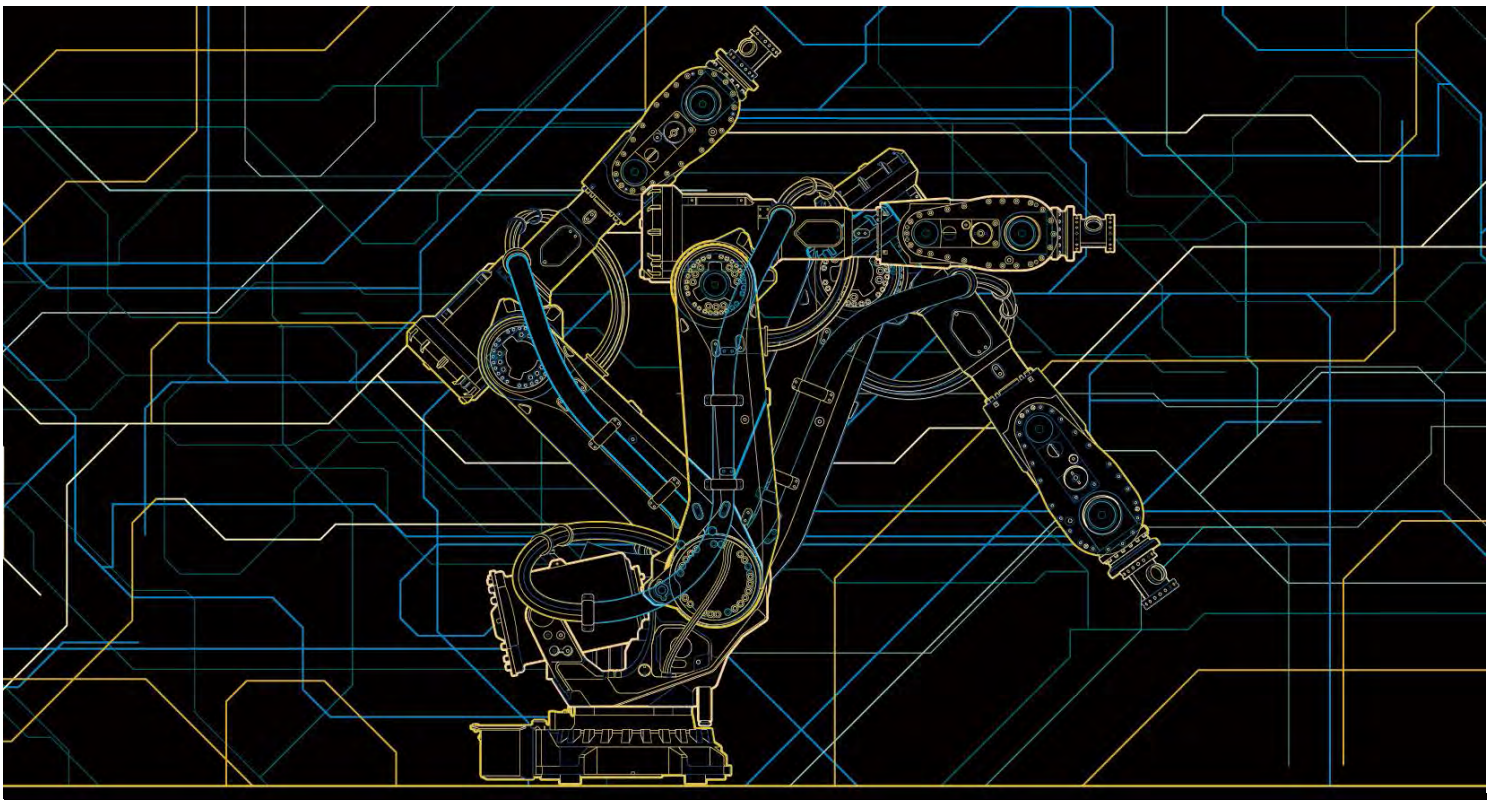

Application manual
PickMT

Power and productivity
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Application manual
PickMT

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Revision: A

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Table of contents

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Overview of this manual

About this manual

This manual describes the software PickMT, which is part of the option FlexMT.

Usage

User manuals are used to understand how to use the product, for example to install, configure, or operate.

Users

This manual is intended for:

- Personnel that are responsible for installation and configuration of robot systems
- Programmers
- Service engineers

Trademarks

FlexMT is a trademark of ABB.

PickMT is a trademark of SVIA, Svensk Industriautomation AB.

References

Reference	Document ID
Product specification - FlexMT	*3HAC049820-001*
Product manual - FlexMT	*xyz-1*
Product manual - IRB 2600	*3HAC035504-001*
Product manual - IRB 4600	*3HAC033453-001*
Product manual - Safety center for FlexMT	*3HAC051769-001*
Application manual - PickMT with ABB robot	*3HAC051770-001*
Application manual - FeedLine Light	*3HAC052311-001*

Revisions

Revision	Description
-	First edition.
A	Minor corrections.

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1 What is PickMT?

PickMT is a vision system designed to guide industrial robots during materials handling. A camera is used to identify the location, position and orientation of a detail and this information is sent to the robot. The robot can then pick up or manipulate the detail in some other way without the need for any mechanical fixtures.

PickMT can be connected to machines with conveyors that stop before a picture is taken, or with continuously moving conveyors. These systems are known as Stop & Go and Conveyor Tracking respectively.

PickMT can also be connected to machines with various types of feeding of details, or use a camera that is attached to a robot

PickMT for Stop & Go operation can serve up to four cameras that may work one at a time (standard version) or with several cameras that work simultaneously (MultiCamera version).

PickMT for Conveyor Tracking may be equipped with one camera or several cameras.

PickMT is very powerful and will work with most robotic materials handling applications. PickMT also uses a patented method for avoiding tool collisions when gripping or handling materials.

PickMT has a simple and intuitive user interface that is designed to minimize set-up times.

PickMT can be operated together with several different robot makes. To integrate robots with PickMT, read the PickMT Robot integration manual for the relevant robot manufacturer together with this manual.

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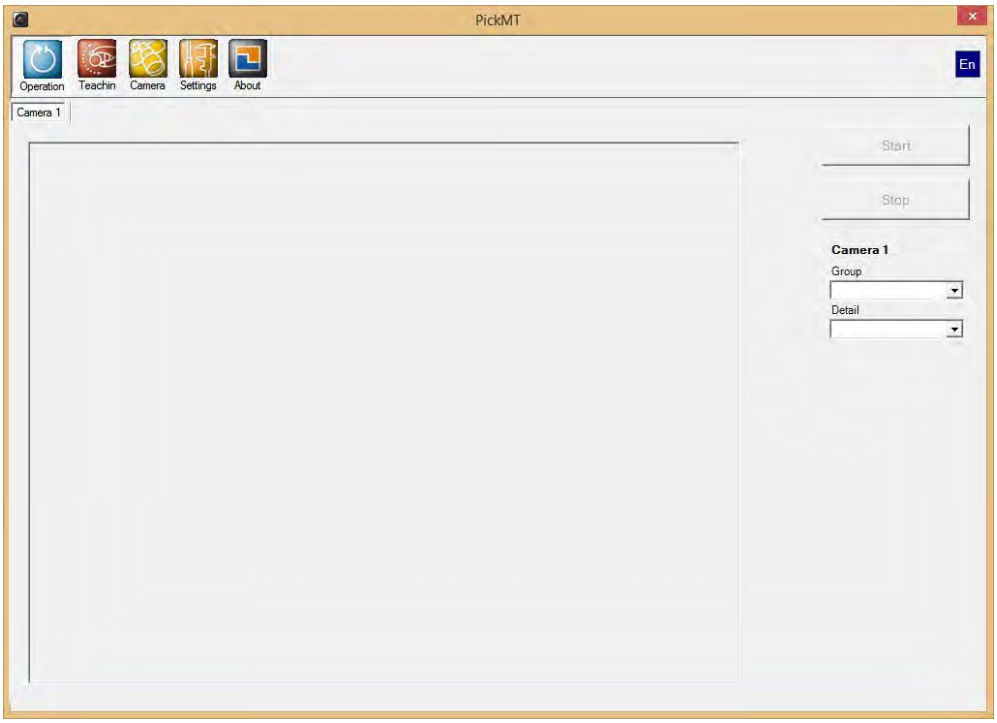
2 Overview

2.1 Activity field

After PickMT has been started up you will see the following screen.



At the top of the PickMT window is an activity field showing a number of icons that represent various system activities.

Operation – Used to start and stop the system. Information on the current operation is also displayed here.

Teachin – This is where you teach the system how to handle details.

Light (option) – Detail teachin is carried out here if the machine is supplied as a FeedLine Light.

Camera – Used to calibrate the system and make other camera-related settings.

Continues on next page

Settings – This is where you find general tools for configuring, servicing and maintaining the system.

Information – Provides information on the current software version and contact information for service and support.

2.2 Image operations

PickMT displays images at many different locations. To the right of each image there is a tool palette. Not all the tools are displayed for every image – only the tools that can be used for the relevant operation are displayed. When a tool is chosen the button is highlighted and that operation will be carried out when you click somewhere in the image. The functions of each of the icons in the tool palette are described below.

Reset zoom: Select when you want to zoom in or out of an image and see it at normal scale again.

Zoom in: Select when you want to zoom in on an image.

Zoom out: Select when you want to zoom out of an image.

Pan: If you have zoomed in on an image you can use this tool to move around the image. Press the mouse button and drag the mouse to pan. Then release the mouse button.

Define position: Used to define position or gripper limit. Press the mouse button, drag the mouse diagonally to draw a box of the desired size, then release the mouse button.

Define grip: Used to define grip. Press the mouse button to place the grip point at the current mouse position.

Draw: Used to draw. Press the mouse button to draw a point at the current mouse position. Release the mouse button to stop drawing. To change the drawing size, adjust the slider as required.

Clear: Used to delete objects. Press the mouse button to delete the drawing at the current position. Release the mouse button to stop deleting. To change the delete size, adjust the slider as required.

Draw line: Used to draw lines. Press the mouse button where you want the line to start, drag the mouse to the point where you want the line to end, then release the button.

Continues on next page

Draw box: Used to draw boxes. Press the mouse button where you want the box to start, drag the mouse to the point where you want the box to end, then release the button.

Draw circle: Used to draw circles. Press the mouse button where you want the circle to start, drag the mouse to the point where you want the circle to end, then release the button.

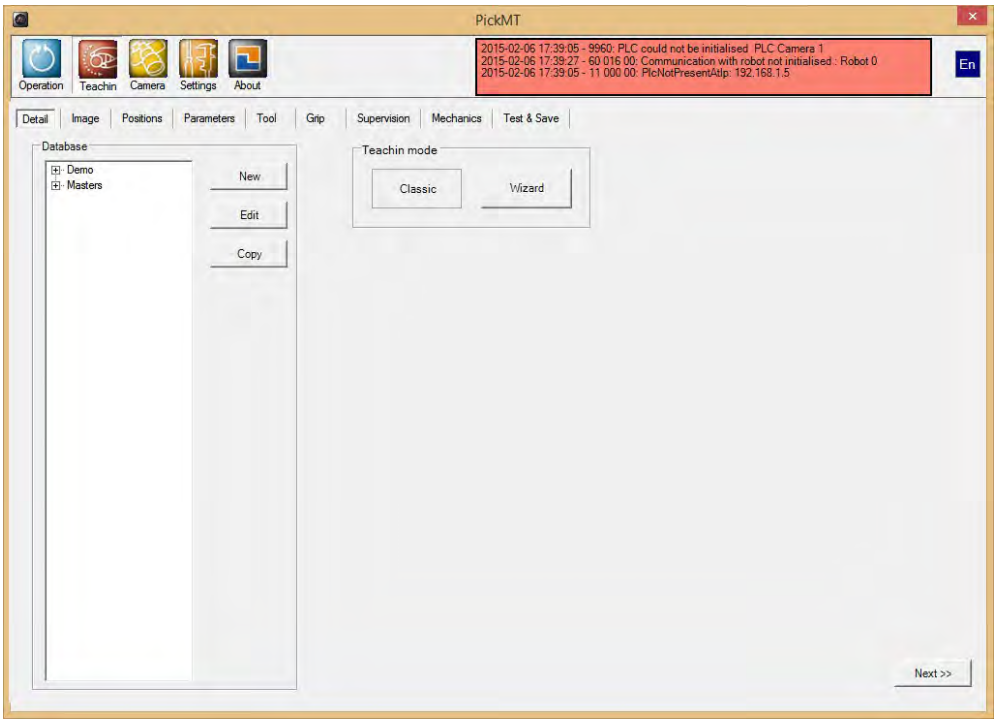
Rollback: Used when you want to undo the last drawing action.

Changing brush size for drawing.

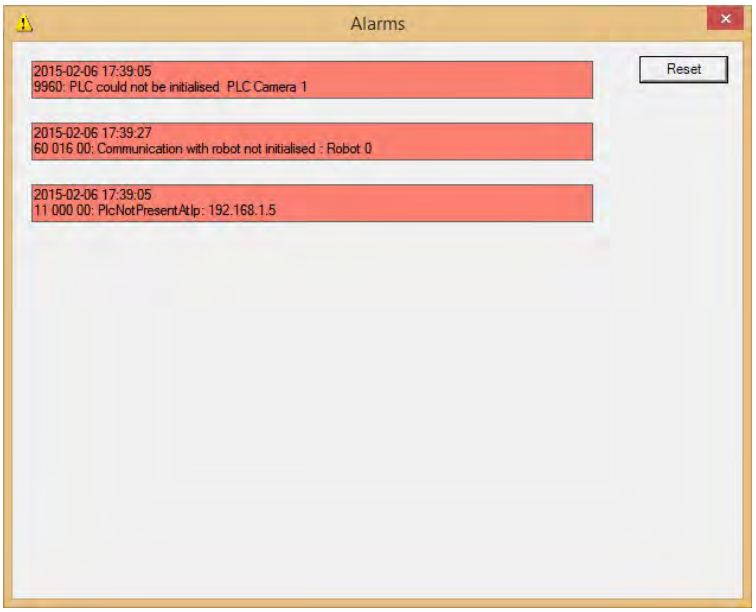
Changing brush size for drawing.

2.3 Alarm

The system continuously carries out tests to check that all the units are working. If a unit is not working it triggers an alarm that appears at the top of the window next to the activity field. It is always the most recent alarm that is displayed.



Clicking on the alarm gives a list with all active alarms and brings up more information about its cause.



2.4 System information

The above window appears when you click on the ‘About’ icon. It gives information about the current version of software being used, license information and contact information for obtaining service and support.

3 TeachIn

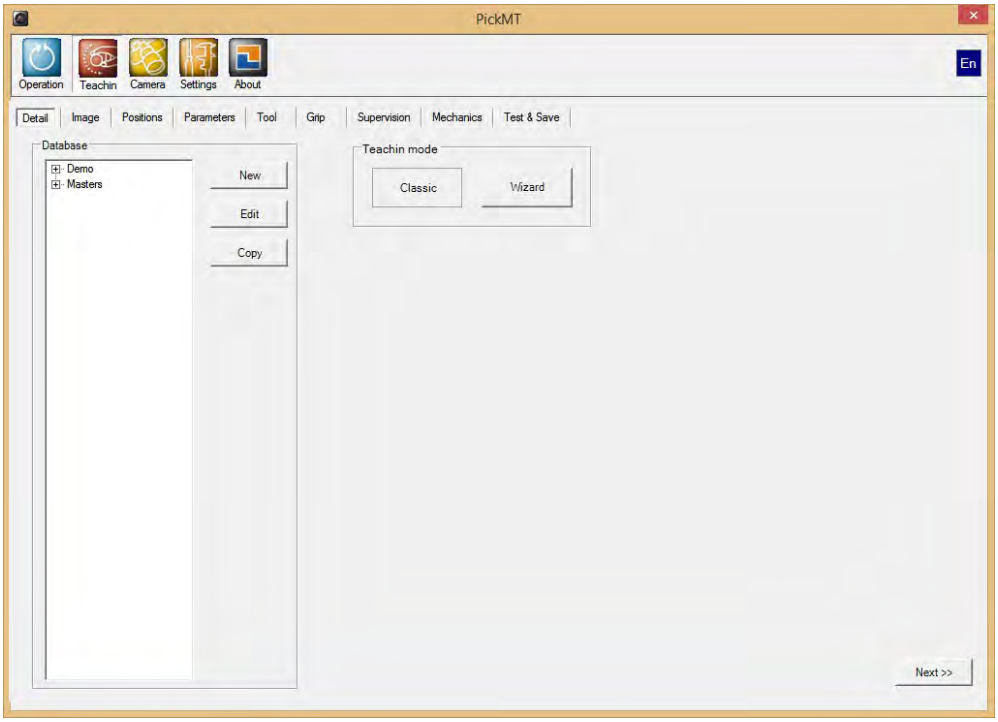
Before the system can be used it must be taught about the details it will handle. During the ‘Teachin’ process you tell the system what it should look for and how the robot should grip or handle the identified details as well as how the feed equipment is to be set. ‘Teachin’ is divided into a number of stages. At the bottom right of each stage there are 2 buttons: ‘<< Back’ and ‘Next >>’. These allow you to move quickly between the different stages. To change something in the previous stage, press the ‘<< Back’ button.

You can also get extra help during the ‘Teachin’ process. If you click the ‘Wizard’ button you will see the help text. The user must then go through the ‘Teachin’ process step by step in a preset order. In ‘Classic’ mode the help text will not be shown. The user then has the option to move freely between the various ‘Teachin’ stages.

Continues on next page

3.1 Detail

The first tab that appears during ‘Teachin’ is ‘Detail’. All the details that are learned by the system are saved in a database. The database is divided into various groups. Each group can contain details. An unlimited number of groups and details can be saved in the database.



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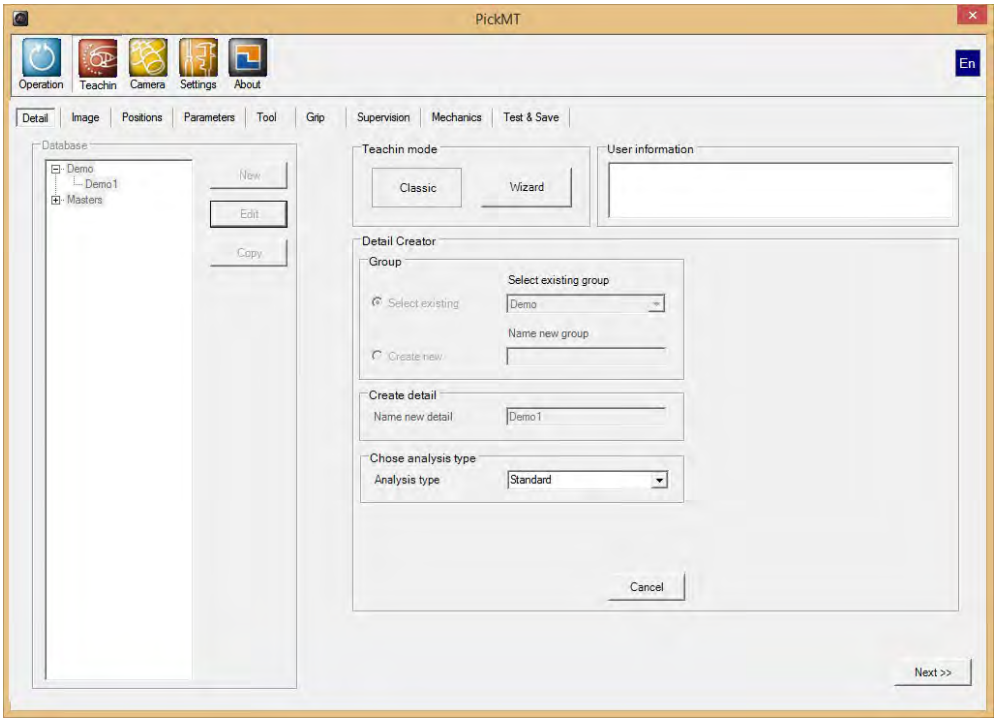
On the left is a box labelled Database. This shows the various groups in the database. Clicking on the + sign in front of a group expands that group so you can see the details in the group.

Create new detail

Clicking on the ‘New’ button creates a new detail in the database.



You can choose here if you want the new detail to be saved in an existing group or if you want to create a new group. The detail should also be given a unique name. Several details can share the same name, but they must all be placed in different groups.

If the system has more than one camera you will also see a box headed ‘Select Camera’. Here you should choose the camera to be used for the ‘Teachin’ process. This box will not appear if there is only one camera connected to the system.

Select analysis type (option)

If the option for blob searching is enabled in the system, the operator can choose which search method is to be used for this detail: Standard or Blob.

Edit detail

To modify a detail, first select it and then click on ‘Edit’. Double-clicking on the detail in the database box also selects the detail for editing.

Continues on next page

Copy detail

Very often a system will handle many types of details that are similar. The copy button can be used to quickly create a copy of a detail that can then be modified when teaching the system to use a similar detail. This lets you reuse many settings that are identical.

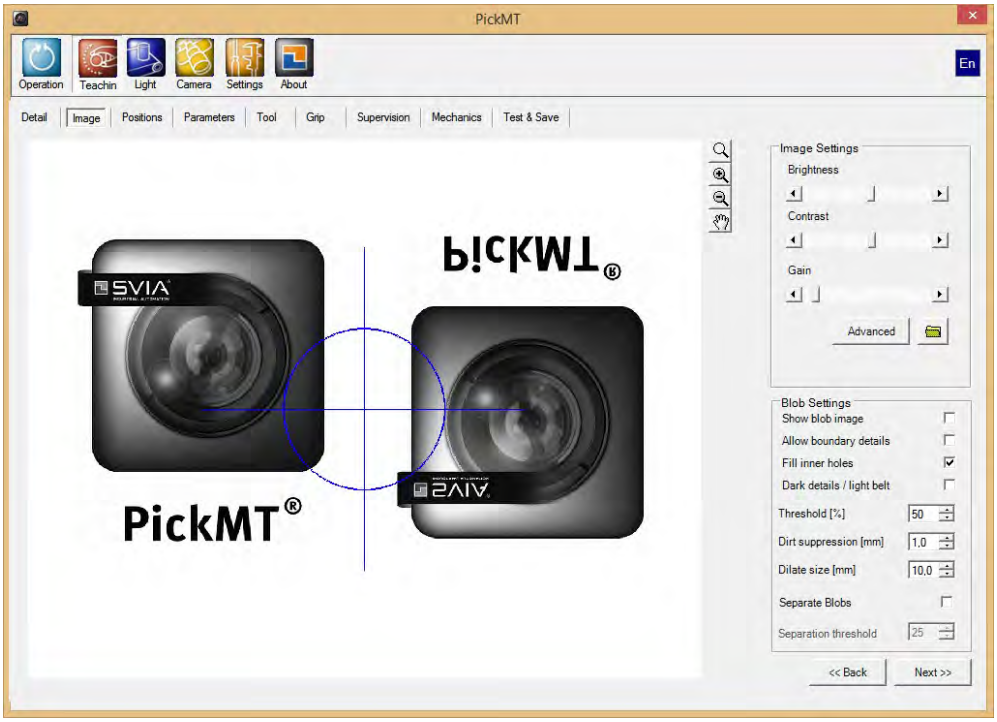
To copy a detail, select the detail in the database box and click ‘Copy’.

You should then enter a new name for the detail as shown in the image above. The detail will be placed in the same group as the original detail.

3.2 Image

3.2.1 2D sensor

The camera settings are configured under the ‘Image’ tab. These settings are then used when images are taken of the current detail. The image can be adapted by adjusting its brightness, contrast and gain. The effect on the image is seen immediately.



Fast and reliable identification of taught details requires the clearest possible contrast between the background and the detail. If the contrast between background and detail is poor this will result in reduced system performance. Place a number of details in different positions underneath the camera and adjust the camera settings so that the contrast is as clear as possible.

Blob settings (option)

To obtain the search image for blobs, the image is divided into zones that are considered detail (marked as black) and zones where the background can be seen (white). To activate blob image display you must tick the “Show blob image” tick box.

The ”Permit details at image edge” tick box makes it possible to pick details despite these touching the image edge. Since this can lead to collisions, this option is disabled by default.

The ”Fill inner holes” tick box is ticked as standard. For details with important hole patterns, it may be necessary to disable this box.

Continues on next page

3.2.1 2D sensor
Continued

The “Dark details/light belt” tick box can be used to indicate if the conveyor is light in colour and the details dark, or vice versa. The resulting search image is updated continuously to permit rapid checking.

The threshold setting should then be adjusted so that the details appear as black as possible and the background as white as possible.

The dirt suppression setting allows individual black marks on the conveyor to be filtered out, since these are often just dirt.

By specifying a value for shrinkage, details with irregular outer contours are smoothed slightly.

There are occurrences where some details are placed on top of each other and are considered as one big blob. It might be desirable to split these large blobs for further analysis. This is done by ticking the “Split blobs” box.

