See the section <i>3D Search Score</i> on page 55 for information on how the score is computed.	Member of run parameters object.
Coarse Confusion Factor	The highest score something other than a valid model instance may receive. You specify this value to provide a hint to the tool regarding how confusing the run-time image is. (Unlike other Cognex alignment tools, the OmniView 3D Part Alignment tool confusion threshold is only applied during the coarse phase of the alignment.)	Member of run parameters object.
Number to Find	How many model instances to find. In most cases, this value is 1.	Member of run parameters object.
Fuzzy Contrast Range	A weighting function that allows you to control the weight assigned to features in run-time images based on their contrast.	Member of run parameters object.

Table 2. Training time inputs

OmniView 3D Part Alignment Tool Results

For each model instance that the OmniView 3D Part Alignment tool finds in the image set that scores above your acceptance threshold, the tool returns the 3D pose of the object (expressed as the pose of the trained model's coordinate system in calibrated 3D space) and the score that it received. The instance is considered a valid instance only if its score is above the accept threshold that you specified at run time.

Note

The returned pose does not include any information about the rotation of the object about the model z-axis. You can use the Image Unwrap and Align tool, described in the next chapter, to obtain the rotation of the part.

Image Unwrapping and Registration

6

- This chapter describes how OmniView creates and aligns unwrapped images of the surface of your part.

You can specify multiple unwrap regions, in which case the tool will generate multiple unwrapped images. The tool also allows you to define an anchor point in the unwrapped image, and it will automatically align subsequent images to the anchor point that you specify.

Image Unwrap Tool

To use the Image Unwrap tool, you specify one or more *unwrap regions*. Each unwrap region is given as a range of z-positions in the 3D model coordinate space. The Image Unwrap tool creates a separate 2D image for each unwrap region that you specify.

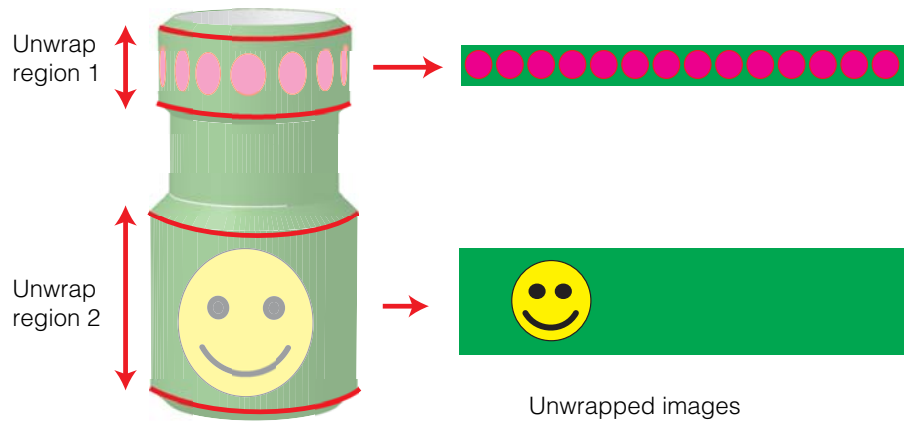


Figure 17. Unwrap regions

Overlap

In most cases, adjacent OmniView cameras will have partially overlapped views of the part being inspected, as shown in Figure 18.

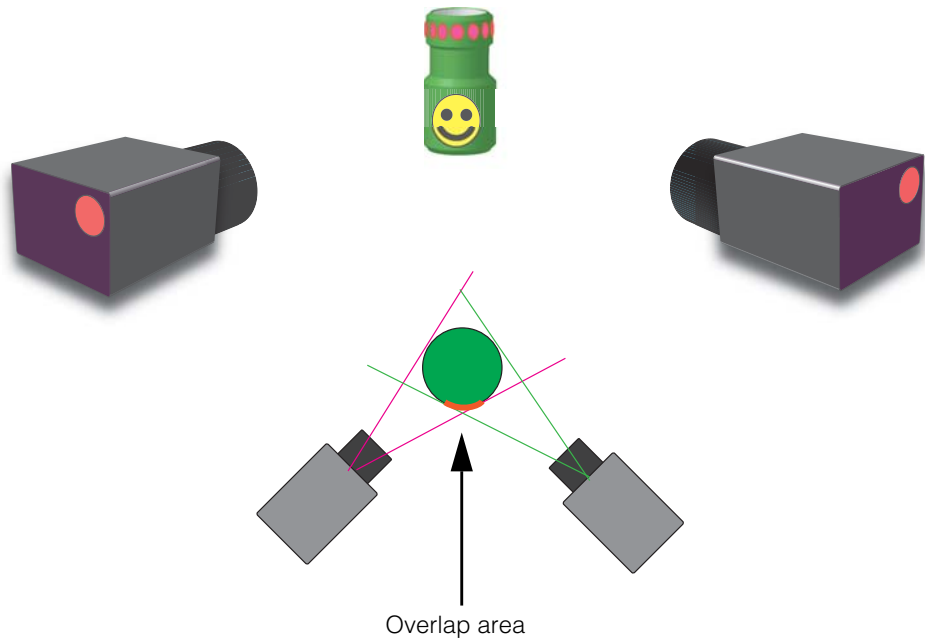


Figure 18. Overlap

The amount of overlap is determined by the size and location of the part with respect to the cameras. You can control how OmniView processes the overlapped image data.

The amount of image overlap is expressed as the difference in angle between the apparent edge of the part in images from adjacent cameras, expressed in the 3D model coordinate space. By specifying a *maximum overlap angle* you can limit the amount of overlapped image data that the tool processes.

Figure 19 shows the effect of using a reduced maximum overlap angle on the output images from adjacent cameras.