If you want to split the blobs, the threshold for this must be set. Preferably add a number of details with varying overlaps under the camera. The threshold is set so that the split is performed correctly, i.e. details with permitted overlaps are split, while the details with too large overlaps are not split.

Laser line settings (option)

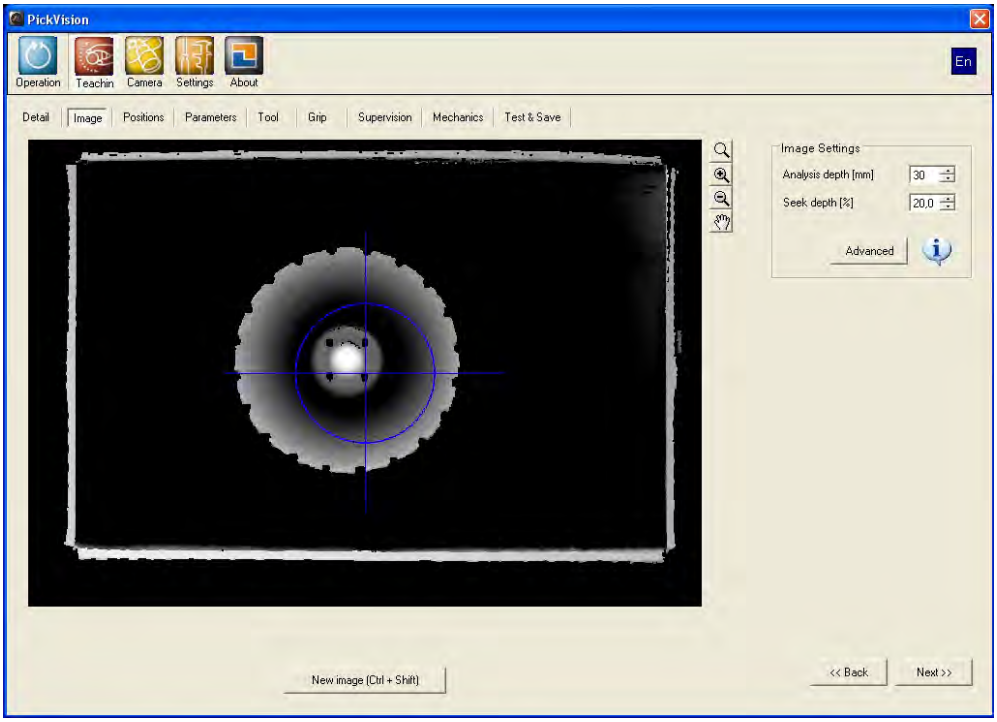
If PickMT is used with a laser line to measure heights in the image, a separate image can be taken for height measurement with the laser line. If so, the image settings for this extra image are made when the tick box ”Laser line settings” is ticked.

3.2.2 3D sensor

The 3D sensor does not need settings for brightness, contrast and gain and so they are not visible on the user interface. The grey scale in the image represents height, lighter colours mean that the object is higher up.

The parameters analysis depth and search percent determine which height area within the scanner's range must be used to evaluate an image.

Some 3D sensors take a long time to obtain a new image. It would make PickMT difficult to work with if the sensor took new pictures the whole time. Therefore the images are not automatically updated in these cases. Use the 'New image' button or short cut 'Ctrl+Shift' to take a new image.



Analysis depth

The analysis depth indicates how far down PickMT must search for details from the highest located point. This dimension directly affects what is visible in the image in PickMT. The highest point is white and then gets darker down to black at the entered analysis depth. The upper edge of the pallet collar can lie at a greater height than the highest located point and is therefore also completely white.

Search percentage

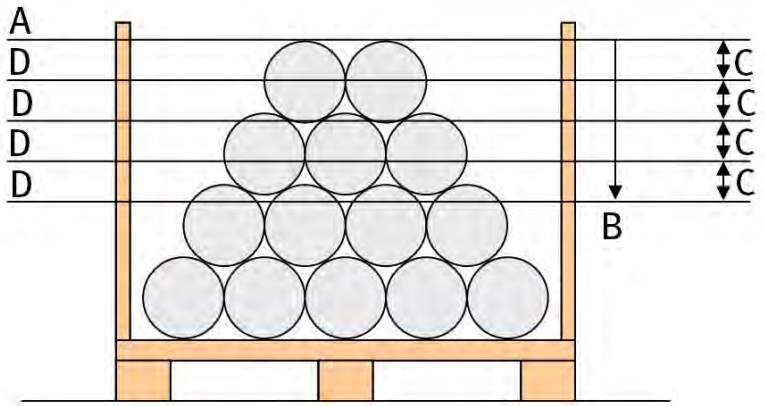
With this parameter the analysis depth can be split up. With detail identification PickMT searches from above at several heights until a part has been found or the whole analysis depth has been analysed. The analysis depth is thereby layered from above and down for best possible search results.

Stated search percentage of the analysis depth gives the first search level for PickMT. If no detail is found on the first search level the next level is added and a new analysis carried out. This is repeated until a detail has been identified or the whole analysis depth has been analysed. Note that the number of search levels

Continues on next page

3.2.2 3D sensor
Continued

depends on the set search percentage. Do not use an unnecessary low percent because it will require more analysis time for PickMT.



A Highest located point, B Analysis depth, C Search percentage * analysis depth, D: Search level

Interlayer serach

If the function to search for interlayers is activated, PickMT will look for interlayers when no details are identified. When an interlayer is identified, PickMT will send information to the robot that an interlayer is found and at what height it is.

Several checks are performed to ensure that an interlayer can be picked. Some parameters can be adjusted to modify search behaviour.

Search for interlayers

Activates function to search for interlayers.

Interlayer at pallet bottom

If this function is activated, PickMT will send commands to the robot to pick an interlayer when the bottom of the pallet is detected.

Threshold height above interlayer

PickMT starts interlayer detection by fitting a plane to all data points within the specified height search volume (see camera settings). After fitting the plane, a check is performed if anything is still present on top of the plane (i.e. the interlayer). This parameters specifies the height at which PickMT shall search for remaining objects. Its value must be less then the height of parts to be picked.

Maximum total area above threshold

Indicates the total area allowed to protrude above the specified threshold height. If the protruding surface exceeds this value, no interlayer is found. Contour lines for these areas are marked green in PickMT during analysis.

Minimum allowed dust thickness

All areas in the threshold image that are narrower than this value will be filtered prior to analysis.

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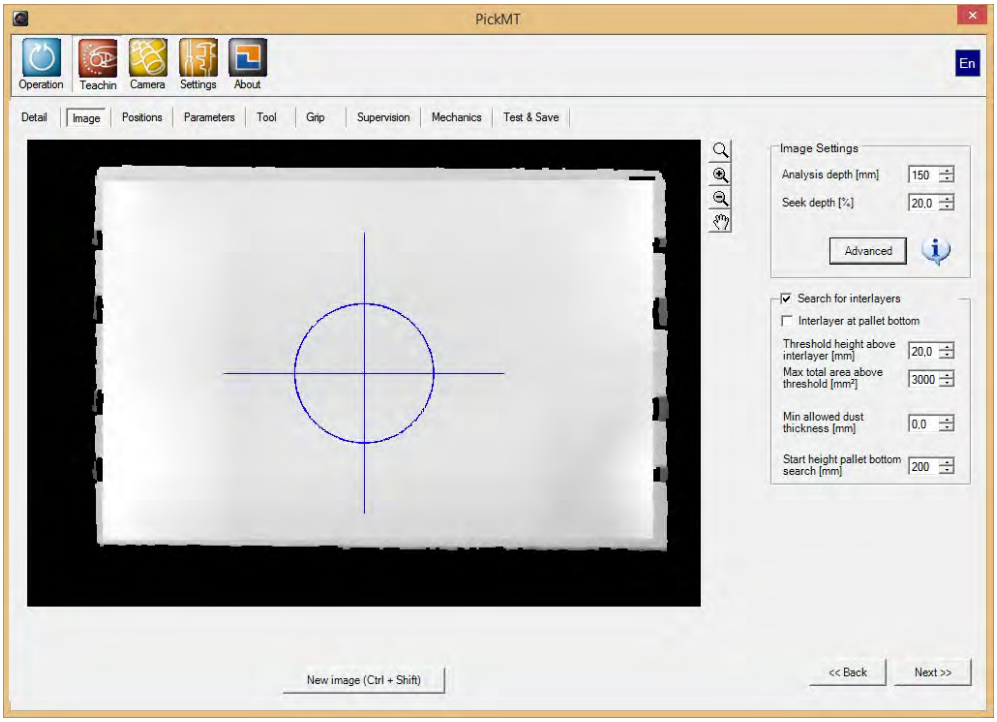
Start height pallet bottom search

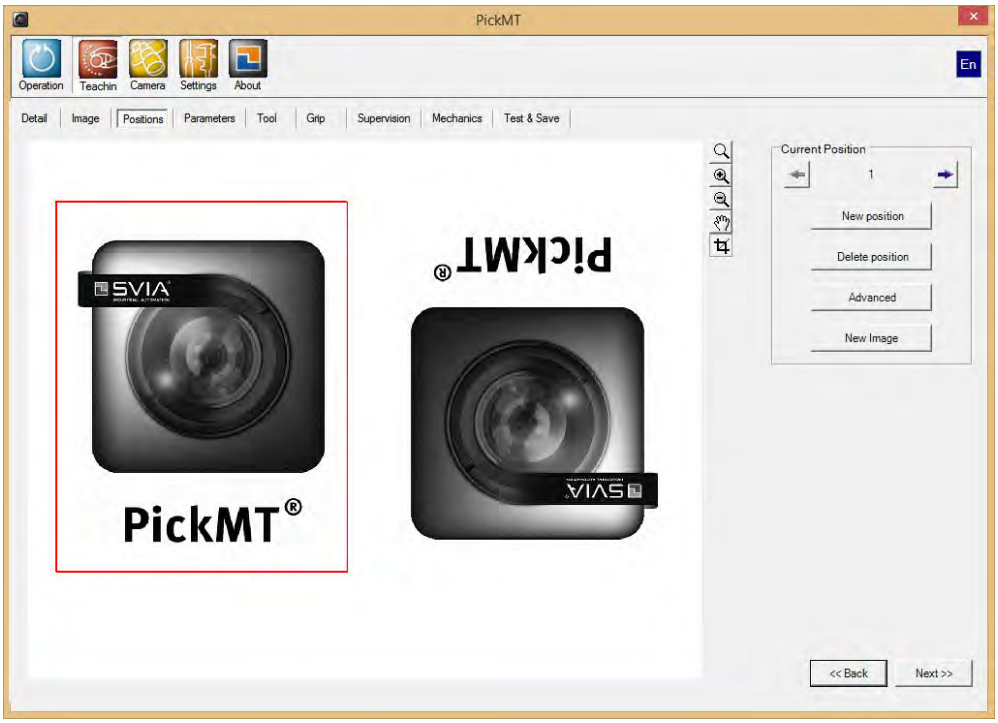
Interlayers or empty flat areas are considered as pallet bottom if their height is below this value.



After interlayer analysis, the letter “I”, together with a blue ring, will be drawn in the images to indicate where an interlayer has been found. If a blue cross is drawn on top of this, the analysis was performed without finding a valid interlayer. Observe that no detail was found in this case. Areas protruding the threshold height above interlayer are marked green.

3.3 Positions

A detail can often lie in a number of different positions. These must be defined under the ‘Positions’ tab. In the example below we teach the system to recognize the text “PickMT”. The text can lie in two positions, either the right way up, or its mirror image. Clicking on the button ‘New position’ creates a new position. This position must then be defined by drawing a red box around the detail in the field of view that corresponds to the position. This is done using the define position drawing tool.



The next position is then defined by clicking on ‘New position’ again and drawing a box around the mirror-image text.

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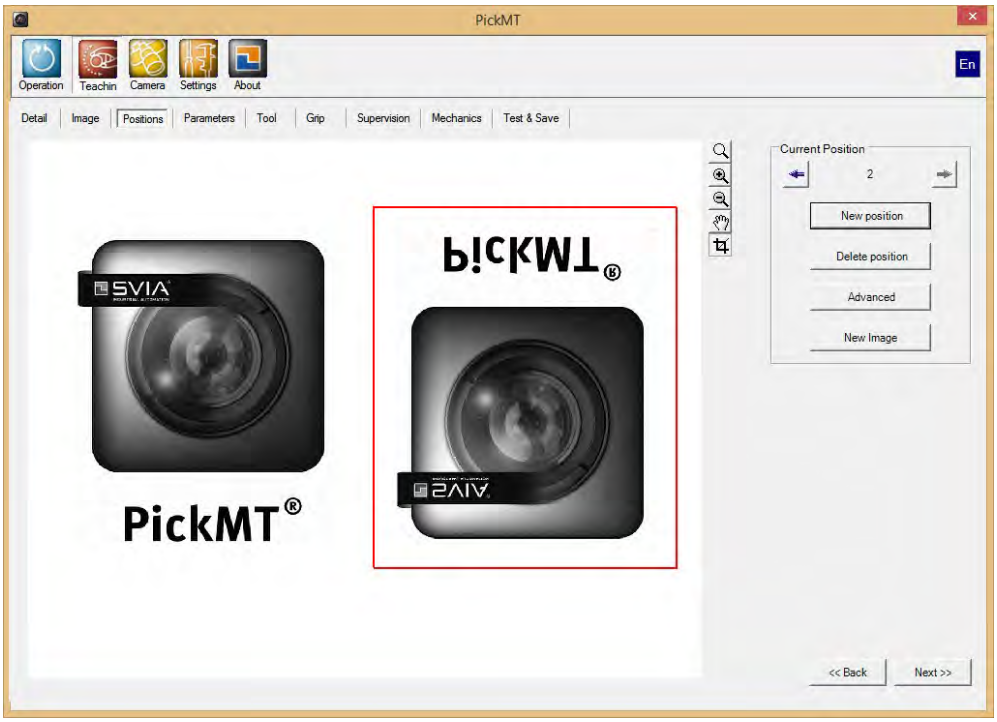
If the ”Blob” analysis type for the detail is used, the outer contour and the found angle of the detail are drawn instead.



By clicking on the current position arrows you can browse through all the teachin positions.

There are certain factors to bear in mind when defining a position. All positions must be defined in a way that makes it possible to create a clear geometric model of the position, i.e. a model that unambiguously identifies that position.

The definition shown in the image is an example of an unclear definition. The geometric section shown above exists in many different places along the shaft of the screwdriver and could result in incorrect positioning when the detail is gripped or handled. It is often best to define a box around the entire position.

However, you should avoid drawing a box that is larger than necessary around the detail. The information that exists outside the detail could affect the analysis results in a way that makes it more difficult to set the parameters.

If a position is not wanted you can remove it by clicking on ‘Delete position’.

If it is difficult to draw a box around a position you can adjust the location of the detail under the camera and then click on ‘New Image’. A new image will be taken and the content of the box will be redefined.

3.4 Parameters

The way a detail is identified and the requirements that must be met before a detail is assumed to have been identified can be adjusted in a number of ways. The basic threshold values for identification are set under the ‘Parameters’ tab. Note that the parameters differ between the analysis types ”Standard” and ”Blob” (option).

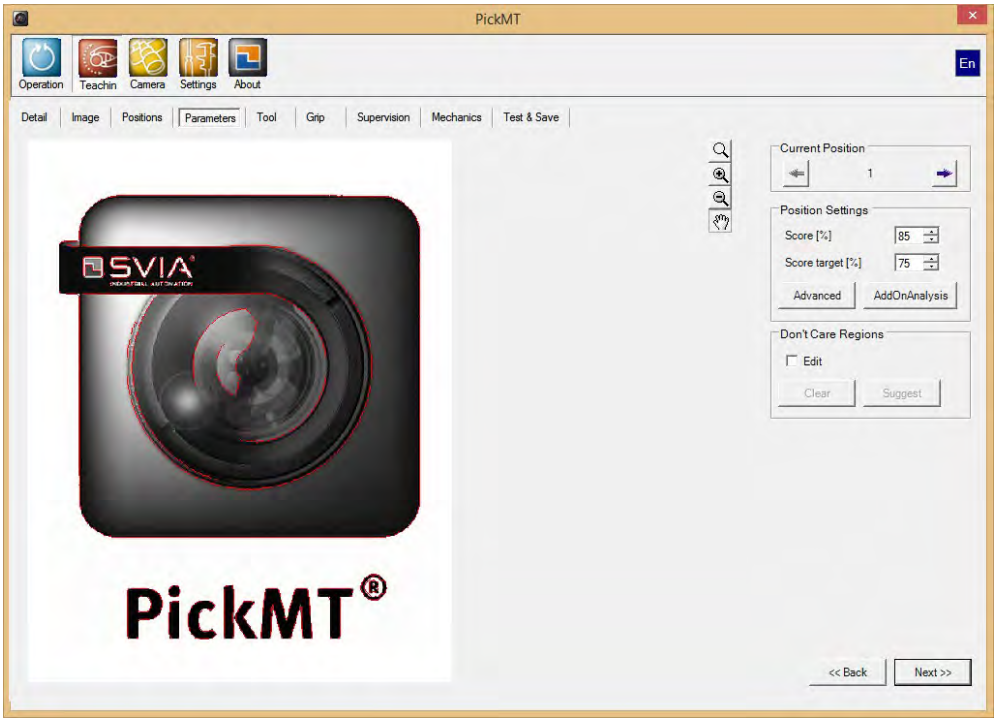
Continues on next page

3.4.1 Standard analysis

Position Settings ”Standard”

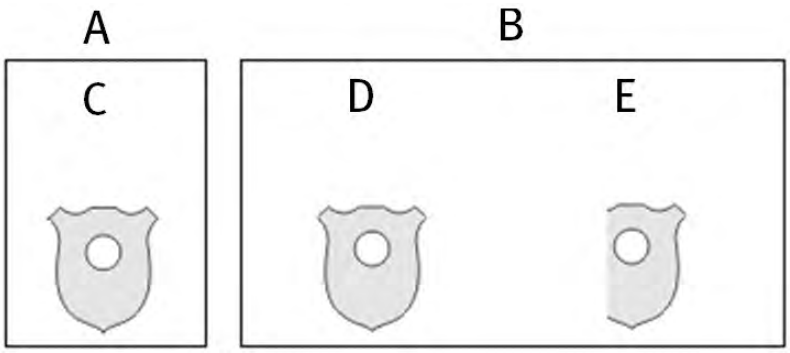
To identify a position the system searches for edges in the image. The edges that it finds are marked with red lines on the image. All the edges that are found are then joined together to form a geometric model that is compared with the teachin geometric model.

Before adjusting the search settings you should understand how the search results are decided when comparing the teachin position and found position. The main parameters that determine the search results are known as score and score target.



Score

Score is a measure of how well the found edges match the taught edges.



A: Teachin position, B: Found positions, C: Position 1, D: Position 1, Score 100%, E: Position 1 Score 75%

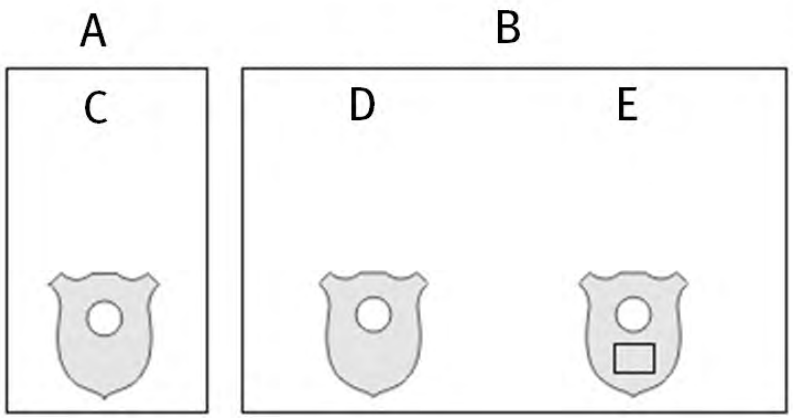
The image above shows an example in which a number of edges have been missed in one of the two found positions. This has a negative effect on the score.

Continues on next page

3.4.1 Standard analysis
Continued

Score target

Score target is a measure of the found edges that do not match up with the teach position, in other words extra edges. Found edges that do not match those in the teach position will reduce the score target.

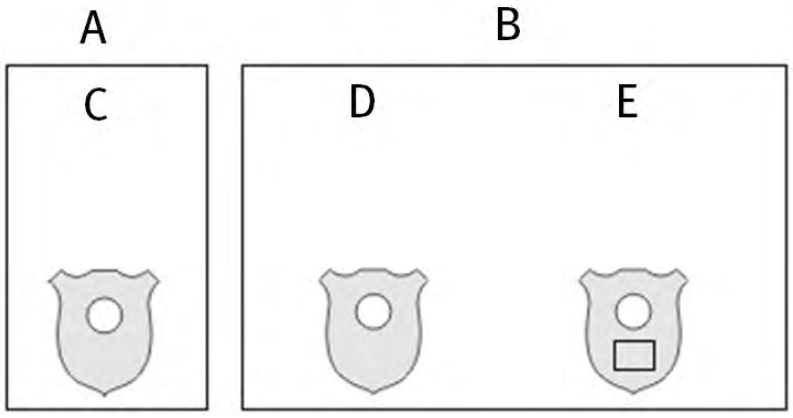


A: Teachin position, B: Found positions, C: Position 1, D: Position 1, Score 100%, Score target 100%, E: Position 1, Score 100%, Score target 85%

The image above shows an example in which extra edges have been identified in the found position on the right. In this case the score target value is reduced to 85%. However, the score for both found positions is 100% because the found positions still have a 100% geometrical match with the teachin position.

Don't Care Regions

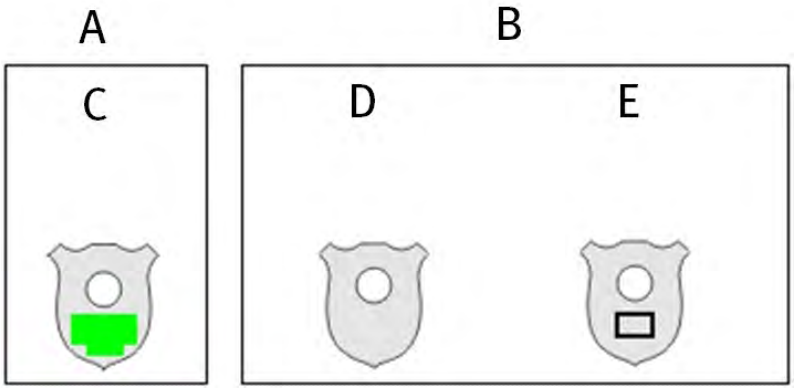
After a position has been defined you can mask out certain parts of the position by marking them as areas that the system should ignore during analysis. For example, a position may contain some parts that can appear very differently to the camera depending on their orientation, a situation that is very common when light reflections from the detail vary from detail to detail. By masking these parts you can ensure that they do not affect the search results.



A: Teachin position, B: Found positions, C: Position 1, D: Position 1, Score 100%, Score target 100%, E: Position 1, Score 100%, Score target 85%

Continues on next page

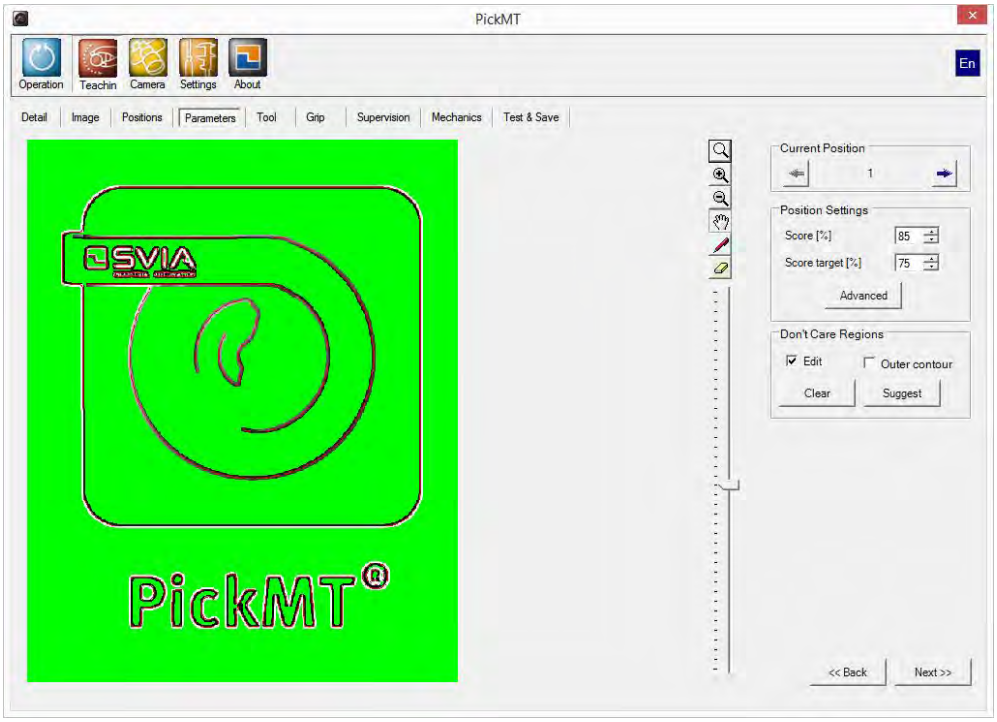
In the image above there are extra edges in the found target on the right. These extra edges have a negative effect on the score target, and in this case the result is 85%.