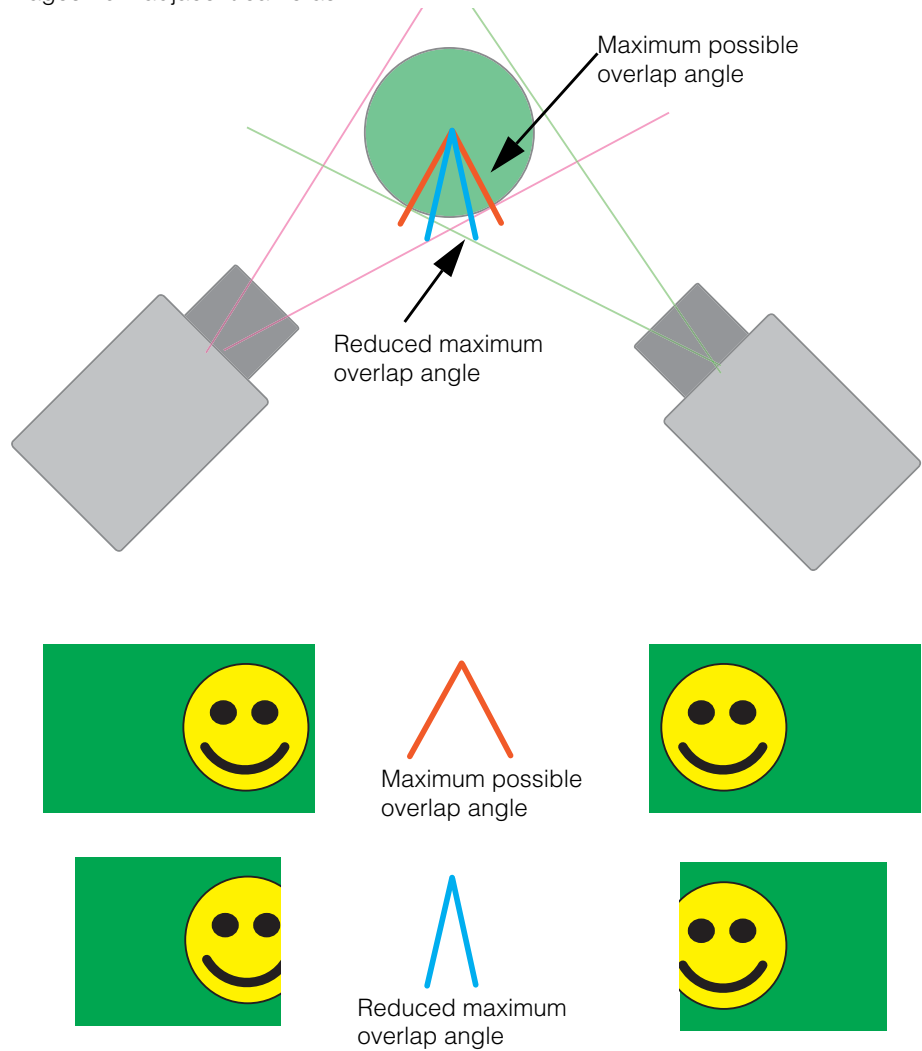


Figure 19. Overlap angle

Blending

By default, OmniView will blend the overlapping pixel data from adjacent cameras to create the output image. Because of the effect of residual calibration error, part variation, and lighting effects, features may not be precisely aligned in the adjacent camera images.

When blending is enabled, the unwrap tool will perform the following steps to create the blended output image:

- The tool automatically registers the features from the two images.
- If the features are misaligned, the tool resamples both images to shift the features so that they are aligned.
- The tool applies a linear weighting function so that each pixel in the output image has a value determined by pixels from the two adjacent cameras' images. At the center of the overlap region, the two images both contribute equally to the output image pixel values.

Blending Errors

If the tool is unable to register features in the adjacent cameras' images, it will apply the linear weighting function without attempting to resample the image. Depending on the image content, this can result in image artifacts such as blurred or doubled features.

You can adjust the threshold that the tool uses to determine whether the images are registered, which may help avoid this problem.

If you experience blending errors, verify the following items:

- Validate the camera calibration using the 3D camera calibration validation tool. Recalibrate if needed.
- Make sure that your cameras' positions and optical characteristics have not changed since calibration. Recalibrate if needed.
- Check the score received for the alignment result. Low-scoring alignment results may produce poor-quality blending.
- Make sure that the search space (range of degrees of freedom) is large enough to accommodate the actual variation in part position.

Disabling Blending

You can disable blending completely, in which case the tool will simply concatenate the images from adjacent cameras. Figure 20 shows the effect of disabling blending on the output image.

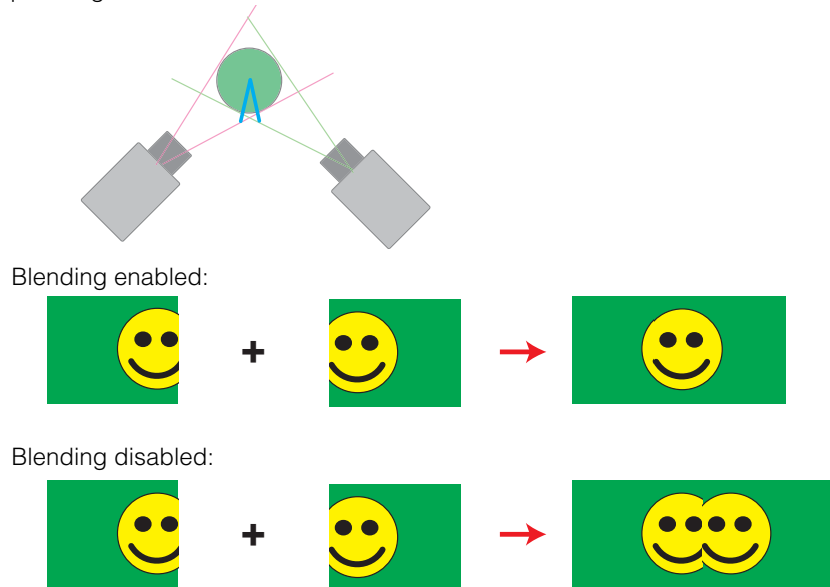


Figure 20. Blended and unblended images from adjacent cameras

Disabling blending will result in duplicated image content at the image boundary. The amount of duplication depends on the maximum overlap angle that you specify, as shown in Figure 21.