A: Teachin position, B: Found positions, C: Position 1, D: Position 1, Score 100%, Score target 100%, E: Position 1, Score 100%, Score target 100%

In the image above, parts of the teachin position have been masked. During searching any edges that are found in this area are excluded from calculations. In the example above this means that the score target result for the two teachin positions is unaffected by the extra edges in the position on the right.

To mask a position, tick ‘Edit’ in the ‘Don’t Care Regions’ box.



You can now use the drawing functions to mask those areas that are not wanted. You can also click on ‘Suggest’ to see a suggested masked area.

The option ‘Outer contours’ can be selected in order to obtain a suggestion only for outer contour lines.

Continues on next page

3.4.1 Standard analysis
Continued

By clicking on the current position arrows you can browse through all the teachin positions.

Extra analysis (option)

After a position has been defined further analyses can be defined. These can for example help differentiate very similar positions. These extra analyses can be controlled by clicking ”Extra analysis”.

3.4.2 Blob analysis

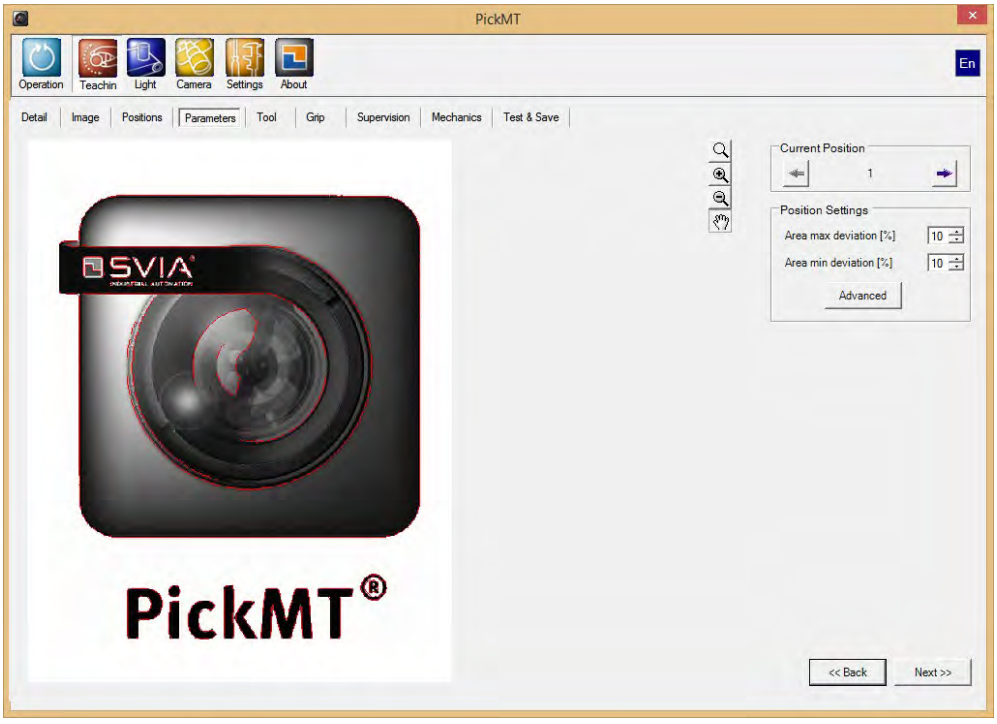
Position settings “Blob”

During identification of a position the system analyzes the properties of each blob found in the image and compares them with the corresponding property of the learned blob. The properties that are evaluated are area, perimeter, elongation and compactness. The analyses of all properties except area can be deselected.

For all properties, an upper (maximum deviation) and lower (minimum deviation) limit is given as a percentage. The requirements for the two positions must be completely different in at least one property, otherwise a warning is displayed to the user.

In many cases, the area is sufficient as conditions to identify details. Settings for area are therefore directly accessible on the user interface.

In some cases, these may need to be supplemented with perimeter, elongation and compactness in order to differentiate the details better. These settings are accessed by clicking on ”Advanced” and described in the section for advanced settings.



In order to understand the meaning of these parameters, descriptions and some examples in which different types of details are set against each other are listed below:

The values for area and perimeter are evaluated directly from the image.

The value of the elongation is the relationship between the blob’s length and width. It is assumed for simplicity that the area is [length × width], and that the perimeter is [2 × (length × width)]. This applies if the blob’s length and width is the same along the entire blob, but also applies for elongated thin blobs, even if they are curved.

Continues on next page

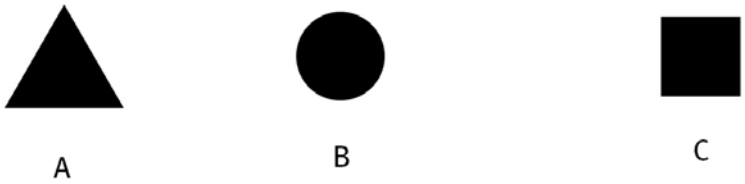
3.4.2 Blob analysis
Continued

The following image shows the difference in elongation for a blob with the same area.

A: Area = 1 Elongation = 1, B: Area = 1 Elongation = 4, , C: Area = 1 Elongation = 16

The value of compactness is a measurement of how close all parts of a blob are to each other. A circular shaped blob is the most compact, with a value of compactness of 1.0. The more the shape deviates from a circle, the greater the value of compactness. Compactness is based on area and perimeter and is calculated as (perimeter × perimeter)/(4 × π × area).

The following image shows the difference in compactness for a blob with the same area.

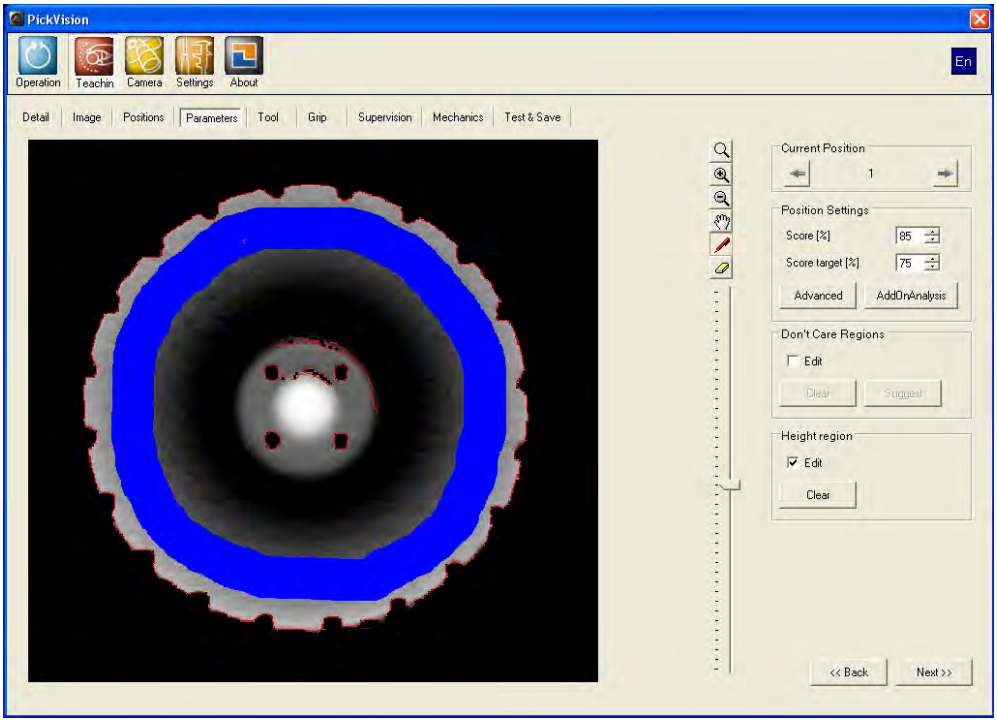


A: Area = 1 Compactness = 1.65, B: Area = 1 Compactness = 1.00, C: Area = 1 Compactness = 1.27

3.4.3 3D analysis

3D analysis uses the same search principles as the standard analysis to identify a detail. This means that the position settings and masking work in exactly the same way.

3D analysis includes finding the height and angle in the x and y axes for the detail. To make this possible a height area is defined. This is done by ticking 'Edit' under the heading 'Height area' and then drawing a blue area on the detail in the image. A height area must always be defined when using a 3D sensor.

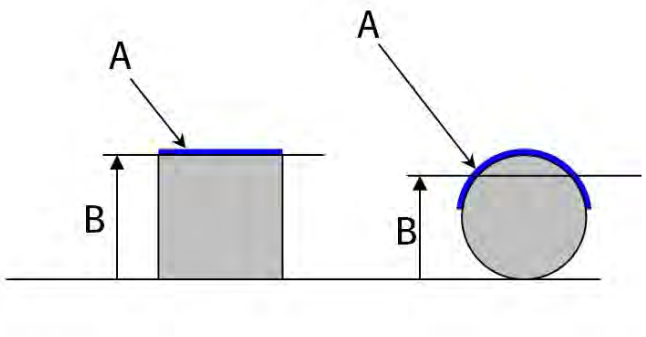


When a detail has been identified by PickMT the height area is used to establish a plane that lies on the detail. The average height of the plane is the height of the detail and the angle of the plane gives the angles in the x and y axes. Too avoid problems, the height area should be drawn on a surface that lies in the same plane. In addition, the height area should not be drawn up to the edge of the detail because otherwise the blue area risks ending up outside the detail if the detail leans more than when learnt.

Sometimes the height area must be drawn so that, despite everything, it does not lie in one plane. A common example is lying cylinders. In this case it is necessary to know that the average height for the located detail surface is actually below the

Continues on next page

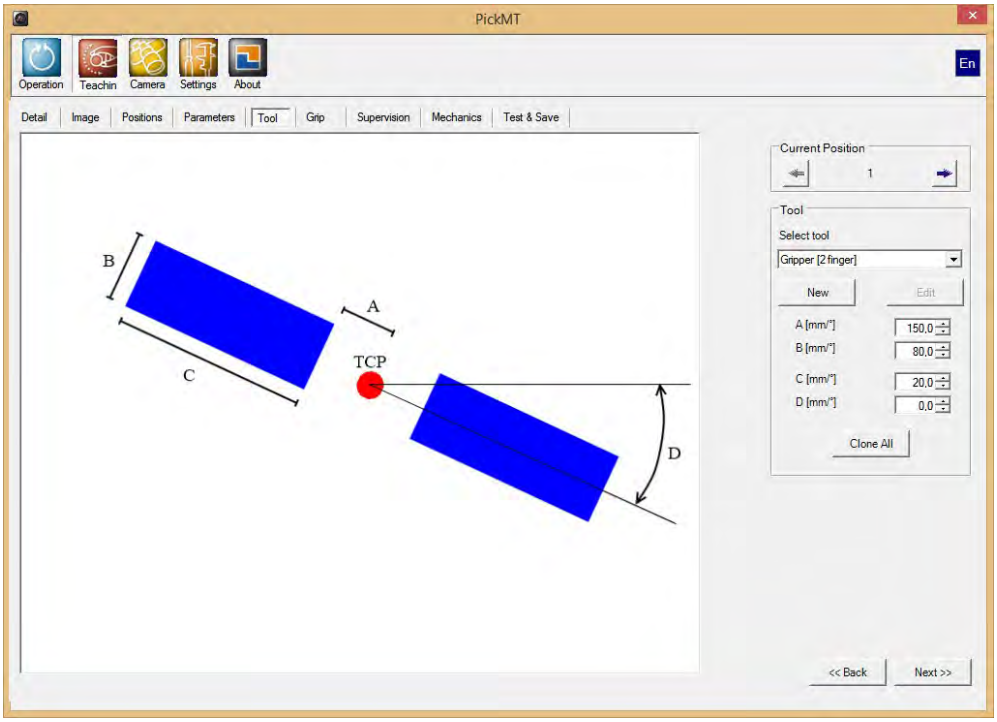
top of the detail. For the robot to pick the detail correctly this must be compensated with gripper settings under the tab ’Grip’.



A: Height area, B: Located height

3.5 Gripper

A gripper must be defined for each teachin position. This information is used to simplify visual definition of the grip point, and to enable the system to supervise tools and so avoid collisions during operation. You select the gripper to be used for the current position under the ‘Tool’ tab.



The system has a number of predefined gripper types. These are defined by parameters and when you select a gripper you must enter the dimensions of the actual gripper. The dimensions that are needed are shown by a schematic illustration of the tool type. The dimensions can be set in steps of different sizes. You can choose the step size by right-clicking with the mouse to bring up the following menu.

This lets you choose the size of the adjustment to be made. The current adjustment step is shown by a tick on the left.

If none of the predefined tools is suitable you can also draw your own tool for the system.

It is possible to have different tools linked to different positions. Usually, however, the same tool is used for all positions, and if this is the case you can easily link a defined tool to all the positions by clicking ‘Clone all’.

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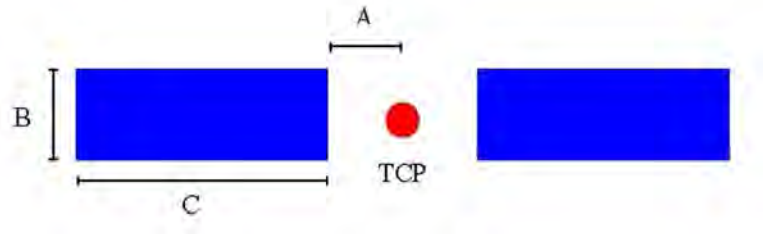
By clicking on the current position arrows you can browse through all the teachin positions.

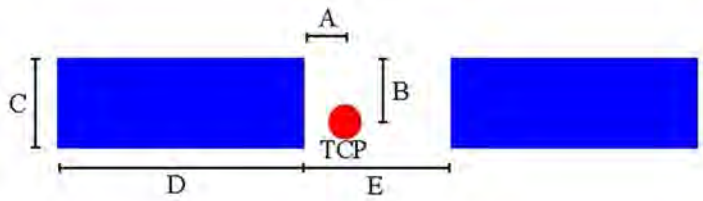
Predefined tools

Gripper [2 finger]



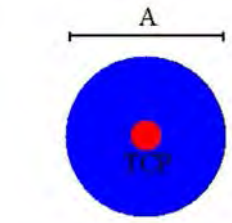
Corresponds to a gripper with two gripping fingers and the tool centre point (TCP) between the fingers. The indicated dimensions are with the fingers open.

Gripper [2 finger advanced]



Corresponds to a gripper with two gripping fingers and offset TCP. The indicated dimensions are with the fingers open.

Suction cup



Corresponds to a tool with a single suction cup and TCP in the centre of the suction cup. Note that when a suction cup is used, tool supervision is not active. This is because one suction cup must always be positioned on the detail.

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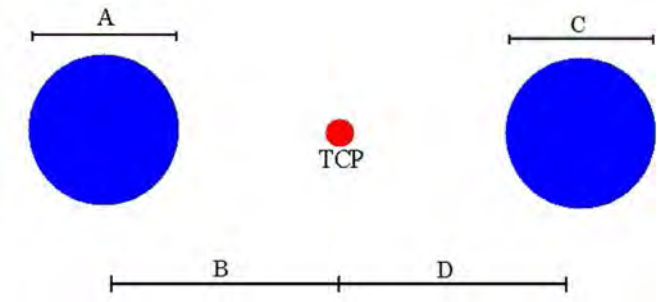
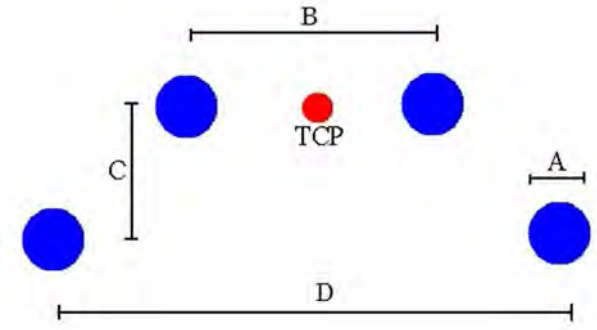
DoubleSuctionCup



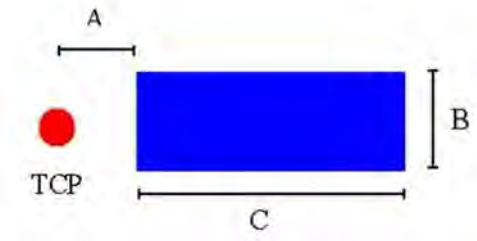
Corresponds to a gripper with double suction cups, which can be of different sizes. TCP can be offset between the suction cups. Note that when double suction cups are used, tool supervision is not active. This is because the suction cups must always be positioned on the detail.

Four suction cups



Corresponds to a tool with four suction cups and with TCP located between the two upper suction cups. All suction cups are the same size. Note that when the four suction cups are used, tool supervision is not active. This is because the suction cups must always be positioned on the detail.

Single-sided gripper



Corresponds to a gripper with a single gripping finger and TCP offset to the left of the finger.

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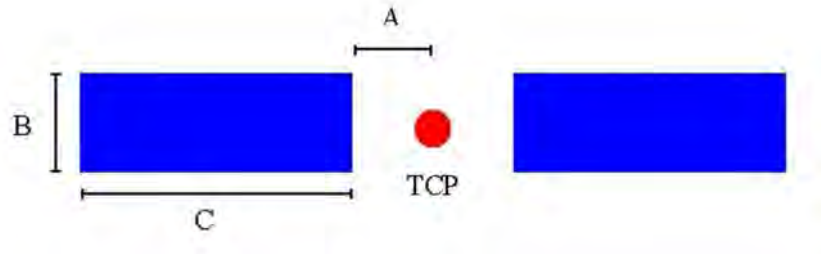
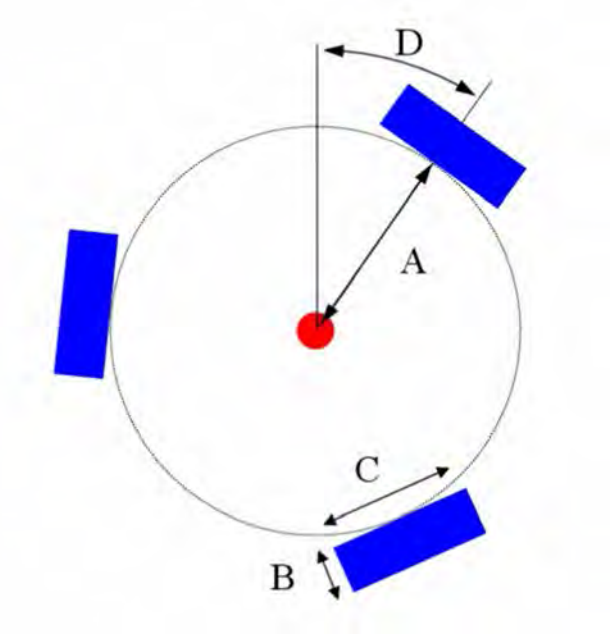
3.5 Gripper
Continued

Gripper [2 finger] rotated



The same as a two-finger gripper, but rotated 90° to cover alternative mountings on the robot arm.

Gripper [3 finger]



A three finger gripper that can be turned relative to the robots wrist coordinate system..

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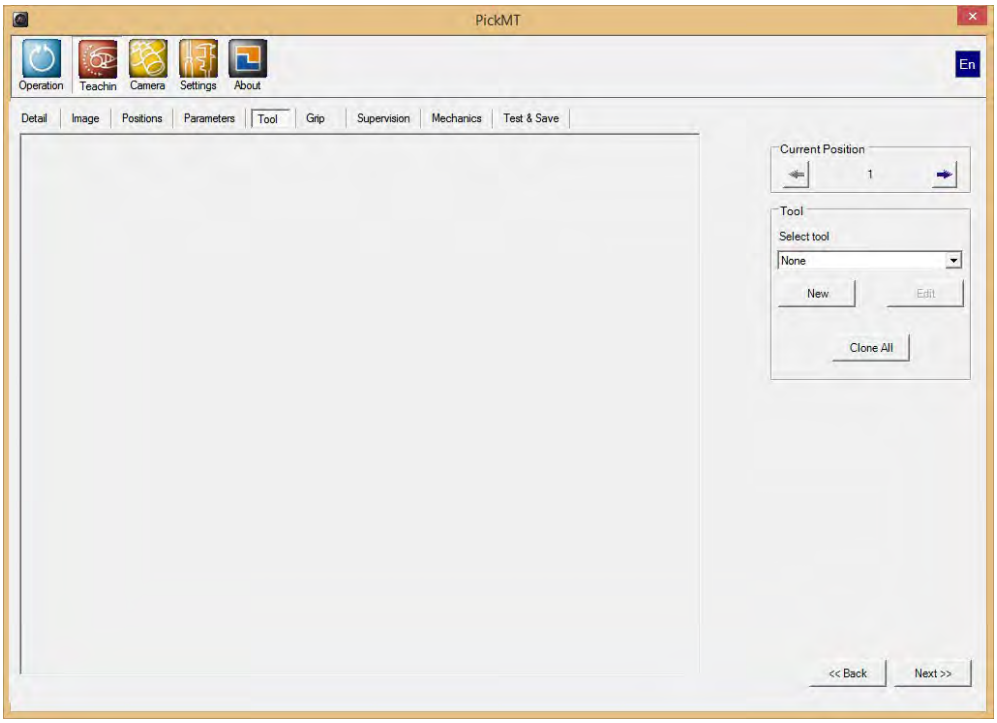
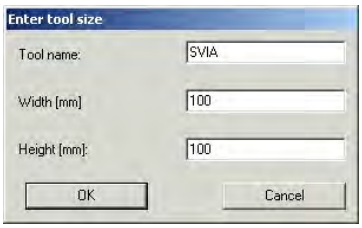
Creating your own tool

If none of the predefined tool types are suitable it is also possible to draw the tool you intend to use.



Clicking on the ‘New’ button under the gripper brings up the following box.



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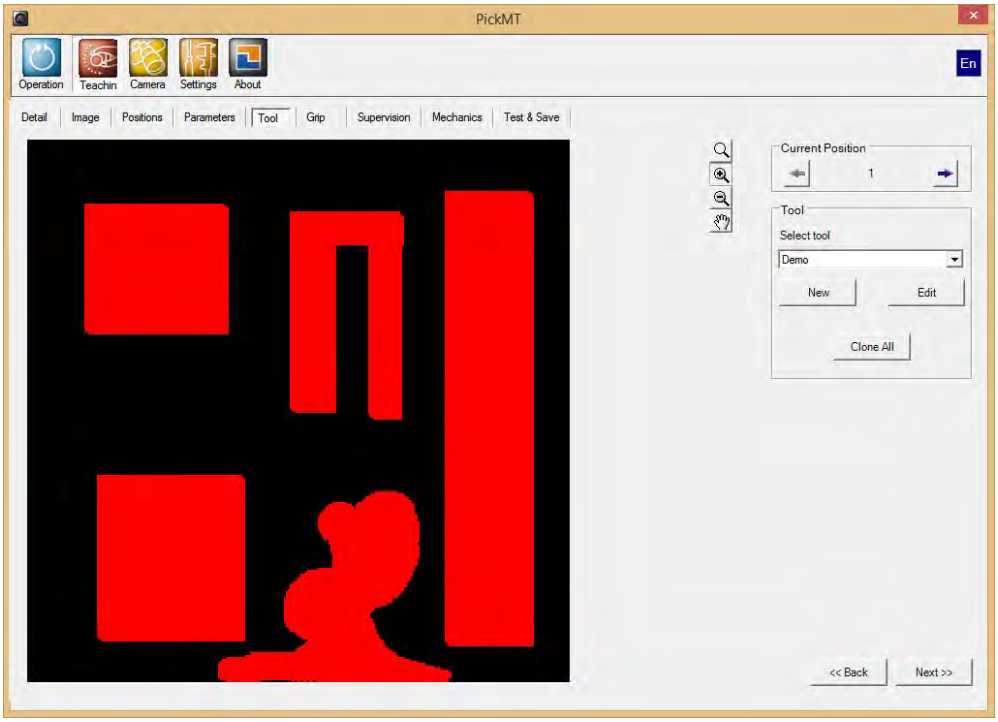
Enter the name of the new tool and its external dimensions. The reason for giving the external dimensions is to determine the accuracy to which you will need to draw the new tool. A small tool is easier to draw accurately than a large tool.



The above information will appear during drawing. The image appears against a grid, with the grid resolution shown in the top left corner. The tool TCP is indicated by a grey box in the middle of the image.

Using the drawing tools, you can now draw the desired tool. The entire tool must be marked in red, see the example in the image above.

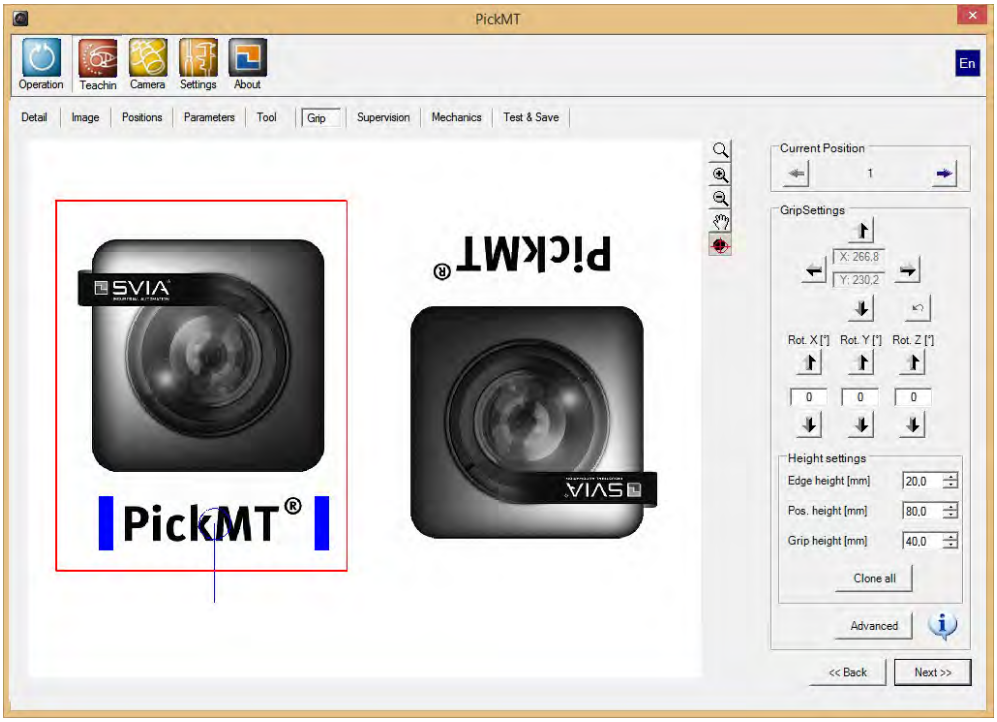
When you have finished drawing the tool, exit the drawing function by clicking ‘Save’.

If you want to modify a tool you have defined at a later time you can do this by selecting the tool and clicking ‘Edit’. Once the tool has been modified you can either save the tool by clicking ‘Save’, or save it with a different name by clicking ‘Save As’.

3.6 Grip

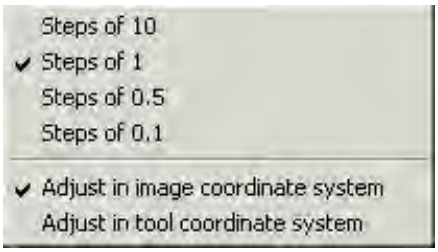
3.6.1 2D sensor

The grip point for each defined position should be marked under the ‘Grip’ tab.



This is done by choosing the tool, defining the grip point and marking the tool position in the image. Once the position has been marked you can make fine adjustments using the arrows. Fine adjustment can be carried out in steps of different sizes. You can choose the step size by right-clicking with the mouse to bring up the following menu.

The objective should be that the detail has been positioned at Teachin so that the grip point is in the centre of the image. This is particularly important at teachin for details with high edges or large grip height. If the centre of perspective does not align with the image centre, the grip point should end up at the centre of perspective instead.



This lets you choose the size of the adjustment to be made. The current adjustment step is shown by a tick on the left.

You can also choose which co-ordinate system to use for movement; the image coordinate system or tool co-ordinate system. If the image co-ordinate system is

Continues on next page

3.6.1 2D sensor
Continued

chosen, movement will always be directly related to the directions of the arrows. If the tool co-ordinate system is chosen, movement will be in relation to the current rotation of the tool.

The current setting applies to all adjustments available under the tab.

The Rotation X, Rotation Y and Rotation Z settings control the rotation of the robot during gripping or handling the position. When you adjust Rotation Z the adjustment is illustrated graphically in the image. When you adjust Rotation X and Rotation Y it will be necessary to do an actual gripping test to see how the setting works in reality.

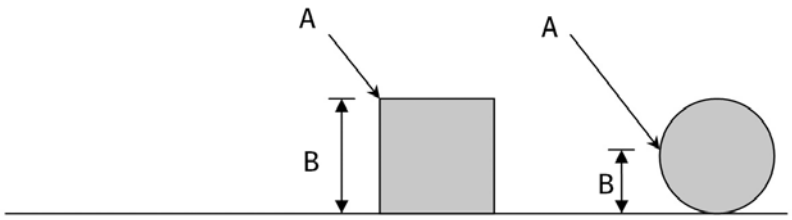
It is important to note that the gripper rotation during blob searches is not unequivocally determined, but can be rotated 180 degrees.

Height settings

Edge height

The edge height must be given for each position. The edge height is the difference in height between the visible edges and the calibration plate. The visible edges are those edges that are marked with red lines in the image.

A: Edges, C: Detail, B: Edge height

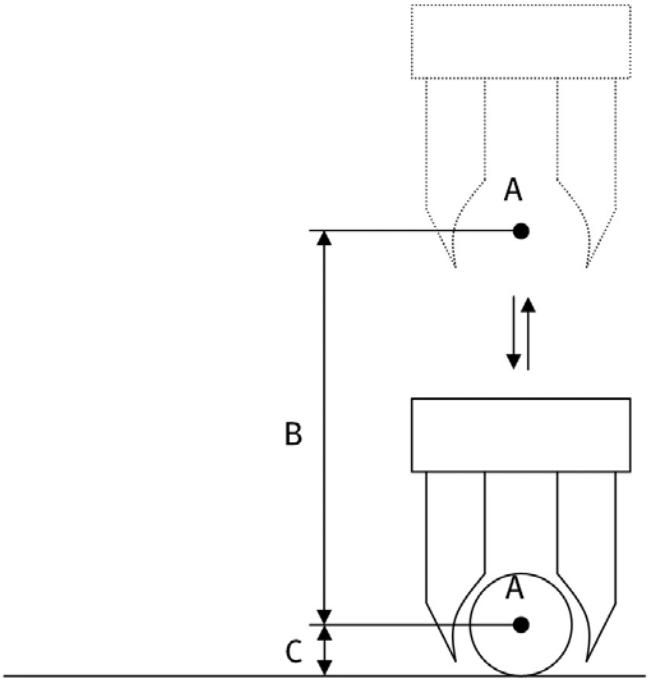


The edge height directly affects the positioning accuracy during gripping and handling of the position, so it is extremely important that this height is correctly set in the system.

Continues on next page

Positioning height and grip height

The positioning height specifies the height of the point above the grip height where the tool must be positioned before gripping.



A: Positioning height, B: Grip height, C: TCP

The grip point specifies the height at which the position must be gripped or handled.

If all the positions have the same edge height, positioning height and grip height then these settings can be used for all positions by clicking ‘Clone all’.

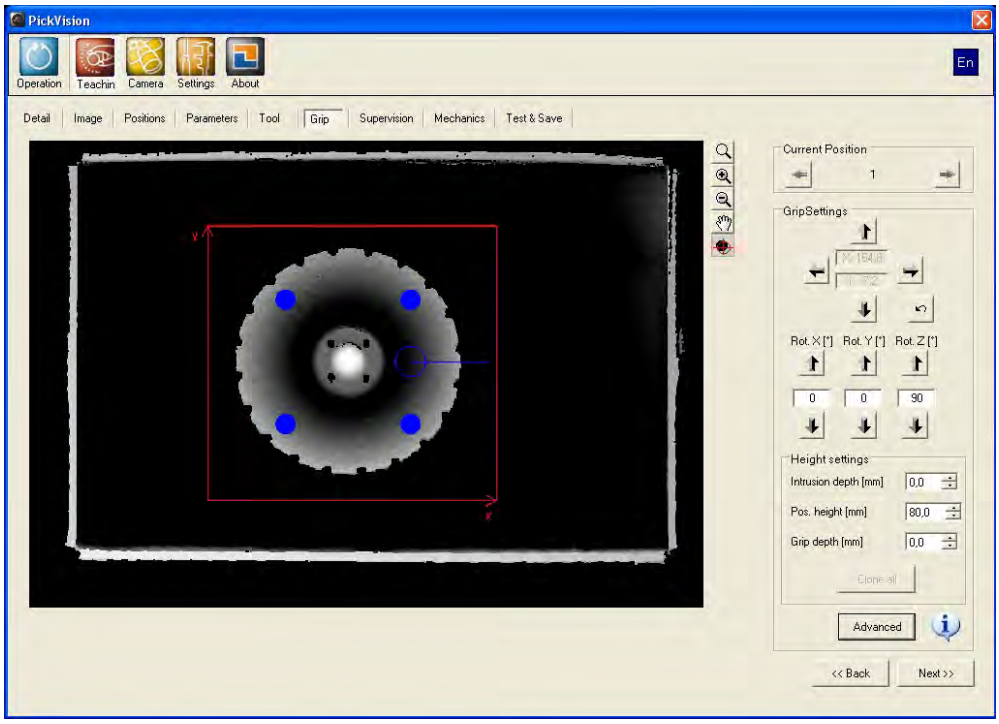
3.6.2 3D sensor

Grip points are positioned in the same way as for 2D. However, there are some setting differences as follows.

Note that perspective concerns do not exist when the 3D sensor is used so that there are no problems with this when the grip point is positioned.

Rotation Z sets the robot tool rotation around the detail's Z alignment. There is a direct connection with the image of how the grip device rotates, exactly as the 2D sensor.

There is no direct connection in the image for X and Y rotation. However, X and Y axes for the detail are drawn in the image. To understand how the grip device will rotate bear in mind that the z-axis occurs first, then rotation around the y-axis and finally rotation around the x-axis.



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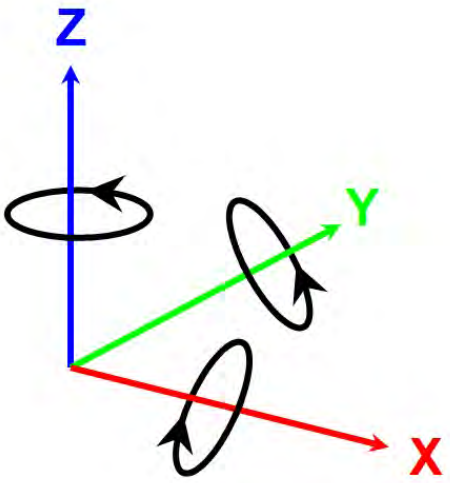
Directions of rotation are clarified in the image below.



Height settings

Penetration depth

Penetration depth describes how deep the grip device goes below the located detail height at the picking position. The depth is measured positively from the located detail height and down. This value is used to determine at what height a check for gripper collision occurs.

Positioning height

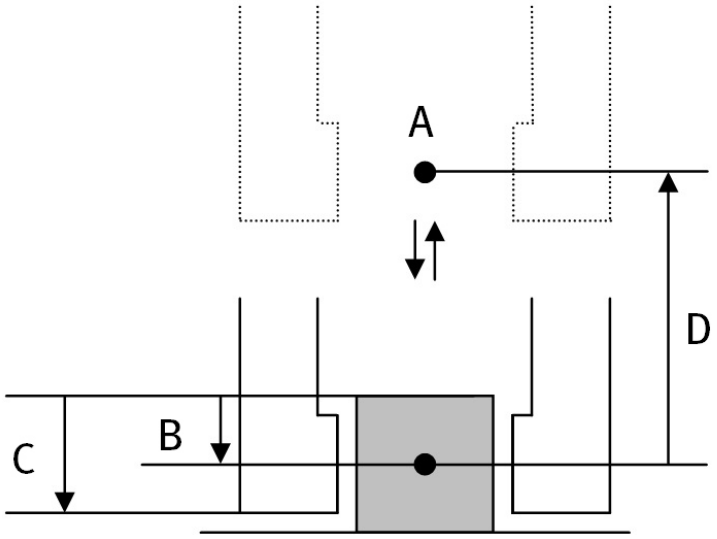
Same function as for 2D.

Continues on next page

3.6.2 3D sensor
Continued

Gripper depth

Gripper depth describes how deep the grip device TCP goes below the located detail height at the picking position. The depth is measured positively from the located detail height and down. This value is used to determine what gripper height is to be sent to the robot.



A: TCP, B: Grip depth, C: Penetration depth, D: Positioning height

3D sensor

The image supervision settings are always used when the 3D sensor is run and adjusted automatically.

The detail supervision functions in exactly the same way as in 2D. It is however good to know that the drawn red area is always placed at the height where the detail has been identified.

Tool overlap (for 3D sensor)

The gripper is allowed to collide with objects in the image to a certain extent, if the tool overlap is activated. The degree of collision permitted is set in square millimetres. When tool collision is detected PickMT will compare the collision area with the set permitted overlap area.

If the collision covers less than the overlap area the robot is permitted to pick the detail. This can for example be used if the robot grip fingers are permitted to knock away nearby details when picking.

3.7 Supervision

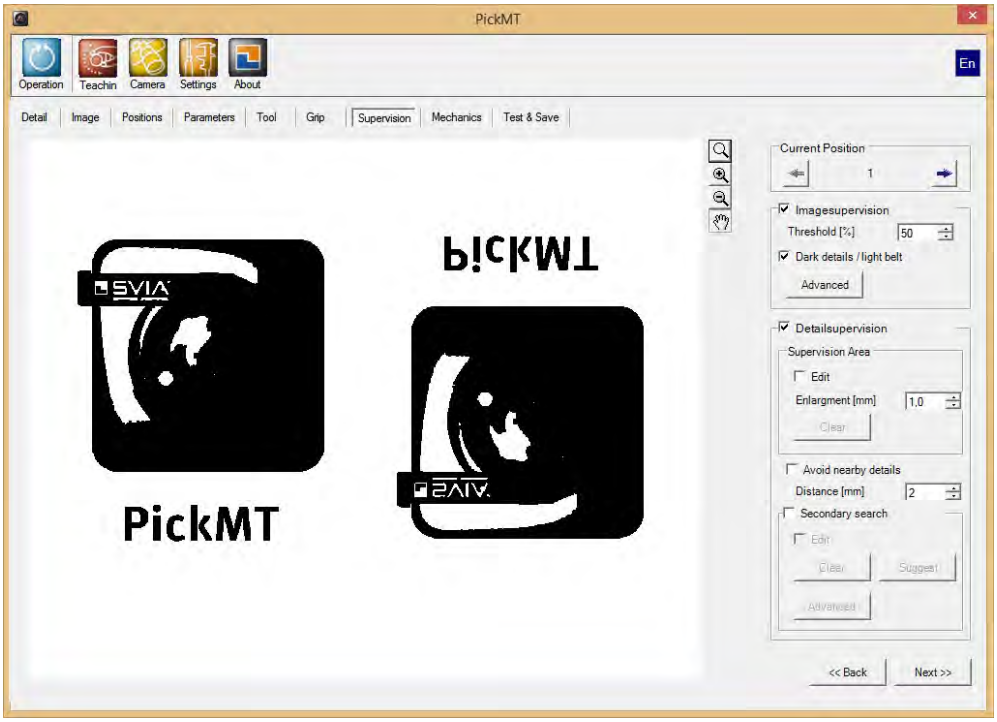
Under the ‘Supervision’ tab you can adjust the settings for collision sensing. The patented technology for collision supervision prevents collisions between the gripper and the adjacent details to the greatest possible degree.

Collision supervision is achieved by calculating a collision risk image and then comparing this image with the desired tool positions. If the settings are incorrect or if collision risk image calculation is disabled, collisions could occur during picking.

The collision risk image can be calculated in two ways, which can either be used independently or in combination: Image supervision and detail supervision.

Image supervision

In image supervision, data from the entire camera image is used to provide information about the collision risk image. The image is built up of zones where there is a collision risk (marked in black) and zones where there is no risk of collision (white). To activate image supervision you must tick the image supervision tick box. The threshold setting should then be adjusted so that the details appear as black as possible and the background as white as possible. The “Dark details/light belt” tick box can be used to indicate if the conveyor is light in colour and the details dark, or vice versa. The resulting collision risk image is updated continuously to permit rapid checking.



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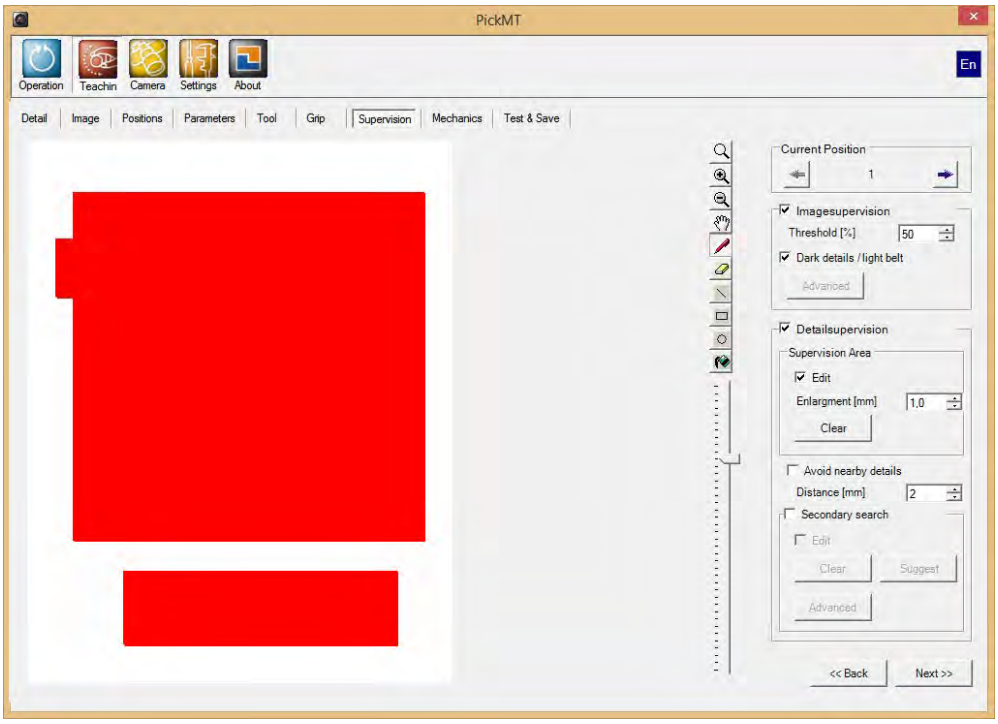
Detail supervision

Detail supervision can be used to provide a more advanced form of collision supervision. It is based on the details that are found by the system and therefore does not apply to details that are not found, for example details at the edge of the field of view or incorrect details. Therefore this technology is not comprehensive.

Detail supervision is mainly useful in two situations: Either when parts of details are difficult or impossible to make black, or when the system is configured for conveyor tracking. Detail supervision also permits more effective ways of picking more details.

In order for detail supervision to work fully, it is necessary to mark all parts of the detail that could cause a collision, for each position. Clicking on ‘Edit’ brings up an image of the teachin detail. All parts of the detail that may cause a collision must be marked in red here. It is extremely important that all parts of the detail that can lead to a collision are marked in red. This information will then be used during current operation. Even the parts of the position that are not visible are then included in collision sensing.



When detail supervision is enabled a further two advanced options can be used: Checking nearby details. Checking nearby details can be used for the detail that is to be picked. If it is closer to any other detail than the set distance it will not be picked. This is to avoid disturbing any other details or knocking them over the camera belt. If all pickable details must be picked then this setting should be disabled.

Secondary result

In certain cases the detail supervision is not sufficient to identify all collision risks, because only the details that have been found for picking are taken. The method with detail supervision can therefore be extended by a secondary result.

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The user can enter lower values for the agreement requirement with the teachin model in order to find more details, even those that are not approved for picking but can still be found. The user defined supervision area will be drawn for these details and some collisions can be avoided. Note that this method significantly improves the collision protection, but does not provide absolute protection.

The secondary search is not possible for details with ”Blob” analysis type.

3.8 Mechanics

What you see under the mechanics tab varies from system to system, depending on the application and the type of robot that the system is configured for. See product documentation for relevant product for more information.

The operator can specify two user defined parameters. The robot program can retrieve these parameters if necessary. This function can, for example, be used to transfer detail specific information to a general robot program.

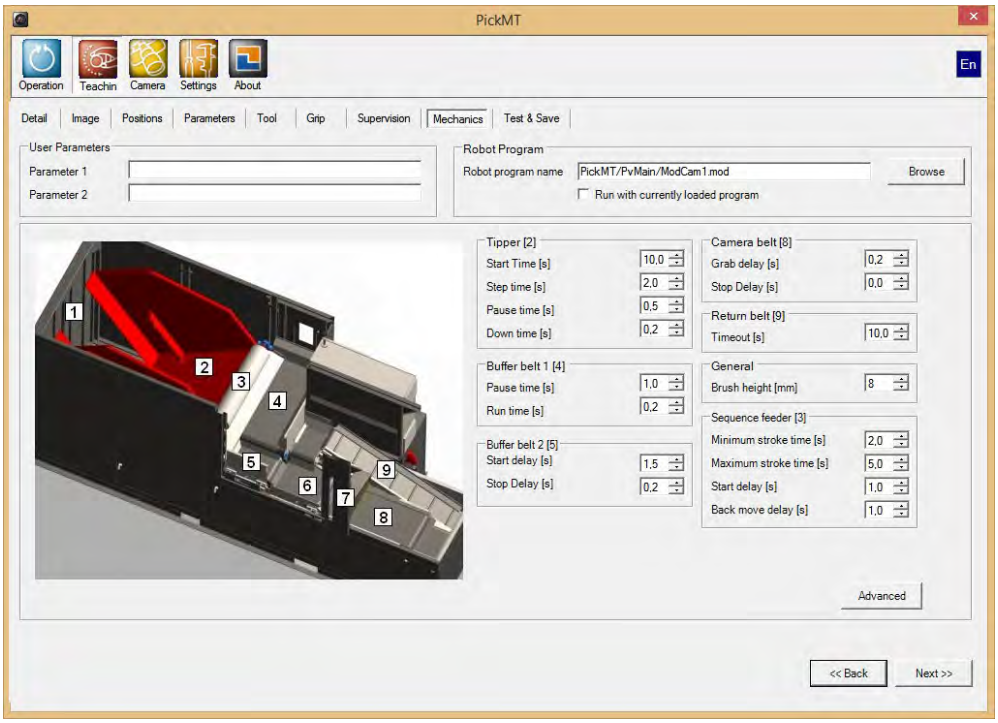
Robot Program

When PickMT starts and stops the right program is automatically loaded by the robot. The robot can also be started with the program that has just been loaded. If this is required you must tick the ‘Run with currently loaded program’ box. Normally the program should be loaded each time the system starts.

Note that this function is not supported by all robot makes, see the PickMT robot integration manual for further information about the relevant robot.

Multiflex

If PickMT is used in a Multiflex system it is also possible to adjust the parameters that govern mechanical control. An image of a Multiflex will then appear under the ‘Mechanics’ tab and you will be able to set the parameters. The available parameters and their functions are described in the Multiflex product manual.



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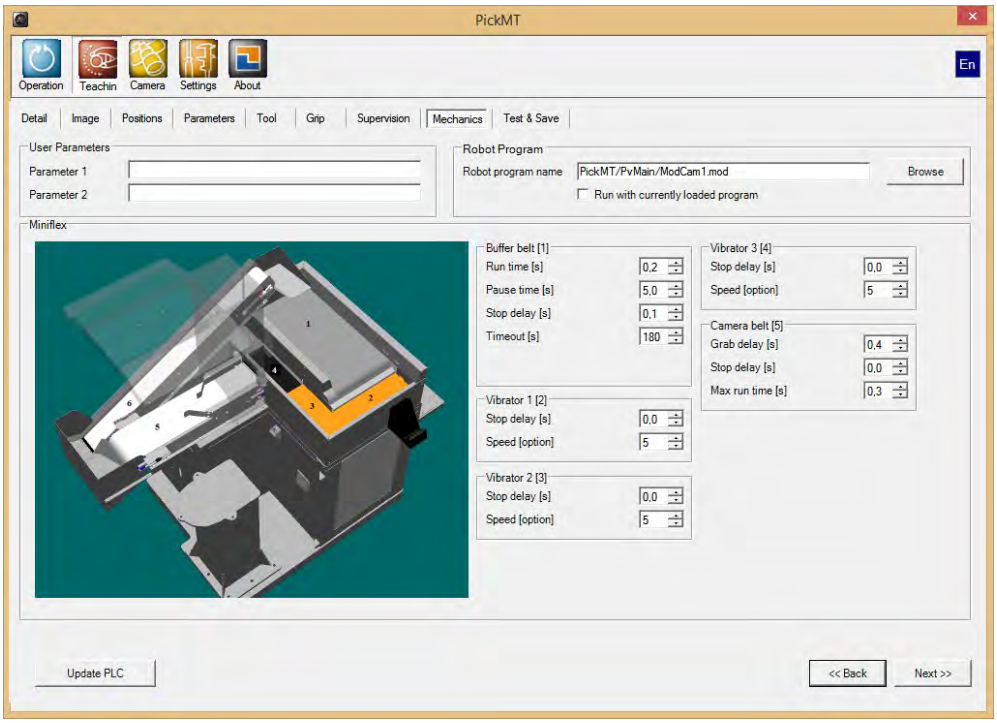
Miniflex

If PickMT is used in a Miniflex system it is also possible to adjust the parameters that govern mechanical control. An image of a Miniflex will then appear under the ‘Mechanics’ tab and you will be able to set the parameters. The available parameters and their functions are described in the Miniflex product manual.