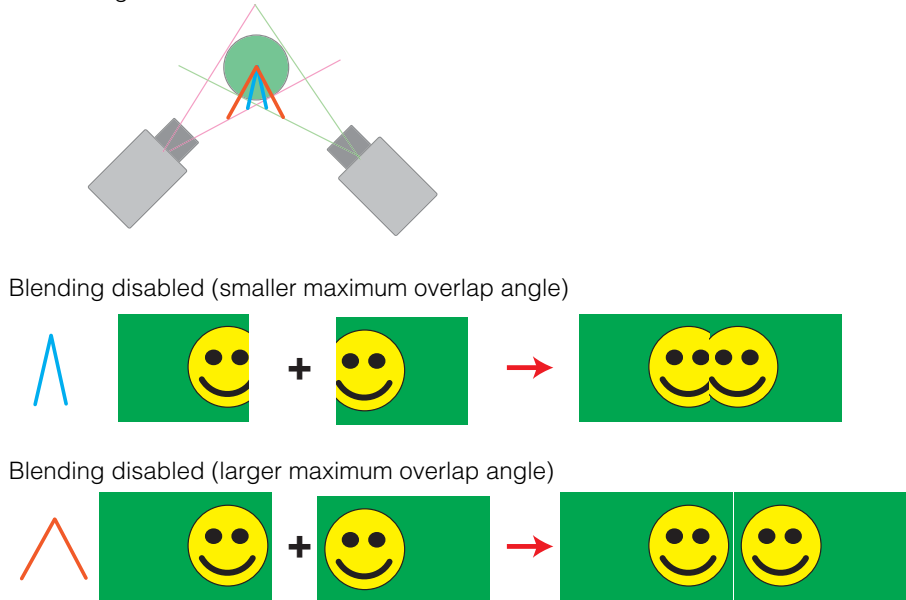


Figure 21. Effect of varying maximum overlap angle on unblended images

Unwrapped Image Information

In addition to an unwrapped image for each unwrap region, OmniView also provides lookup tables that allow you to:

- map a given image column to the radial angle (in 3D model space) at which the pixel was acquired;
- map a given image row to the Z-position (in 3D model space) at which the pixel was acquired;
- map a given image row to the physical dimensions of the pixel (for example, at the specified image row, each pixel represents 1.1 x 1.3 mm of the physical surface of the part); and
- map a given image column to a table giving the blend weight (how much of that column of pixels came from the left camera, how much from the right camera).

Aligning Unwrapped Images

The OmniView Unwrap Align tool can be used to align unwrapped images based on features that are always present in the same location on each part. Like most Cognex alignment tools, the tool must be trained before it can be run.

You train the Unwrap Align tool by specifying the start column within an unwrapped image of a known good part. If you are using multiple unwrap regions, you must specify which of the regions to use for alignment. The tool will automatically generate aligned output images for all unwrap regions, but it always performs the alignment using a single unwrap region.

Training the Unwrap Align Tool

To train the unwrap align tool, you must provide the inputs listed below.

Input	Description	How Supplied
Unwrap Tool Result Set	The output from a single run of the Unwrap tool. This result includes the unwrapped images produced for all unwrap regions. This result set should contain an image that represents a known good part.	Argument to Execute method
Unwrap Region Index	An index that specifies which of the unwrap regions to use for alignment	Argument to Execute method.
Offset Column	The pixel column within the unwrapped image to use as the starting column for aligned images. This pixel column redefines the X-axis of model 3D space (see the section <i>Model Coordinate Space</i> on page 48 for more information).	Member of train parameters object.
Grain Limits	Information about the feature size and sampling rate for the unwrap align tool.	Member of training parameters object.
Sub Align Region	One or more defined areas to assist in locating the offset you want to use to start the unwrap of each image.	Member of training parameters object.

Table 3. Training time inputs

Running the Unwrap Align Tool

To run the unwrap align tool, you must provide the inputs listed below.

Input	Description	How Supplied
Unwrap Tool Result Set	The output from a single run of the Unwrap tool. This result includes the unwrapped images produced for all unwrap regions.	Argument to Execute method.
Unwrap Size	The amount of image information, in radians, that you want to generate, between $[2\pi, 4\pi]$.	Member of training parameters object.

Table 4. Run time inputs

Since the unwrap align tool can determine the part's rotation by registering its surface features, the output from the tool includes aligned images for all unwrap regions, the angle of the part in 3D physical space, and the 3D pose of the part in 3D physical space.