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User defined mechanics tab

As an option PickMT can also be used to control user defined mechanical equipment. If so the screen shows an image, two groups of parameters with a maximum of 32 values, and a button to transfer these values to PLC. Refer to the product manual for the user defined equipment.

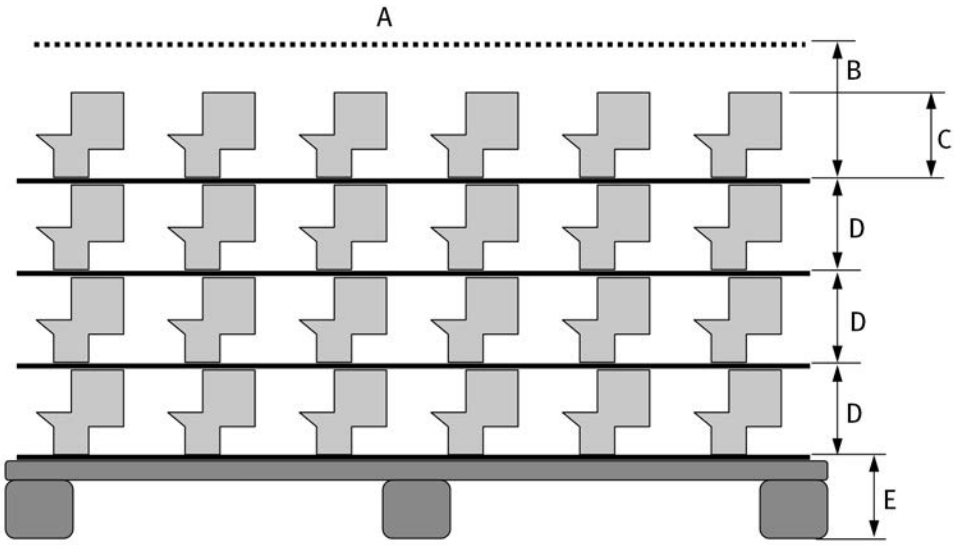
PalletPicker 2D (option)

As an option, PickMT can also be used to pick from pallets. To grip details from a pallet, PickMT must have information on how the pallet is built-up. The user can therefore define a number of pallets in the mechanics tab and then select suitable pallets for the actual detail.

A pallet consists of a number of layers with details in. The distance between the layers must be known and be the same throughout the entire pallet. There are a

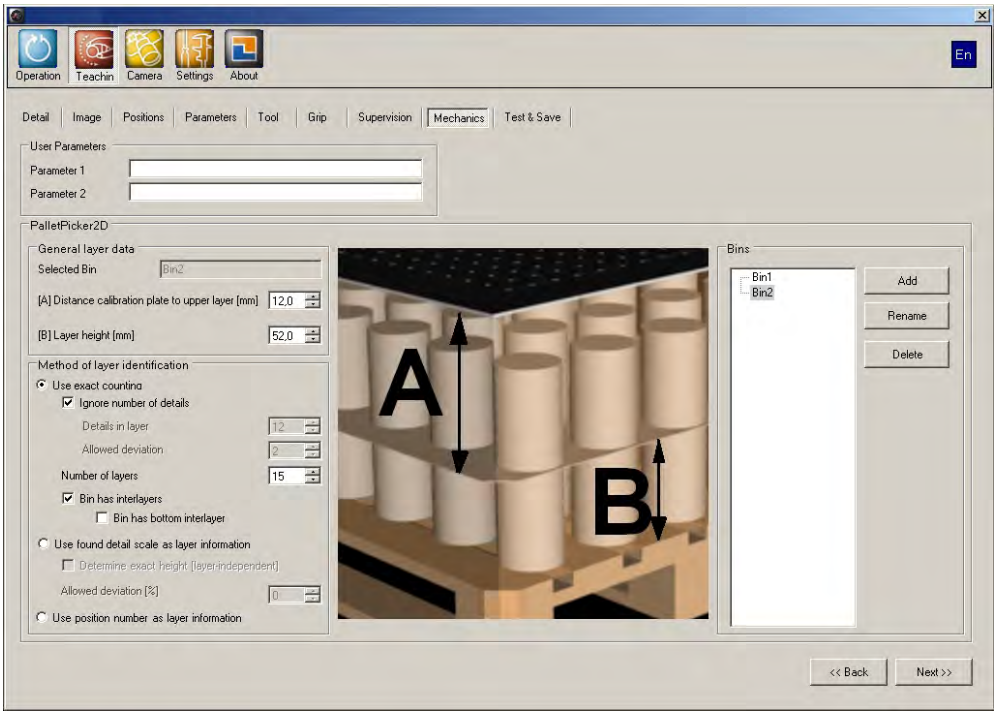
Continues on next page

number of details in each layer. The distance from the calibration plate to the upper layer must also be known.



A: Calibration plate, B: Distance calibration plate to upper layer, C: Grip height, D: Layer height, E: Height above floor.

Following mechanics tab is shown to the user:



Pallets can be added, renamed or removed. PickMT requests a new name if necessary. If the user tries to remove a pallet that is being used by other details, a warning is given.

For each pallet, the distance is then given from the calibration plate to the upper layer (distance A in the image) and the layer height (distance B in the image).

Continues on next page

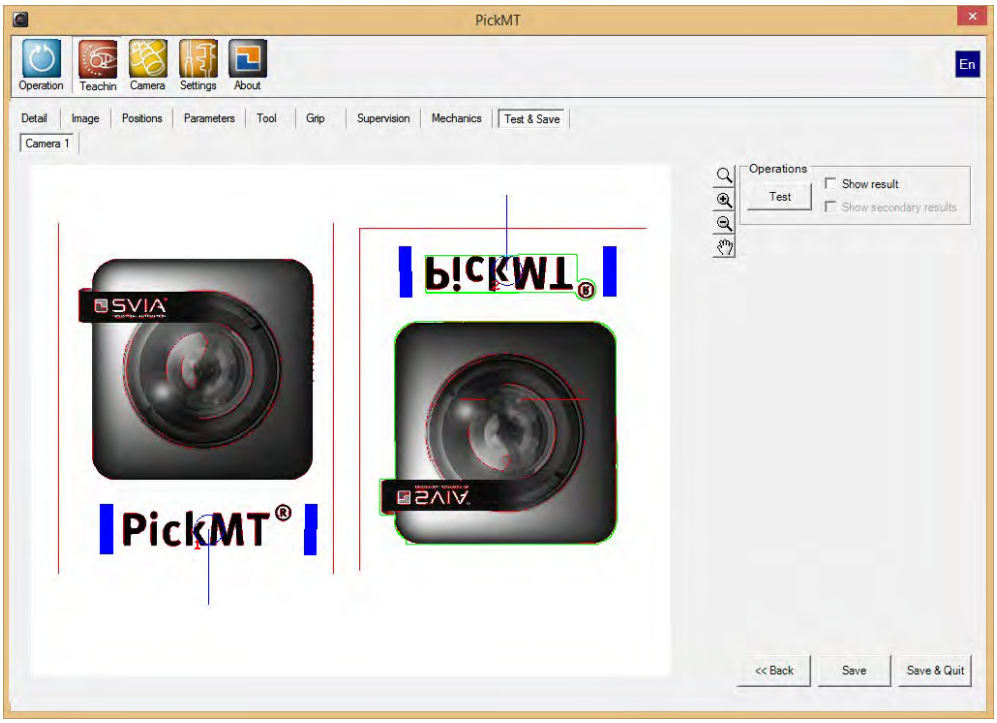
The user must then select which method is to be used for layer identification.

- Use exact counting: The robot counts the number of details and layers that have been picked and compares with the number of details and number given. If the operator changes the number of details in the pallet, this information must be given to PickMT. The following parameters must be given:
  - details per layer
  - number of layers (upper layer closest to the calibration plate is layer 1)
  - permitted deviation. PickMT gives an alarm when the number of found details does not correspond with the number given. The operator can indicate that a certain deviation is tolerated.
  - pallets have interlayers marked if the pallets have interlayers that the robot needs to take care of
  - pallets have interlayers marked at the bottom if the pallet has an interlayer at the bottom that the robot needs to take care of before a pallet change
- Use found detail scale as layer information: A detail can appear to be a different size to the camera depending on the how far the detail is from the camera. Therefore, the layer that the found detail finds itself in can sometimes be determined by how large the detail appears to be on camera. This can be useful when the number of layers and/or number of details are not known in advance. Note that the layer height is recommended to be at least 10% of the camera height in order to use this method. The following parameters must be given:
  - calculate exact height: Height measurement by analysis of the detail's size is rarely accurate. Therefore, in most cases the closest layer is selected for the determination of the gripping point. If this option is marked, the actual calculated height is selected instead.
  - permitted deviation in %: Indicates how much (in % of the layer height) the calculated height may deviate from the expected grip height. 50% means that the grip height must stay within 50% of the layer height. Details that have a calculated grip height outside the permitted deviation are rejected as not found.
- Use position number as layer information: Position numbers can be used as layer information in cases where details in each layer can be taught as different positions that differ considerably.

3.9 Test & Save

Details are saved in the database under the Test & Save tab. But before a detail is saved you have the opportunity to test how well identification works.

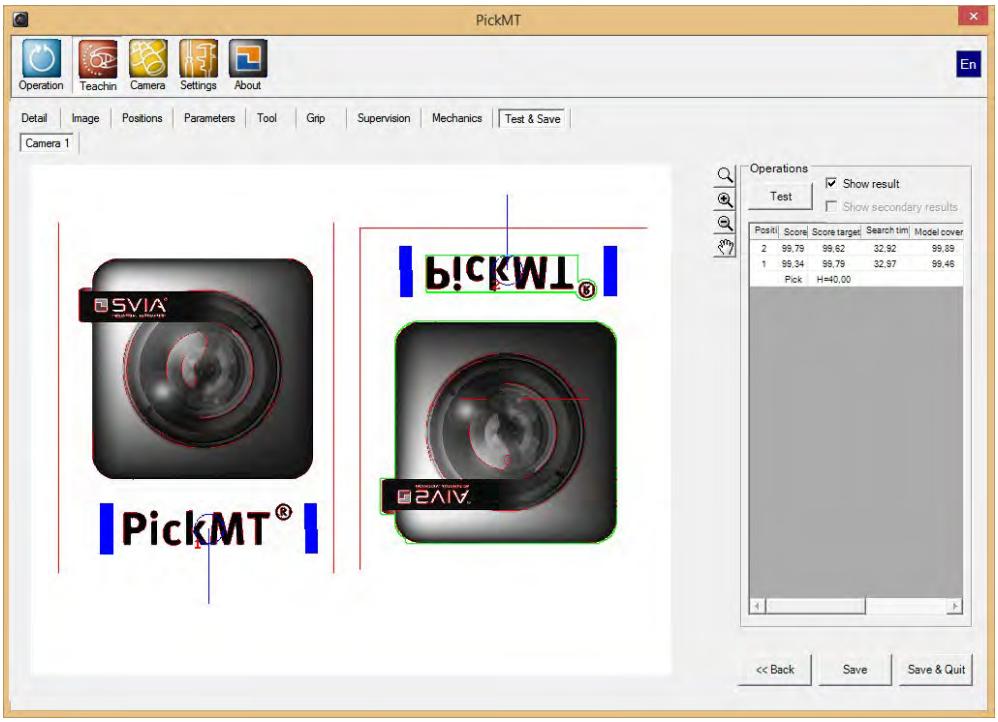
Place a number of details in different positions under the camera and click on ‘Test’. The identified positions and associated grip positions will be shown in the image.



In order to fine-tune settings it is usually necessary to obtain more information about the identification results. Clicking on ‘Show result’ opens up a window with

Continues on next page

detailed test results for each identified detail. When a row is selected the associated detail is indicated by a blue circle in the field of view.



The information shown in the image is the same as in normal operation.

The results for secondary results can be displayed by ticking ”Show secondary results”.

When all the settings have been made the detail can be saved in the database by pressing the ‘Save’ button. The detail tab will then be displayed again.

If the ”Blob” analysis type is selected for the detail (option), the properties of the found blobs are shown in % in relation to the learned position.

When PickMT has identified a pickable detail another line is displayed in the list for test results. This will be marked with the text “Pick” and what would have been sent to the robot in normal operation is written. The data corresponds to coordinates for the robot’s TCP.

4 Advanced Teachin

The ‘Teachin’ steps described in the previous section are usually adequate to provide a working ‘Teachin’ set-up. However, under certain circumstances it may be necessary to make additional settings for optimal ‘Teachin’. Some of the additional settings available are described in the following chapter.

Continues on next page

4.1 Advanced image settings

If it is difficult to obtain an image with good contrast, additional settings for adjusting the image can be accessed by clicking on ‘Advanced’ under the ‘Image’ tab.

The user can also configure detail specific movement supervision to prevent the details moving after taking images.

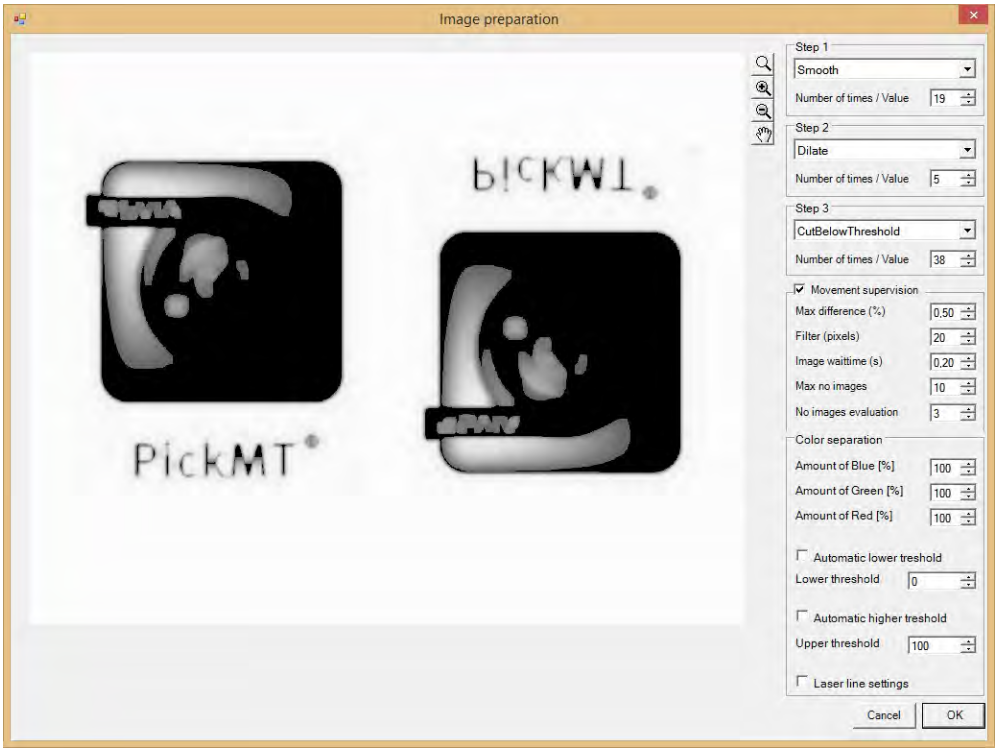


Image Settings

The advanced image settings allow you to radically change the appearance of an image by adding one or more filters before the image is analysed further. This can be especially useful in cases where the image is very uniform or the detail is not clearly defined against the background, etc.

The filters can be added in three stages, which makes it possible to alter the appearance of the image dramatically. Note that the order in which the different filters are applied can make a big difference to the end result, and this gives a very large number of possible combinations. The effect of a given filter is immediately seen in the image, which makes it easy to see how the different filters affect image processing.

Smooth

The “Smooth” filter makes the image fuzzier and softens up the edges.

Sharpen

The “Sharpen” filter makes the edges in the image more distinct.

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SobelEdge

The “SobelEdge” filter creates a new image that reflects the edges in the original image.

VerticalEdge

The “VerticalEdge” filter is similar to the “SobelEdge” filter but primarily reproduces the vertical edges in the image.

HorizontalEdge

The “HorizontalEdge” filter is similar to the “SobelEdge” filter but primarily reproduces the horizontal edges in the image.

LaplacianEdge

The “LaplacianEdge” filter is similar to the “SobelEdge” filter. However, the edges are made thinner and softer. This can be useful if the original image has a very high contrast.

CutBelowThreshold

The “CutBelowThreshold” filter converts all the pixels below a certain light level to black. This light level is set as a threshold value by the users.

CutAboveThreshold

The “CutAboveThreshold” filter converts all the pixels above a certain light level to white. This light level is set as a threshold value by the users.

BinarizeAtThreshold

The “BinzarizeAtThreshold” filter divides the image into areas of black and white. All the pixels above a certain light level are converted to white and the rest are converted to black. This light level is set as a threshold value by the users.

Invert

The image is inverted, i.e. all the light pixels are made dark and vice versa.

Erode

The “Erode” filter reduces the size of light areas by deleting a small area along the entire edge.

Dilate

The “Dilate” filter increases the size of the light areas by adding a small area along the entire edge.

Up to three filter steps can be applied one after the other. Note that the results can differ very widely depending on the order in which the filters are applied.

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Prevent Movements

Movement supervision helps the system prevent details from moving after the image has been taken. This prevents, as much as possible, the robot gripping for details that have shifted position or it colliding with details that have moved under the gripper.

Movement supervision takes two images of the image field with a small time delay and compares them. If there are differences between these images, the system assumes that something has moved in the image and takes a new image.

Maximum difference (%)

This parameter indicates what the largest difference can be between the following images. If the images differ more, a new image will be taken. The smaller the details are in relation to the image field, the lower the value must be.

Filter (pixel)

The differences between the images are filtered to minimise the disruptive influence of, for example, noise, dirt or glare. The greater the value, the more the details must be moved for the movement supervision to be activated.

Image waiting time (s)

This is the waiting time between two image takes. The slower the details roll, the longer the times should be.

Maximum number of images

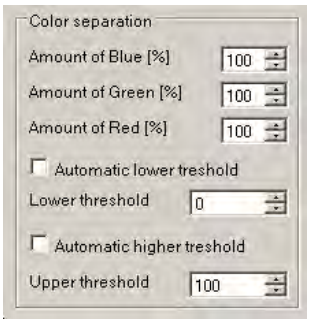
The maximum amount of images indicated here will be taken. When the system has taken the maximum number of images, the images will be analysed, regardless whether any movement has been detected or not.

Colour settings (option)

When a colour camera is used, the operator can determine how to combine the three included colours to give the black-white image that PickMT then analyses. This function can be used to enhance or weaken certain selected colours, or to increase or reduce the contrast between certain colours.

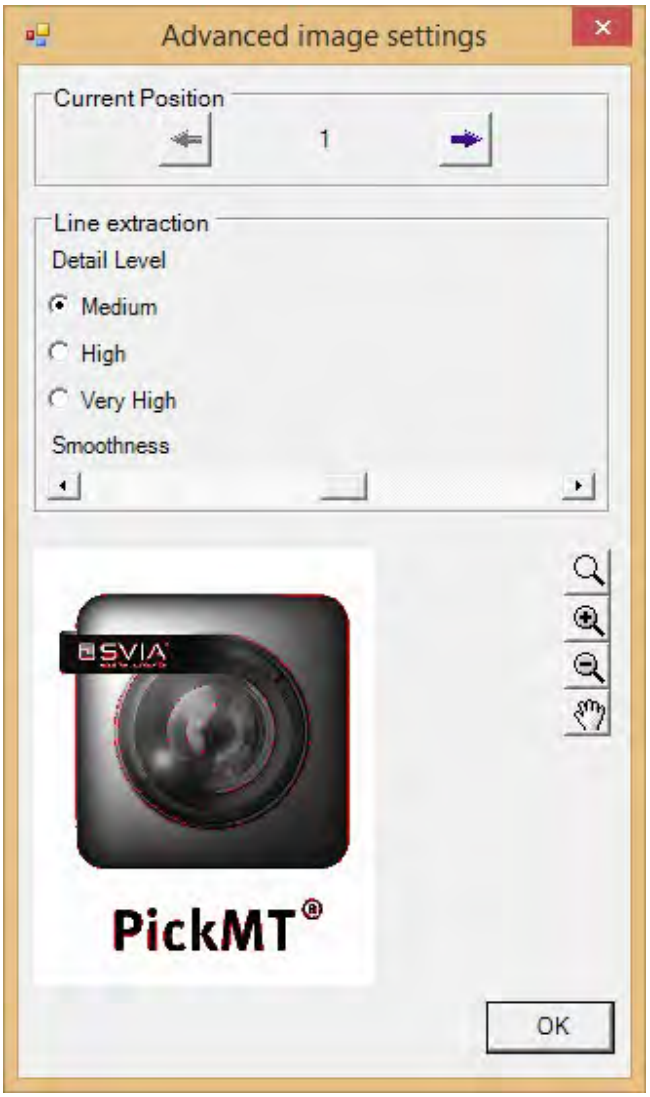
For each included colour (blue, red, green) the proportion that is used to generate the final black-white image is set. Note that it is also possible to subtract colours from each other by giving negative percentages.

The calculated black-white image can then be rescaled, either by allowing PickMT to automatically determine the upper and lower limits, or by specifying specific values.



4.2 Advanced position settings

The advanced position settings allow you to control how the system calculates edges and the geometrical shape of a position. The settings are accessed by clicking on ‘Advanced’ under the ‘Positions’ tab.



The detail level settings govern how edges are extracted from the image. Normally you should not change these settings, but if you have an image with low contrast it may be better to change this setting to high. The slider can also be used to make further adjustments to edge detection. A very high setting should normally only be used in exceptional cases, and then only on images with very low contrast. If this parameter is set very high it can make edge detection less reliable and extremely sensitive to lighting or the presence of dirt. The effect of changing the settings is shown continuously in the image.

Note that smoothness settings affect every position in the system.

4.3 Advanced Parameter Settings

Clicking on ‘Advanced’ under the ‘Parameters’ tab gives access to additional settings for optimising identification.

The advanced parameter settings are divided into those that apply to the detail, i.e. all positions, and those that just apply to the current position. Once again you can browse through the defined positions. If you want to apply the same settings to all positions this can be done quickly by clicking on ‘Clone all’.

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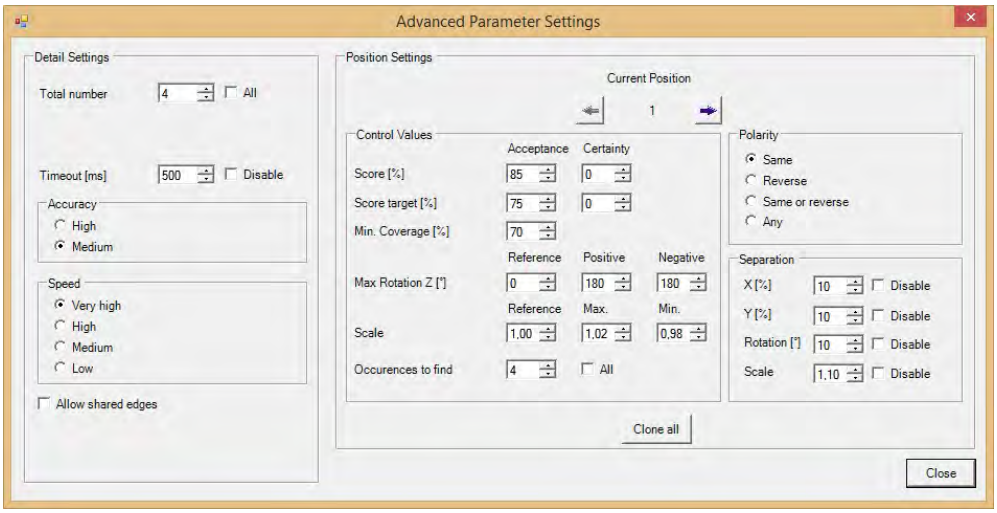
4.3.1 ”Standard” analysis type



Detail Settings

The following settings apply at detail level, i.e. they affect all the teachin positions for the detail.

Total occurrences

The total occurrences to find setting can be used to limit the number of positions that are to be found. Searching for all the positions available takes more time than just searching for one. Searching for just one detail is faster, but on the hand could result in finding a detail that cannot be gripped. A suitable starting value is 6. If searching takes too long this is one of the parameters you could adjust.

Number to send (option)

The value of ‘occurrences to send’ controls how many results are sent to the robot. This is mainly useful for conveyor tracking systems when you do not want to send too many details to the robot. Otherwise the robot would have to process and check considerably more co-ordinates than it is able to pick. In most cases the ‘occurrences to find’ should be set relatively high, while ‘occurrences to send’ can be set relatively low. This is because a number of the details that are found may be impossible to grip due to collision detection.

The robot can also sort and select which details are to be picked when several occurrences are sent to the robot, e.g. based on the signals from the machine that is in service.

Timeout

The timeout parameter lets you adjust the time taken for searching. An image taken against a dirty conveyor belt often contains a lot of noise. This noise results in a large number of edges being found, even in areas where there are no details. Processing all these edges can take a relatively long time, and with the aid of the timeout parameter the maximum search time can be limited so that the identification time does not affect the cycle time of the robot(s). If no timeout is set at all, the search could take several minutes in the worst case.

Continues on next page

4.3.1 ”Standard” analysis type
Continued

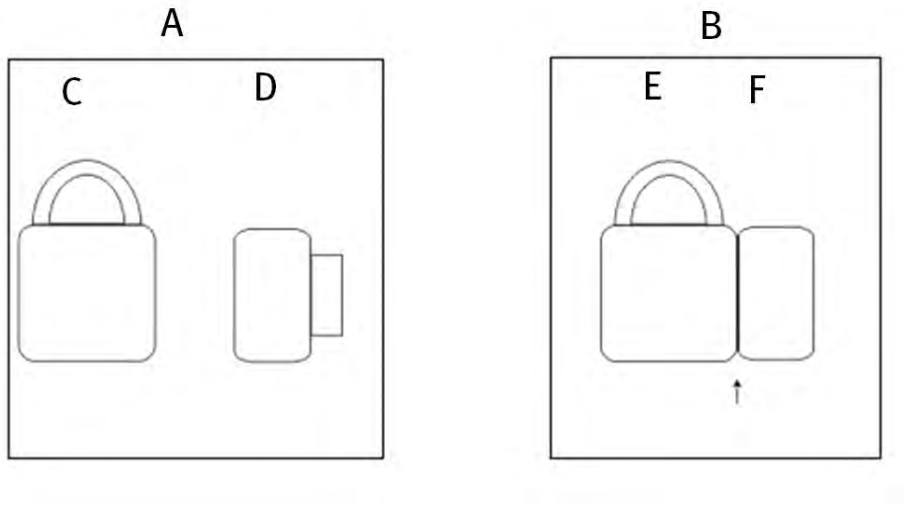
Accuracy and speed

The speed and accuracy settings can be used to adapt searching. However, you should remember that higher speed will have a negative effect on accuracy, and higher accuracy will have a negative effect on speed. The speed and accuracy settings should therefore be balanced against each other and adapted to suit the current application. Setting both the speed and accuracy settings to High will have the same result as setting them both to Medium.

For a longer cycle time the accuracy can be increased and the speed decreased. If short cycle times are required the speed should be increased and the accuracy decreased. In these cases the handling tools should be designed so that they are more tolerant of varying results.

Shared edges

If shared edges are allowed then a found edge can be counted as a result for two or more found positions. If shared edges are not allowed then shared edges are counted as belonging to the result that meets the requirements most closely.



A: Teachin position, B: Found positions, C: Position 1, D: Position 2, E: Position 1 , Score 100%, F: Position 2, Score 75%, G: Shared edges

In the image above this means that if shared edges are permitted the above positions will be found, with scores of 100% and 75% respectively. If shared edges are not permitted then position 1 will still be found, with a score of 100%, while the score for position 2 will be further reduced. This is because an additional edge is missing from the found position when compared with the teachin position.

Search angle

The angle setting decides whether the system should look for positions lying at angles different to that of the teachin position. Even if ‘Search angle’ is disabled, some positions can still be found at angles other than the teachin angle, depending on the appearance of the geometrical model of the teachin position. To be absolutely certain that only one particular angle will be found, you should use the rotation parameter, as described below.

Continues on next page

Search scale

The scale parameter can be used to allow variations in the size of the search object. Even if ‘Search scale’ is disabled, some positions can still be found that differ in size from the teachin position, depending on the appearance of the geometrical model of the teachin position. To be absolutely certain that only one particular size will be found, you should use the scale parameter, as described below.

Use robot specific positions

This tick box will appear if Multiflex is used as a dual or triple system, i.e. with two or three robots that are picking the same details. If the box is ticked, position 1 will only be sent to robot 1, position 2 will only be sent to robot 2 and position 3 will only be sent to robot 3.

Position Settings

The following settings apply at position level, i.e. they only affect the current position. It is easy to switch between positions by clicking on the arrows to change position.

Score

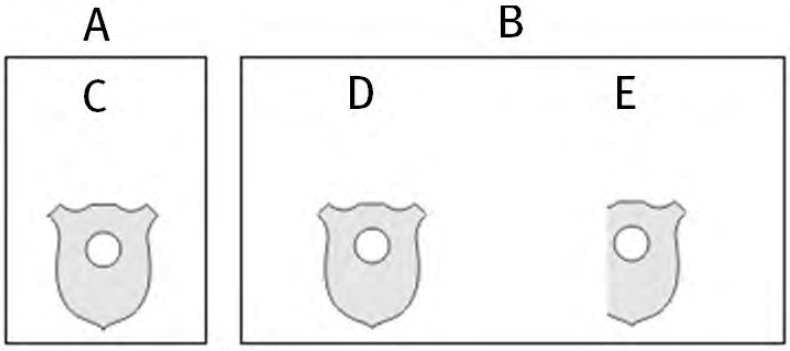
Identification can be speeded up further by using the certainty setting. When the system searches for a position and finds it with a score of 85%, for instance, it will continue searching for a better match until all other possibilities have been ruled out, or it reaches timeout. The certainty parameter can be used to end searching as soon as a position that meets the certainty setting has been found.

Score target

Identification can be speeded up further by using the certainty setting. When the system searches for a position and finds it with a score of 85%, for instance, it will continue searching for a better match until all other possibilities have been ruled out, or it reaches timeout. The certainty parameter can be used to end searching as soon as a position that meets the certainty setting has been found.

Minimum coverage

The minimum coverage parameter lets you adjust the system so that a certain proportion of the position must be visible in order to be considered a match.



A: Teachin position, B: Found position, C: Position 1, D: Position 1, Coverage 100%, E: Position 1, Coverage 75%

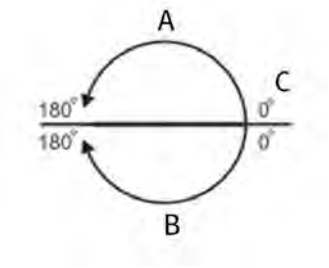
The image shows how the minimum coverage affects searching. Note that the found position with 75% coverage will also give a lower value for score parameter.

Continues on next page

4.3.1 ”Standard” analysis type
Continued

Rotation

The rotation parameter can be used to restrict the system to search for a position within a given range of angles.



A: Positive, B: Negative, C: Reference

Zero degrees corresponds to the angle of the detail during teachin. By changing the reference point and/or the positive and negative directions you can control the permitted range of angles for identification. Often you may just want to set limits on a certain angle range in the robot’s co-ordinate system. In these instances this parameter must not be used, grip limitations must be defined instead.

Scale

By using the scale parameter you can instruct the system to look for a position within a given size range. If the maximum setting is set at 1.02, the minimum setting is set at 0.98 and the reference setting is set at 1 it means that a position can be found within a size interval of ± 2% relative to the teachin position. Often this parameter can be used to instruct the system not to find any position that differs in size from the teach position. In this case it is a good idea to set the tolerance quite tightly, e.g. 1.01 for maximum and 0.99 for minimum if the reference setting is 1.

Occurrences to find

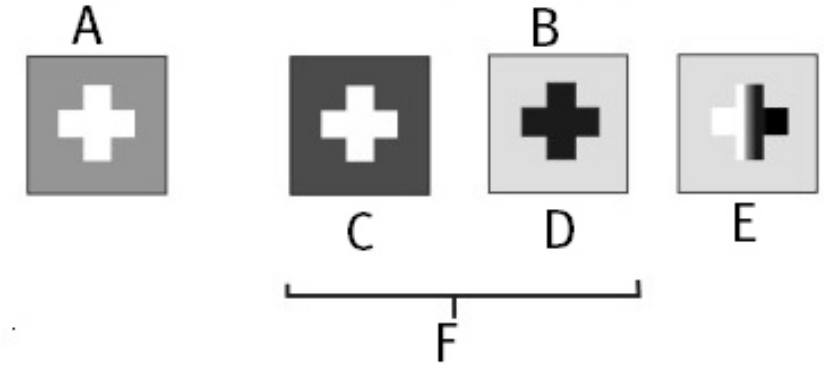
The occurrences to find parameter for the modes works with the occurrences to find parameter for a detail. If the total occurrences to find for a detail is lower than the value you have set for the mode then the maximum number that can be found will be controlled by the occurrences to find parameter for the detail.

If a detail has been taught in two modes, each of which can have four occurrences, and the total occurrences to find is set at six, then the maximum number of occurrences that can be found is six.

Continues on next page

Polarity

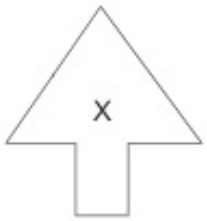
Polarity is how the transfer between different light areas occurs, e.g. dark to light, or vice versa. With this parameter it is possible to control whether to have the same transfer between different light areas during operation as during teachin.



A: Teachin position, B: Found positions, C: Polarity: Same, D: Polarity: Reversed, E: Polarity: Any, F: Polarity: Same eller reversed

Separation

With the parameters for separation (distance) the operator can control how close different occurrences of details may be. The operator can request a minimum distance in X or Y coordinates, in scale factor, or in rotation angle. The operator can also select to ignore separation requirements for certain parameters by ticking the ”None” tickbox.



Learned example detail.

Two occurrences of details that have the same angle and position, but differ in size. If the size differs more than the minimum separation in scale, or if the operator has ticked no separation in scale, both these occurrences are found.

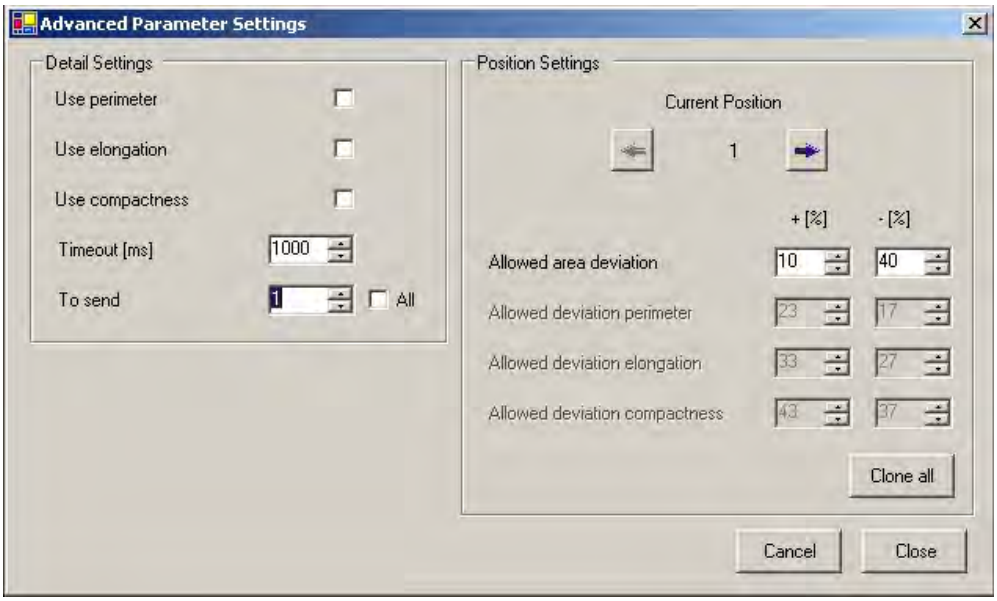
Continues on next page

4.3.1 ”Standard” analysis type
Continued

Two occurrences of details that have the same position and size, but differ in angle. If the angle differs more than the minimum separation in angle, or if the operator has ticked no separation in angle, both these occurrences are found.

Two occurrences of details that have the same angle and size, but differ in the x-position. If the x-position differs more than the minimum separation in x, or if the operator has ticked no separation in x, both these occurrences are found.

4.3.2 ”Blob” analysis type



Detail Settings

The following settings apply at detail level, i.e. they affect all the teachin positions for the detail.

Check perimeter

Check perimeter must be ticked if the perimeter is to be included in the properties that are analysed and compared with the learned details. As soon as the box is ticked, the user is permitted to set the permitted deviations for the perimeter property.

Check elongation

Check elongation must be ticked if the elongation is to be included in the properties that are analysed and compared with the learned details. As soon as the box is ticked, the user is permitted to set the permitted deviations for the elongation property.

Check compactness

Check compactness must be ticked if the compactness is to be included in the properties that are analysed and compared with the learned details. As soon as the box is ticked, the user is permitted to set the permitted deviations for the property compactness.

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4.3.2 ”Blob” analysis type
Continued

Number to send (option)

The value of ‘occurrences to send’ controls how many results are sent to the robot. This is mainly useful for conveyor tracking systems when you do not want to send too many details to the robot. Otherwise the robot would have to process and check considerably more co-ordinates than it is able to pick. In most cases the ‘occurrences to find’ should be set relatively high, while ‘occurrences to send’ can be set relatively low. This is because a number of the details that are found may be impossible to grip due to collision detection.

The robot can also sort and select which details are to be picked when several occurrences are sent to the robot, e.g. based on the signals from the machine that is in service.

Timeout

The timeout parameter lets you limit the maximum time taken for searching so that the identification time does not affect the robot(s) cycle time. If no timeout is set at all, the search could take several minutes in the worst case.

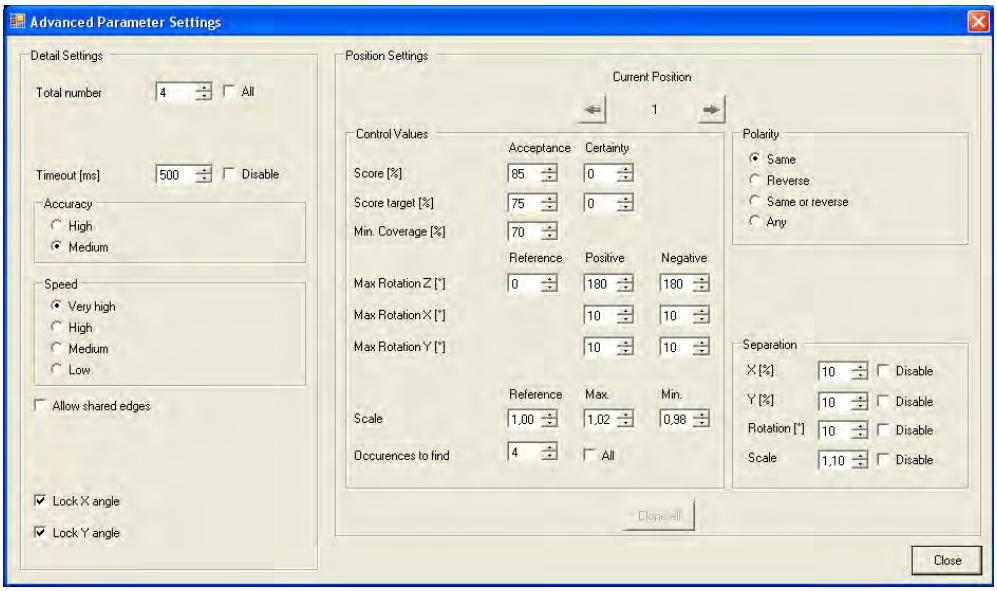
Position Settings

The following settings apply at position level, i.e. they only affect the current position. It is easy to switch between positions by clicking on the arrows to change position.

Permitted deviation for different properties

For all properties, an upper (maximum deviation) and lower (minimum deviation) limit is given as a percentage. The requirements for the two positions must be completely different in at least one property, otherwise a warning is displayed to the user.

4.3.3 Analysis type ”3D”



The parameter settings for 3D analysis are very similar to those for the standard analysis. The difference is that there are some additions for 3D analysis.

Detail Settings

Read X angle

Locks rotation around the x-axis to 0 degrees. The additional rotation stated under the tab “Grip” will be added however despite this selection. This means that the robot will always pick with the same rotation around x, that is stated under the tab ’Grip’. Note that it regards the x-axis for the detail.

Lock Y angle

Locks rotation around the y-axis to 0 degrees. The additional rotation stated under the tab “Grip” will be added however despite this selection. This means that the robot will always pick with the same rotation around y, that is stated under the tab ’Grip’. Note that it regards the x-axis for the detail.

Check values

Max Rotation X

Sets limits for how much rotation is permitted around the detail’s x-axis. If the detail’s angle in the x-axis together with the additional rotation that is given under the tab ”Grip” goes outside the limits the detail will be marked as unpickable.

Max Rotation Y

Sets limits for how much rotation is permitted around the detail’s y-axis. If the detail’s angle in the y-axis together with the additional rotation that is given under the tab ”Grip” goes outside the limits the detail will be marked as unpickable.

4.4 Extra analyses (option)

Extra analyses are used to further investigate different positions that the system finds. These analyses can be used in many different ways and are extremely flexible. Possible applications include, for example, refining the search results, to distinguish between almost identical positions, or to check whether parts of the detail exist or not.

If the conditions in any of the activated extra analyses are not met for a detail that has been found, this detail will not be picked by the robot.

Extra analyses are defined for every learned position. The operator selects the current position and then one of the permitted extra analysis from the dropdown menu. If the extra analysis is to be used it is activated by clicking in the ”Activate analysis type” tick box.

There are different parameters that the operator enters for each analysis type. In addition to this, the operator determines in which area the extra analyses are to be performed by pulling a red rectangle on the position image.

After specifying all parameters and the area where the extra analysis is to be performed, a test can be performed, where the result is shown in the image (marking of certain areas),

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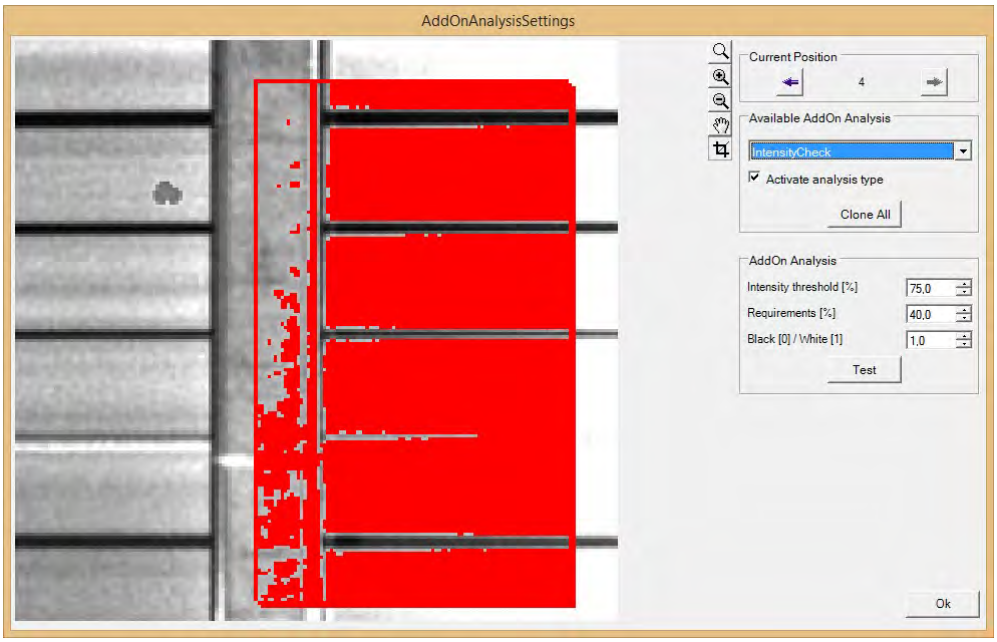
4.4.1 Brightness control (option)

The ”brightness control” extra analysis is used to ensure that the selected parts of the detail’s position are dark or light. The areas of use are, for example, check for material, check for openings, check for labels, etc.



The operator must give the following parameters:

Black[0] / White [1]: Indicates whether the operator is interested in the light (1) or dark areas (0). During testing the pixels above the brightness threshold (1) or those below the brightness threshold (0) are marked.

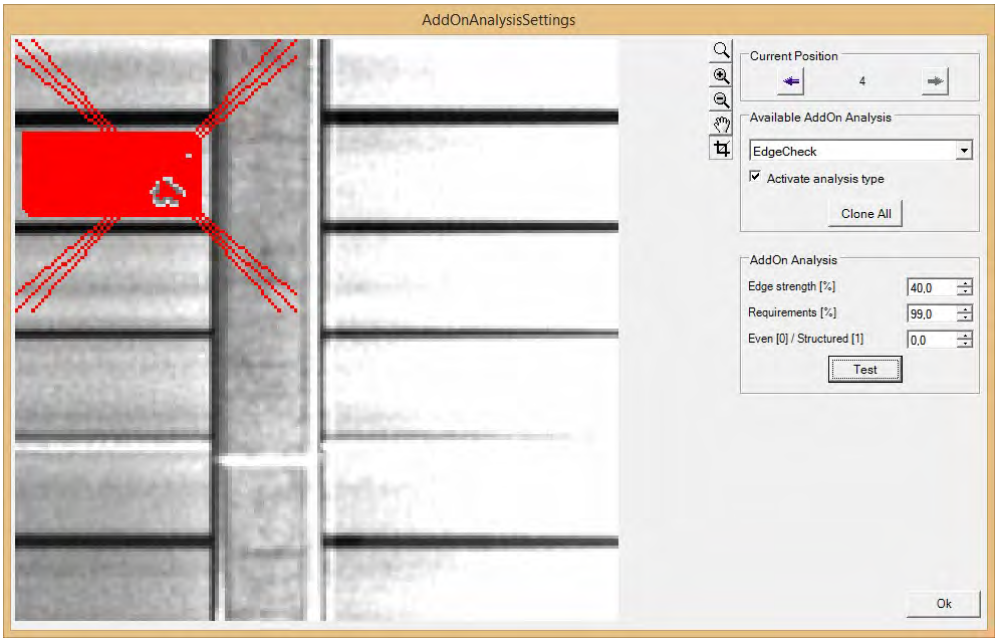
Brightness threshold: Indicates at which brightness pixels are included in the analysis (100% corresponds to a completely white pixel, 0% a completely black pixel).

Requirement: Specify what percentage of the pixels must meet the conditions above.

Example: Black/White = 1, Requirement = 40%, Brightness threshold = 80%: All pixels within the red box with a brightness above 80% are included. If more than 40% of the red box’s pixels meet the conditions, this analysis is approved.

4.4.2 Edge control (option)

The ”edge control” extra analysis is used to ensure that the selected parts of the detail’s position consist of a certain amount of edges, i.e. visible structures. The areas of use are, for example, check for holes, check for embossing, check for large defects on the flat surface, etc.



The operator must give the following parameters:

Flat [0] / Structured [1]: Indicates whether the operator is interested in the flat areas (1) or whether the structured part of the surface is the distinctive part (0). During testing the pixels with an edge intensity below the edge intensity threshold (1) or those above the edge intensity threshold (1) are marked.

Edge intensity threshold: The edge intensity is a measurement of how visible and distinctive an edge in the image is; 100% corresponds to an immediate transition from black to white in the image, whilst 0% corresponds to an even brightness of the area. The threshold indicates at which edge intensity pixels are calculated in the analysis.

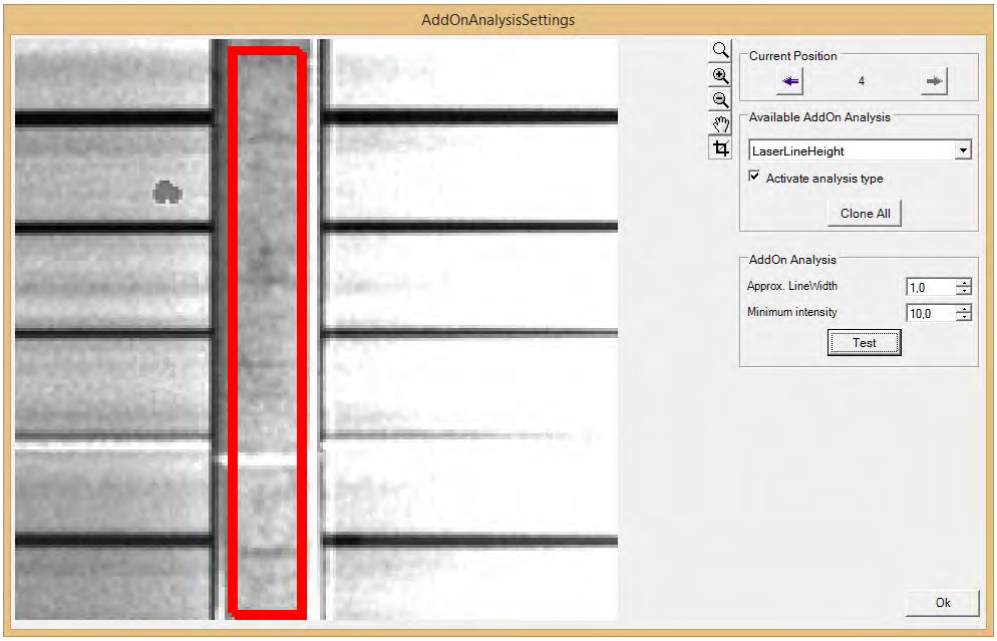
Score: Specify what percentage of the pixels must meet the conditions above.

Example: Flat / Structured = 1, Requirement = 10%, Edge intensity threshold = 50%: All pixels within the red box with an edge intensity above 50% are included. If more than 10% of the red box’s pixels meet the conditions, this analysis is approved.

4.4.3 Laser line height (option)

The ”laser line height” extra analysis is used to measure the actual height of the object within the red box. PickMT must have been calibrated in a particular way for this function to be used. The measured height is then used as grip height that is sent to the robot.

Note that the red box is not used in this extra analysis. The supervision area which is defined in the ”Supervision” tab, is used instead. Only the parts of the laser line that are visible within this supervision area are evaluated for height information. The supervision area must be indicated within a flat area and in such a way that the laser line remains in the area for all possible heights of the object.



The operator must give the following parameters:

Line width: Indicates the expected width of the laser line in pixels.

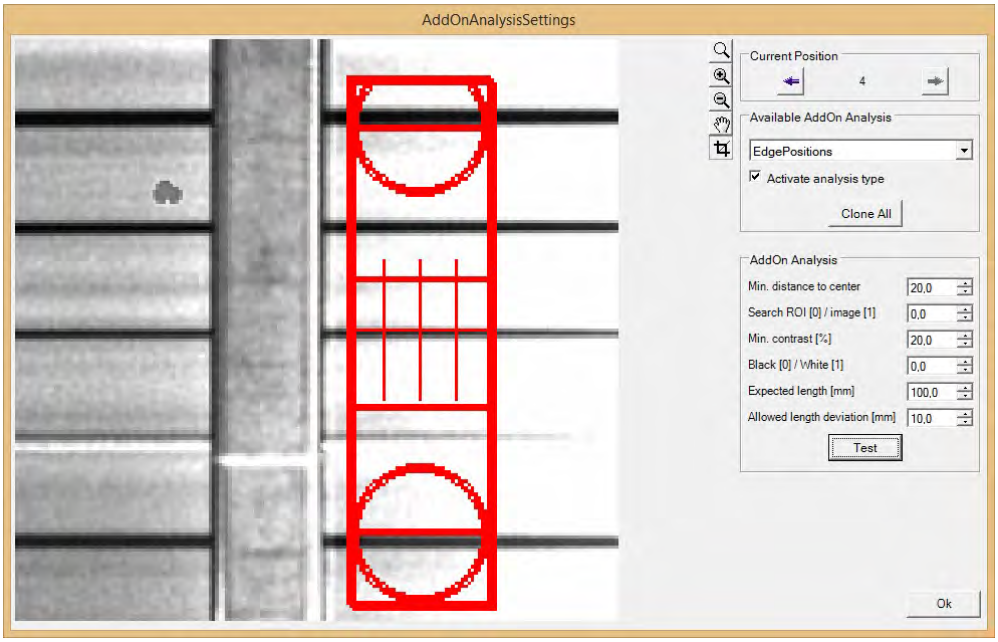
Min. brightness: Indicates the minimum brightness that the laser line must have (averaged above the line width) to be counted as a laser line.

4.4.4 Edge positions (option)

The ”edge positions” extra analysis is used to check length/width of the found object and to adjust the centre position of the found object.

In the first stage, the length of the object is measured by finding the end points according to the operator’s settings. In the next stage, the centre position of the found detail is adjusted to the centre of the detail, regardless of where it was initially found.

In the red box, the original centre position is drawn with a dash in the centre. The found end points are drawn with circles around a dash that marks the end position. The revised centre position is drawn with several ”+” characters.



The operator must give the following parameters:

Minimum distance to the centre: Indicates how many pixels from the centre the search is to start after the end position. With this parameter the search can ”skip over” uninteresting areas. This area in the centre is also used for an average value of brightness that can then be used in the edge search outwards.

Search in ROI [0] / in image [1]: Indicates how the red box affects edge searching: The following values are permitted:

0: Edge searching only occurs within the red box.

1: Edge searching occurs in the entire image, along the red box (longitudinally), over the entire area as the image permits. This can be used if the first search does not position the detail correctly longitudinally.

Minimum contrast [%]: Indicates the minimum brightness change that is required to assume there is an edge.

Black [0] / White [1]: Indicates whether the background is darker than the detail (0) or lighter than the detail (1).

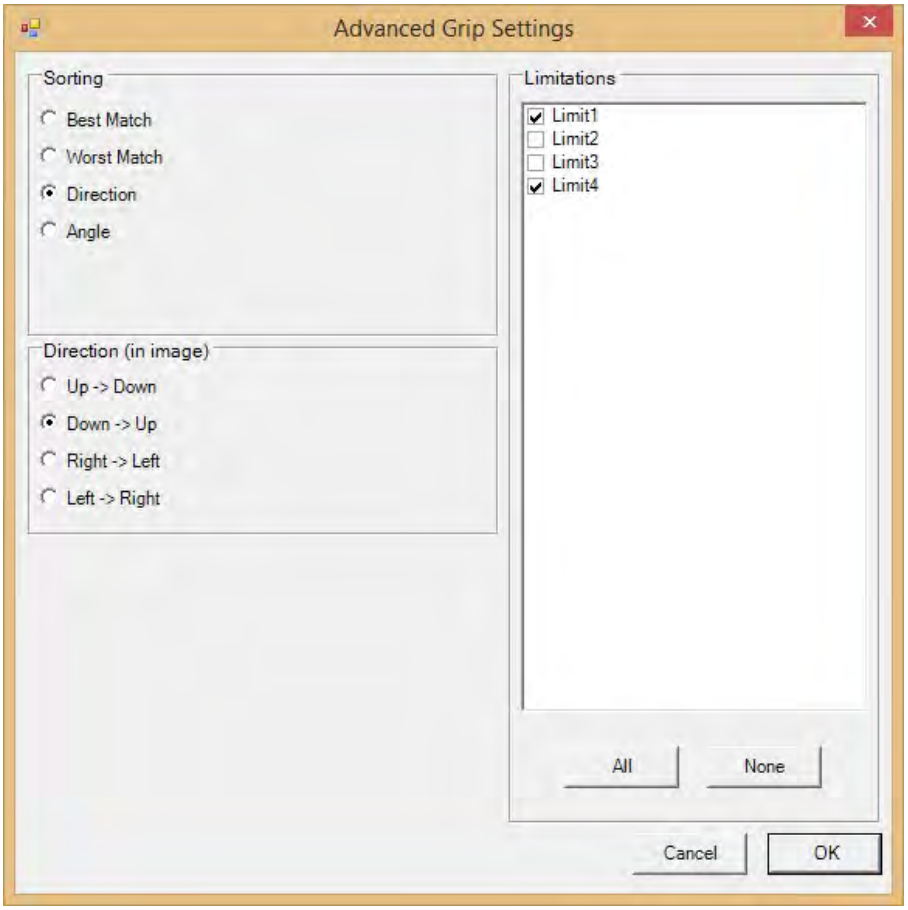
Expected length [mm]: Indicates the expected length of the detail in mm.

Continues on next page

Permitted length deviation [mm]: Indicates by how much the detail's length may deviate up or down to still be approved.

4.5 Advanced grip settings

Clicking on ‘Advanced’ under the ‘Grip’ tab gives access to additional settings for adjusting gripping.

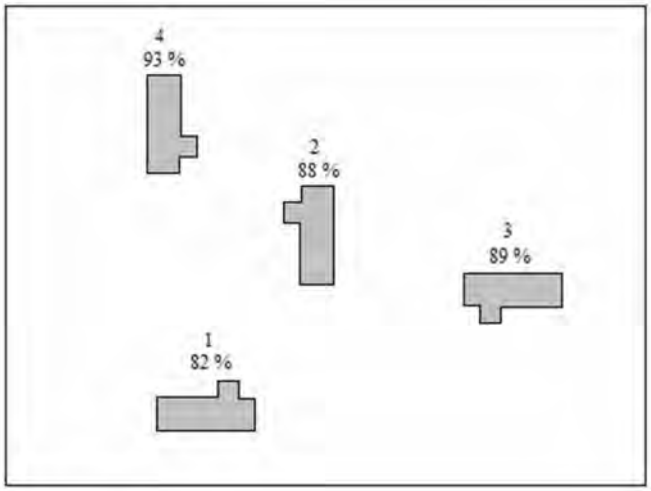


Continues on next page

These allow you to adjust sorting and to set grip limitations.

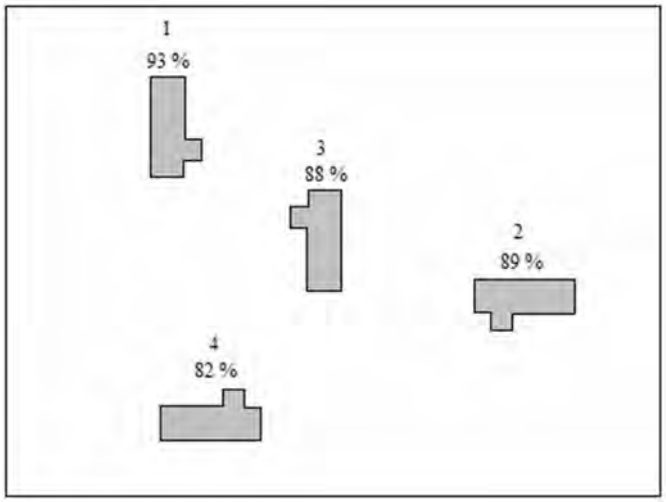
Sorting

The order in which coordinates are sent to the robot is normally controlled so that the position that has the highest identification accuracy is sent first. In some cases it may be preferable for the robot to pick from a certain direction or in a certain way first. The sorting settings allow you to control how the system sorts coordinates.



Worst match

When this setting is selected the system sends the worst identification match first. Because the location for obtaining the best identification result often varies slightly within the field of view, this setting appears to sort positions randomly.

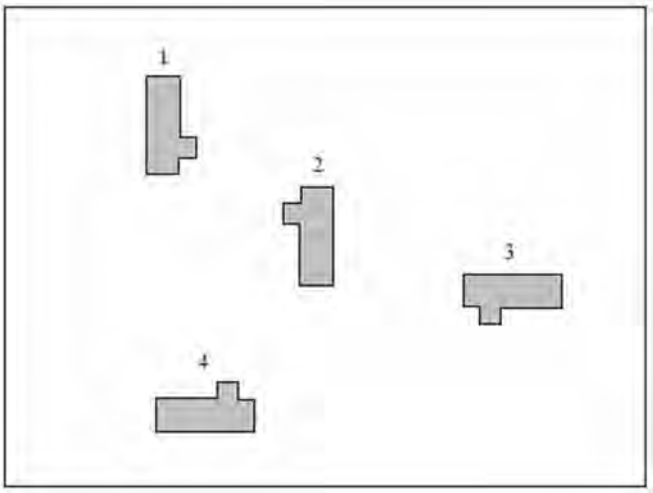


Best match

When this setting is selected the system sends the coordinates of the position that gives the best identification match first. Because the location for obtaining the best

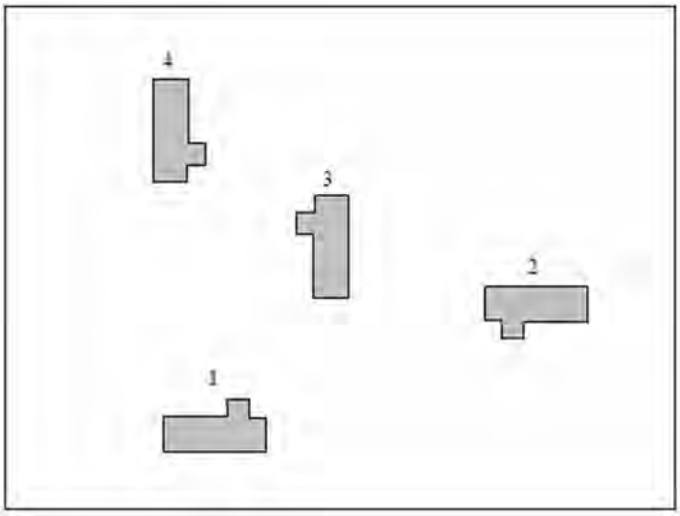
Continues on next page

identification result often varies slightly within the field of view, this setting appears to sort positions randomly.



Alignment – Up -> Down

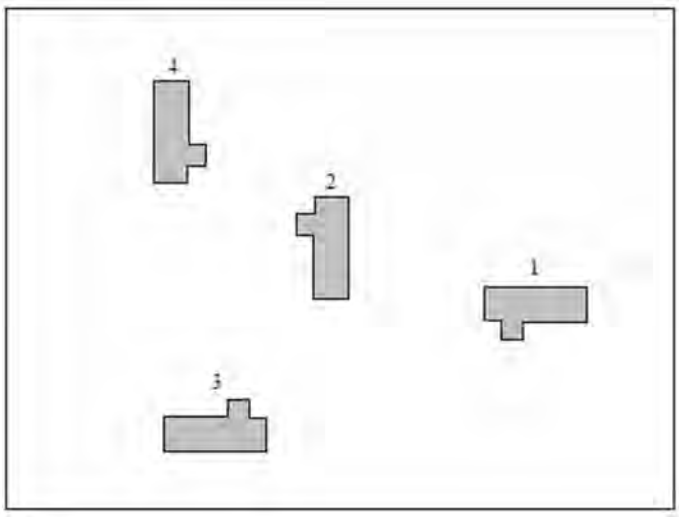
With this setting the coordinates of the position at the top of the field of view are sent first.



Alignment – Down -> Up

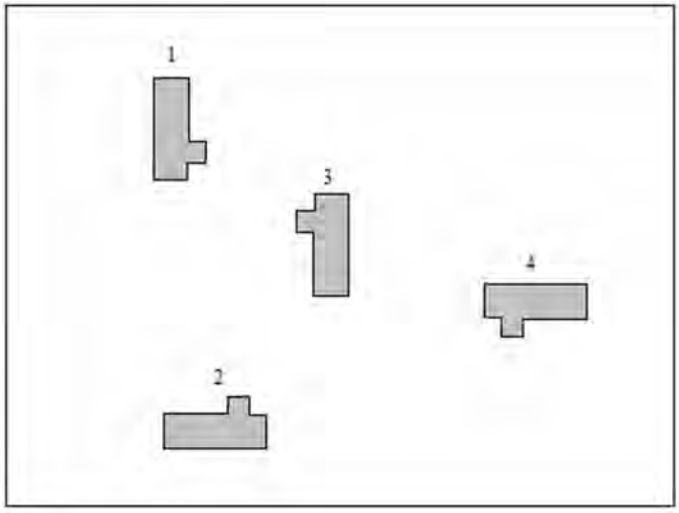
Continues on next page

With this setting the coordinates of the position at the bottom of the field of view are sent first.



Alignment – Right -> Left

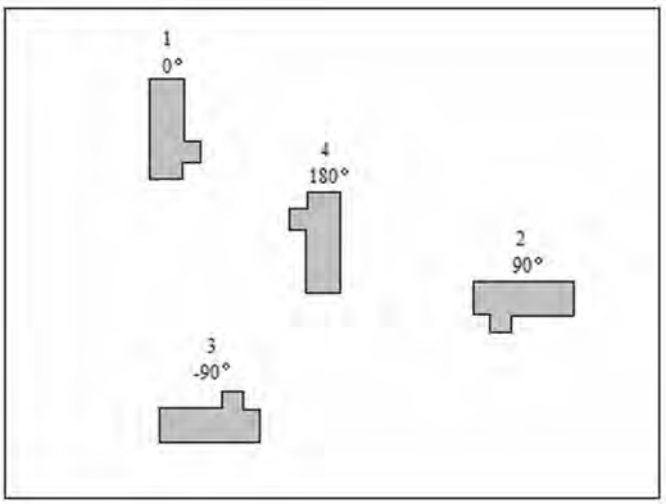
With this setting the coordinates of the position at the far right of the field of view are sent first.



Alignment – Left -> Right

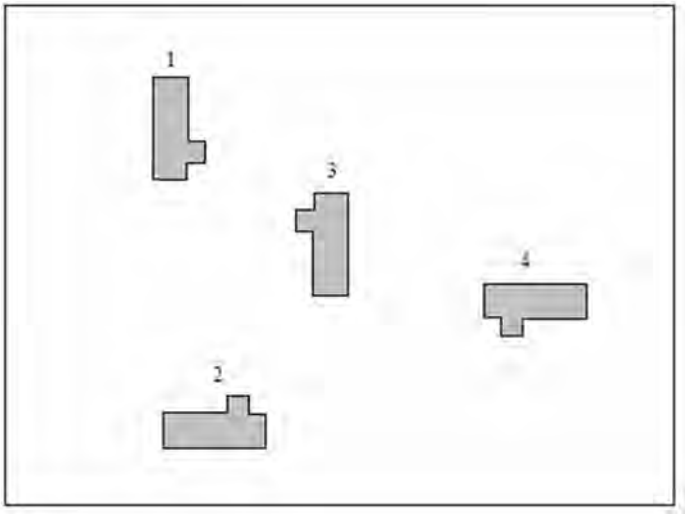
Continues on next page

With this setting the coordinates of the position at the far left of the field of view are sent first.



Angle

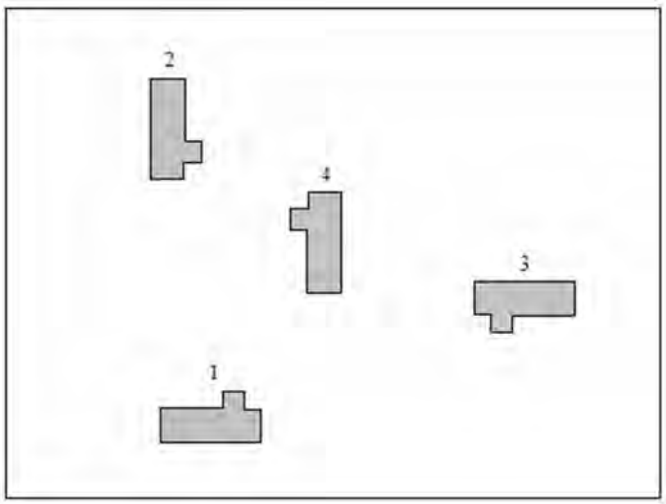
With this setting the coordinates of the position that is closest to the selected angle are sent first. If the selected angle is 0 the coordinates are sent in the order shown in the image above.



Alternate – Up -> Down

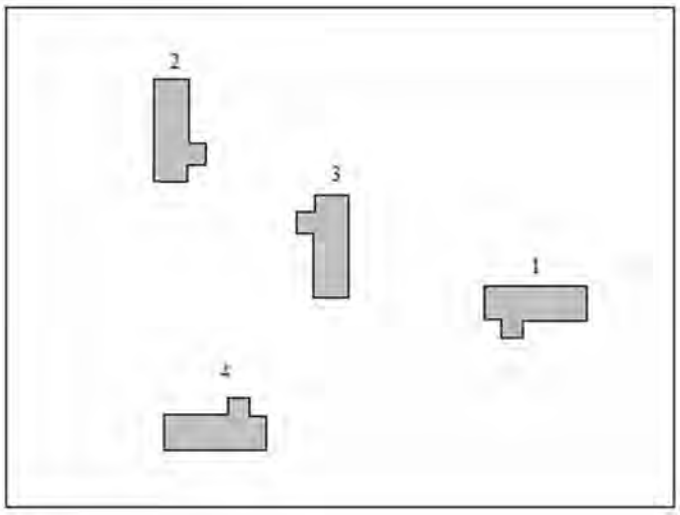
Continues on next page

With this setting the coordinates of the position at the top of the field of view are sent first, followed by the position at the bottom.



Alternate – Down -> Up

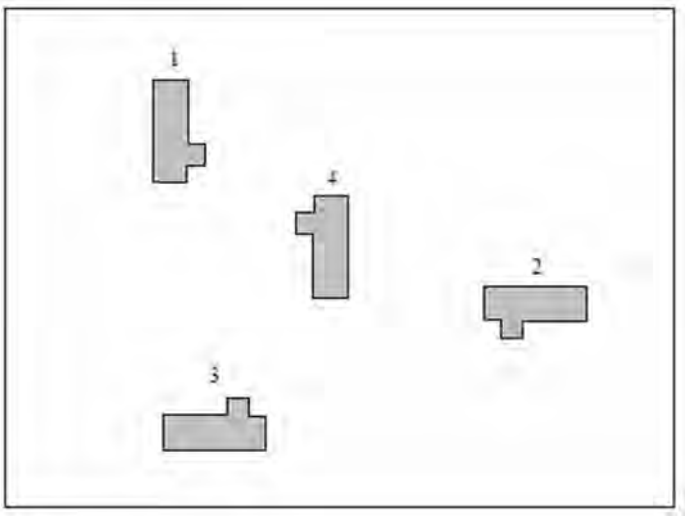
With this setting the coordinates of the position at the bottom of the field of view are sent first, followed by the position at the top.



Alternate – Right -> Left

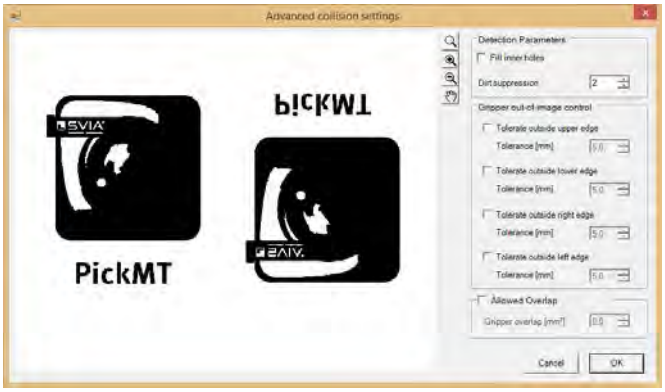
Continues on next page

With this setting the coordinates of the position that is at the far right of the field of view are sent first, followed by the position at the far left.



Alternate – Left -> Right

With this setting the coordinates of the position at the far left of the field of view are sent first, followed by the position at the far right.



Highest match

These sorting conditions are only relevant with 3D sensors. The detail located at the highest height is sent to the robot first. The located height of each detail is shown in the image in millimetres.

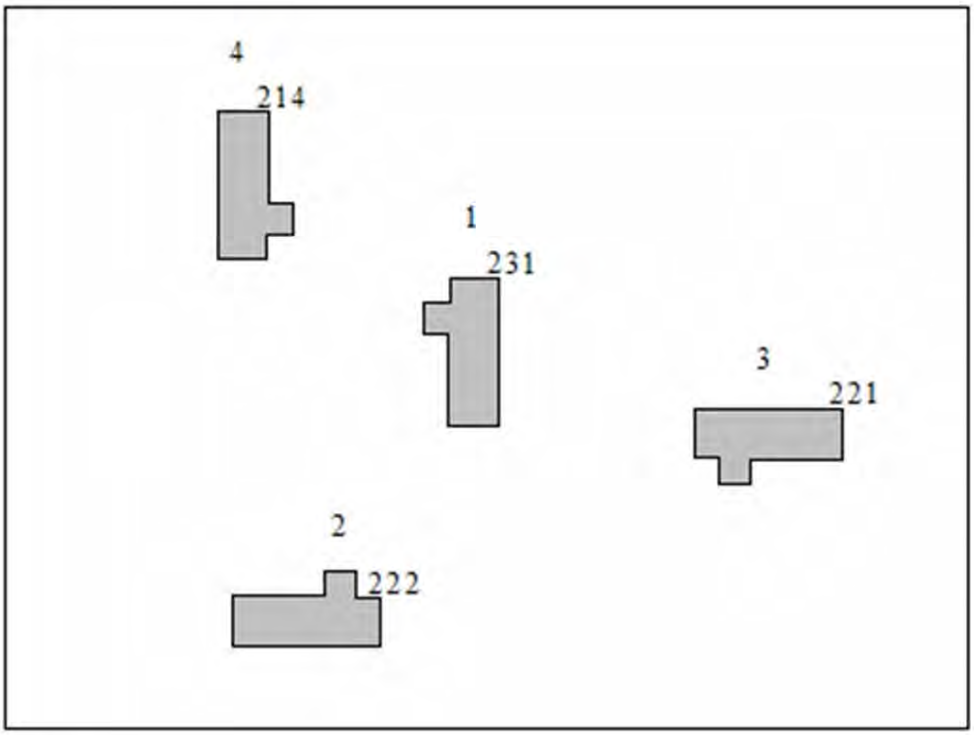
Limitations

In some cases it may be desirable to prevent the robot from gripping or handling modes when they are in certain positions and/or angles. This is done by activating the grip limitations for the detail. Before a limitation can be activated, it must be defined in the system.

From the list you can then tick the limitations that you want to apply to the detail. The number of limitations that can be activated for a detail is unlimited.

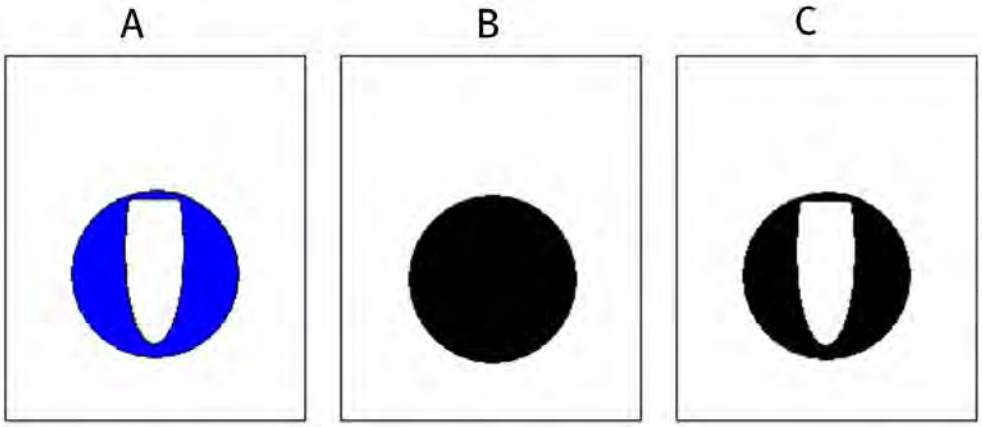
4.6 Advanced supervision settings

Clicking on ‘Advanced’ under the ‘Supervision’ tab gives access to additional settings for controlling supervision.



Detection parameters

The normal setting for collision detection is to fill the inner holes of details. However, in some cases this can give an inaccurate image of the detail.



A: Actual detail, B: With filled inner holes, C: Without filled inner holes.

The image shows an example in which the result of filling the inner holes gives a defective collision detection image for the detail.

The dirt suppression setting allows individual black marks on the conveyor to be filtered out, since these are often just dirt. Dirt suppression can thus improve the reliability of collision detection even on dirty conveyors. However, note that if dirt

Continues on next page

suppression is set too high it may also reject details, which can lead to collisions with the robot during gripping.

Gripper out of image

If a position is close to the edge of the image it can often mean that the location of the gripper would fall outside the field of view. If the gripper moves outside the field of view this is normally regarded as a collision, since the system does not know what is beyond the field of view. In some cases, however, it can be perfectly safe to move the gripper outside certain areas of the field of view, since the operator knows that there is no collision risk there.

The ‘Gripper out-of-image controls’ can be used to set dimensional tolerances for the positioning of the gripper outside the edges of the image. These tolerances can be activated on the chosen edges by ticking the relevant ‘Tolerate outside’ boxes. The required tolerance dimensions can then be entered. The designations for the edges (right, left, upper, lower) refer to the camera image that is seen on the screen.

5 Operation

The system is started and stopped under the ‘Operation’ tab. The appearance of this tab varies a little depending on how many cameras are connected to the system.

Drop-down menus are now provided for the group and detail for each camera. The ‘Group’ drop-down menu for camera 1 is used to select the group for camera 1, the ‘Group’ drop-down menu for camera 2 is used to select the group for camera 2, and so on.

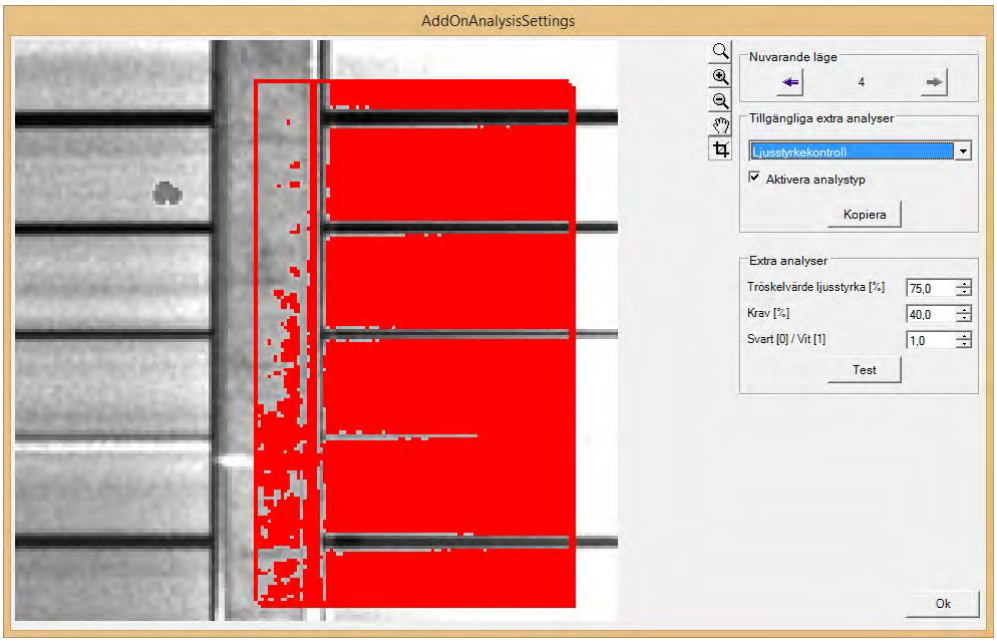
Continues on next page

5.1 Start

To start the system you must first select a detail and then click on ‘Start’. PickMT can also start the right robot program, depending on the robot used. Read more about this in the PickMT robot integration manual.

5.2 Operation information

The following information is displayed during operation.



The field of view always shows the latest image taken. If the system has more than one camera a separate tab will appear for each camera, as well as a tab for all cameras.

A red box and found contours are drawn over those details that have been identified. If the detail is to be picked the tool is drawn. If an identified detail is not to be picked it is marked with a cross and a letter. The letters have the following meanings:

C = “Coverage” Detail does not meet set requirements for minimum position coverage.

L = “Limitation” Detail lies within an active limitation.

P = “Proximity” Detail too close to previously picked detail.

T = “Tool” Tool collision if detail were to be picked.

Collision risk image is seen in green contours.

Displayed to the right of the image are the latest results that have been sent to the robot. The most recent result always appears at the bottom. The results are formatted as follows:

Camera: ‘Camera number’ / Position: ‘Position number’
Result: ‘Result (%)’/‘Score target (%)’

Example:

Camera: 1 / Mode: 2
Result: 86.7% / 87.4%

This means that a detail has been found in position 2 in the image taken by camera 1. It has been identified with an 86.7% score certainty and an 87.4% score target certainty.

Continues on next page

At the top left above the image you can also see which group and which detail are selected for the current camera. The example above shows Camera 1 (SVIA:PickMT), which means that the PickMT detail from the SVIA group is currently running.

5.3 Stop

To stop the system, click on ‘Stop’. PickMT can also stop the robot, depending on the robot used. Read more about this in the PickMT robot integration manual.

If PickMT is used with a Multiflex or Miniflex the mechanical operation of either machine will also stop.

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6 Calibration

In order for PickMT to send the correct co-ordinates to the robot, the system must be calibrated together, e.g. PickMT's co-ordinate system and the robot's co-ordinate system must be made to correspond. The supplied calibration plate and calibration tool are used for this purpose.

The calibration process varies, depending on whether PickMT is used with a machine that has a Stop & Go conveyor or one that has Conveyor Tracking.

Section 6.1 describes the calibration of PickMT.

For a description of robot calibration, read the separate manual.

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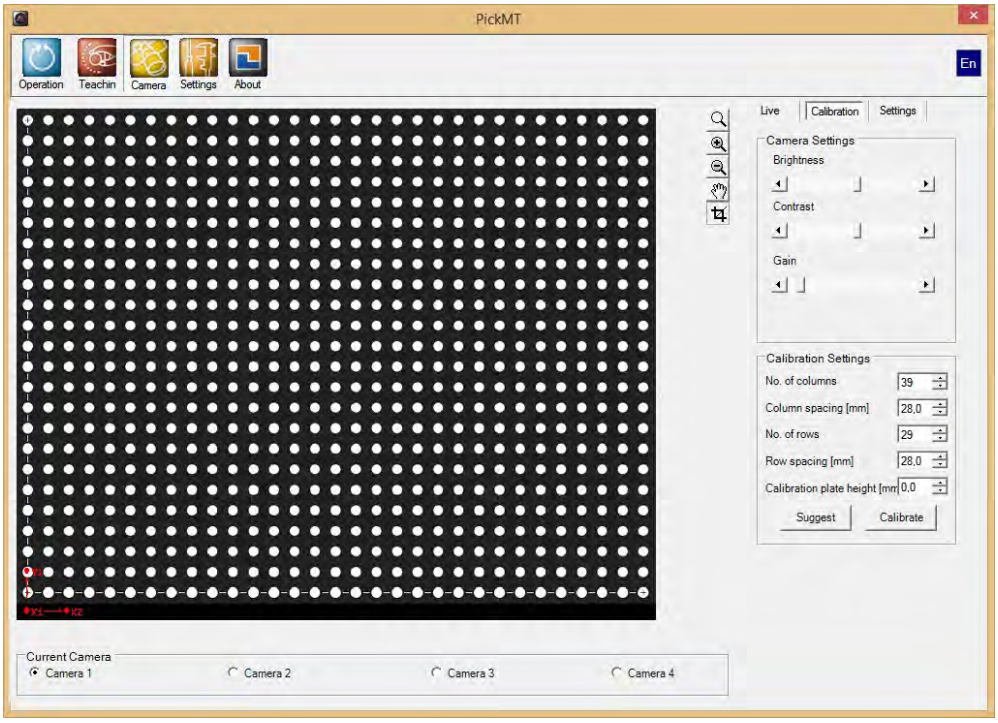
6.1 Calibrating PickMT

6.1.1 2D sensor

PickMT must first be calibrated. The supplied calibration plate is used for this purpose.



Go to the ‘Calibration’ tab under ‘Camera’ in PickMT.

First choose the camera to be calibrated. Then place the plate under the camera so that the point with coordinates x=0, y=0 appears in the bottom left corner of the image. The image also shows a small co-ordinate system that illustrates how the calibration plate should be orientated.

The dots must fill the image and reach as far out to the edges as possible. None of the dots should only be partially visible in the field of view. If it is not possible to adjust the plate so that partial dots cannot be seen then the row of dots that contains partially visible dots must be covered over.

Now adjust the camera settings to create as sharp a contrast as possible between the dots and the background.

Then enter the number of visible columns (vertical) and the number of rows (horizontal). By clicking on the ‘Suggest’ button you can see suggested values for the number of rows and columns that are visible.

The spacing between each dot must be known and measured. The standard calibration plate has these values printed on the plate. If the spacing is not known it must be measured. The values are entered in PickMT. Note that the suggested numbers of rows and columns do not relate to the row and column spacings. PickMT cannot give suggestions for the current row or column spacings.

Now click on the ‘Calibrate’ button.

Continues on next page

It is possible to reduce the area that is used for calibration. This can be useful in several cases, e.g. when having of large field of view with other visible objects outside of the calibration plate.

Activate the region-of-interest tool and draw a red rectangle around the valid calibration dots. Then continue calibration as described above.

Laser line calibration (option)

If PickMT is used with a laser line to measure heights in the image, the laser line measurement must be calibrated. This is done using a flat calibration plate that can be presented to the camera at different heights. These calibration heights must cover the entire expected height range.

Calibration can be carried out manually or automatically. In the manual position, the operator moves the calibration plate to known heights and indicates these for PickMT. During automatic calibration, the robot holds the camera or calibration plate and informs PickMT about the actual heights.

The following rules apply to the values in the specified height data: The height must correspond to the grip height for the robot. I.e. if the distance between the calibration plate for the laser line and camera are the same as during calibration with the dotted pattern, the height 0 mm must be given. When the distance between the calibration plate for the laser line is closer to the camera than what the dotted pattern was during calibration, the height > 0 mm must be given. When the distance between the calibration plate for the laser line is further away from the camera than what the dotted pattern was during calibration, the height < 0 mm must be given.

Click ”Calibrate” in the field ”Calibrate Laser line”. Specify that you really want to perform a calibration. Then specify whether the robot is to send height data or not. For automatic calibration, the robot must then start its calibration procedure for the laser line. Every time an image is taken, information about the height is sent to PickMT. The robot must wait 1 second after each image taking command before further movement.

During manual calibration, the calibration plate moves to the desired height, the height is entered into PickMT. This is repeated for all heights. When the operator has calibrated at all heights, a height of -1 is specified to end the calibration procedure.

6.1.2 3D sensor

Calibrating with PickMT

Start by calibrating the coordinate system wCamera1 (or for example wCamera2 for camera 2) in the robot. The coordinate system should lie with the X-axis along the long side of the pallet and the y-axis along the short side of the pallet, the Z-axis must point upwards. For example, it can lie on the guides for the pallets.

Then installmount the calibration cone on the robot and ensure that the TCP for it is used in all calibration positions. If the calibration positions do not exist they must be created to facilitate calibration.

All positions must lie in wCamerawCamera1 (3D sensor is camera 1) and be within the robot's range and the sensor's measurement range. The calibration cone must point directly upwards at each point. If the sensor is inclined in relation to wCamera1, inclined cone positions shall be considered.

PickMT needs 9 to 30 calibration points (typically 15) in order to perform calibration calculations. Prepare a robot routine for all robot positions used during calibration.

It is strongly recommended that 5 points are used as far down as possible, one in each corner of the area where the pallets will stand and 1 in the middle. Then a further 5 positions in the same way at an intermediate height and, finally, a further 5 in the same way at a height close to maximum height. Remember that the positions must always be atwithin leastthe 1sensors metremeasurement from the sensorvolume.

In PickMT, select 'Camera' and the tab 'Calibration'. StateEnter cone diameter and cone angle for the robot's calibration cone. TheClick dimensions for the cone angle can be given as 5-10% less than the actual value"Calibrate".

- Set robot to autoAfter a confirmation prompt, PickMT will reset the current calibration. This means that the displayed part of the sensor field of view may have moved considerably. PickMT will ask if the image size (settings page) is adjusted to fit a sensor with resetted calibration. If it is not, it must be adjusted, see section for settings and - optionally - the additional sensor manual. Write down the current values in case they are needed after calibration.

- Press 'Calibrate' in PickMTAfter image size confirmation, the operator is asked to start the calibration routine in the robot. Depending on the robot brand, the

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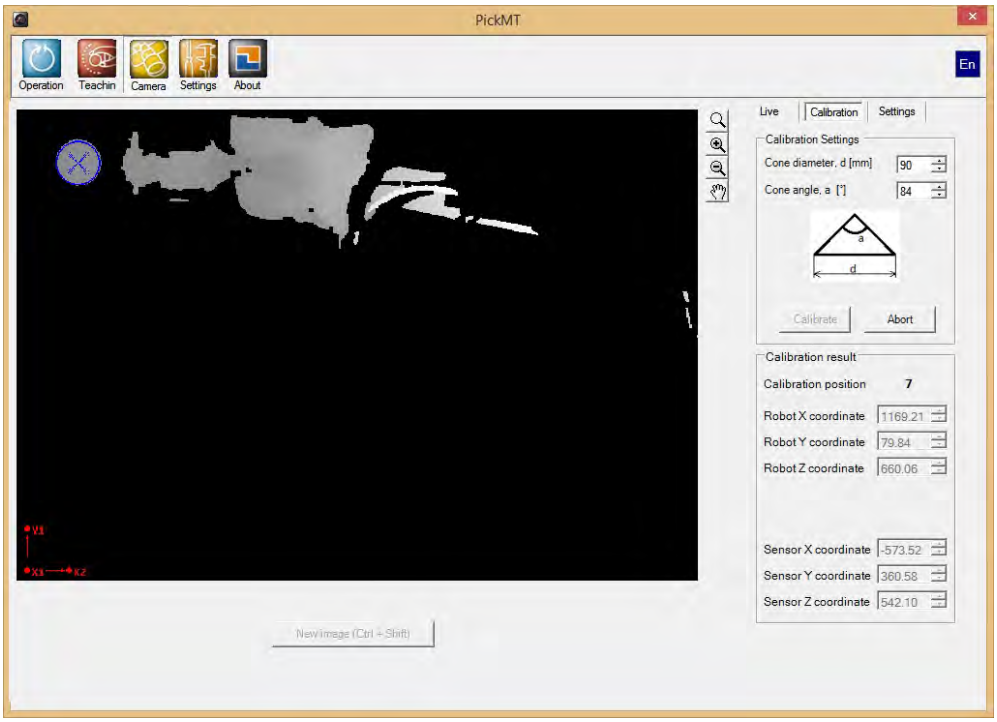
calibration can be performed more or less automatically. See robotic integration manual for more information.



PickMT will provide visual feedback about cone identification progress. A blue circle with a cross marks where the cone was found. Numbers (to the right) display current robot coordinates and identified sensor coordinates. Please note that coordinates must be entered manually for som robot brands. Please refer to the robot integration manual.

When everything is done, information on calibration quality is displayed. The operator can choose to accept the new calibration or revert to the previous one.

- Start the calibration procedure in the robotNote that the image size needs to be adjusted to fit the new calibration.

Calibration will now be managed automatically, the robot runs to each calibration position and waits there for the scanner to capture a new image before it continues. When everything is complete information about how good the calibration was is displayed. It is then possible to use the new calibration or retain the old one.In some cases, a temporary manual adjustment of the 3D sensor’s characteristics is required in order to perform a calibration. Click “Advanced” from the calibration settings and adjust the image in order to obtain a clear and smooth image of the calibration cone.

Also check the PickMT’s sensor integration manual (optional) for further instructions.

NOTE! Calibration with PickMT is not yet possible for 3D. Refer to “Calibrating with the external program” until further notice.

Calibrating with external program

It is possible to calibrate the sensor with external software. Read the separate calibration instructions for this.

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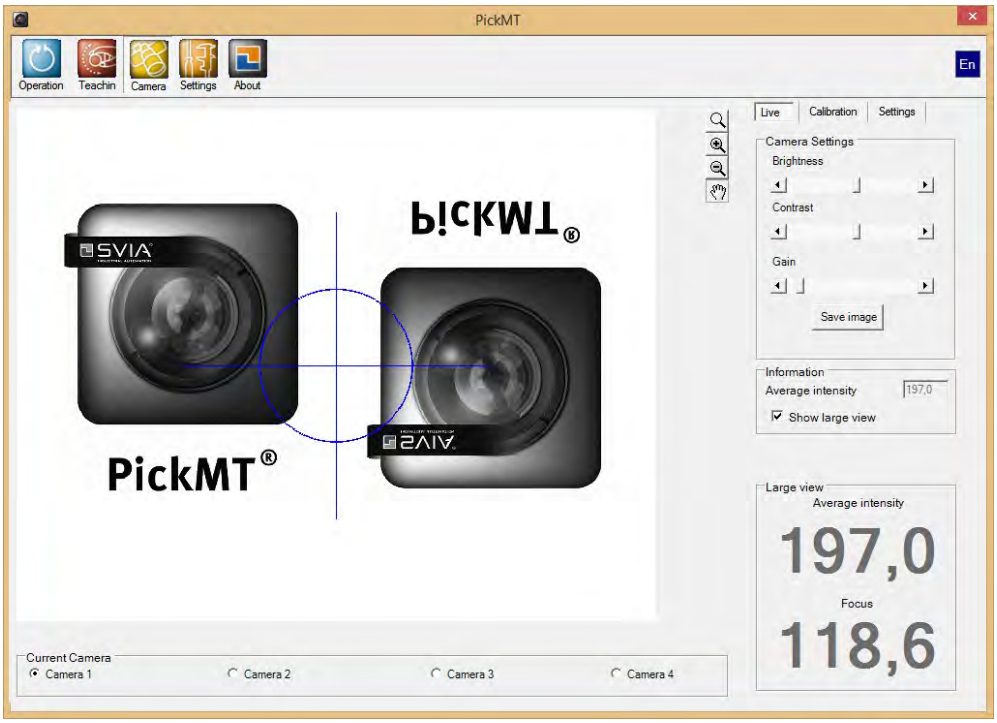
7 Camera Settings

7.1 Live

The current camera image is shown under the ‘Live’ tab.



You can also adjust the camera settings here to provide a quick and easy way of checking different settings. By clicking on ‘Save’ you can save the image, for analysis on another computer, etc.

When the ”Show large view” tick box has been ticked, clearly visible values for the average intensity (brightness) are shown as well as a measurement for sharpness in arbitrary units (higher value usually corresponds to better sharpness). These two can help the operator set the cameras for servicing and maintenance.

Colour settings (option)

When a colour camera is used, the operator can determine how to combine the three included colours to give the black-white image that PickMT then analyses. This function can be used to enhance or weaken certain selected colours, or to increase or reduce the contrast between certain colours.

For each included colour (blue, red, green) the proportion that is used to generate the final black-white image is set. Note that it is also possible to subtract colours from each other by giving negative percentages.

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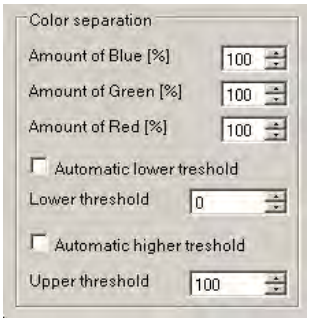
The calculated black-white image can then be rescaled, either by allowing PickMT to automatically determine the upper and lower limits, or by specifying specific values.

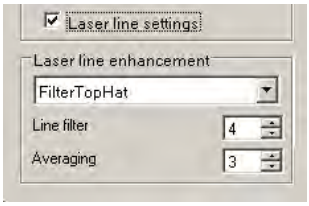


Laser line settings (option)

If PickMT is used with a laser line to measure heights in the image, the evaluation parameters for the laser line must be specified by the operator. Generally, the values that result in a clear image of the laser line with as little background image as possible should be specified.

In the dropdown list the FIlterTopHat or FilterDerivative can be selected. Standard setting should be FilterTopHat. In particularly difficult situations FilterDerivative can be selected to further filter out the background.

The values for line filter and averaging should be selected from the visible result. Typical values are usually around 4 for Linefilter and 3 for Averaging.

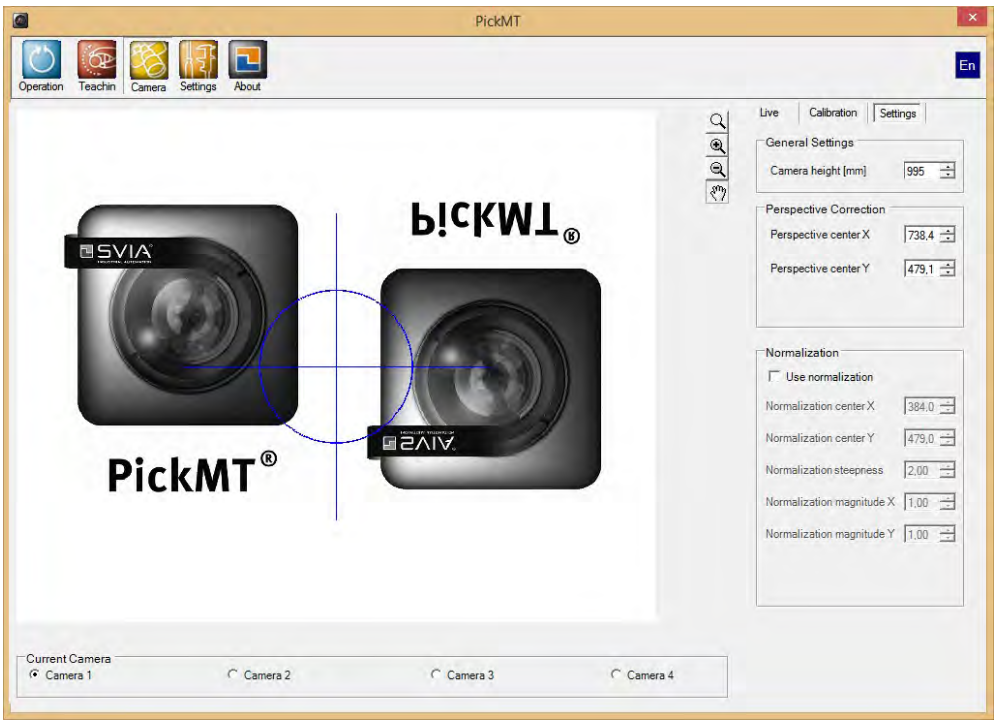


3D sensor

Because the 3D sensor does not need settings for brightness, contrast and gain this page is only of interest for saving images. Therefore only the ’Save image’ button is visible on the page.

7.2 Settings

7.2.1 2D sensor



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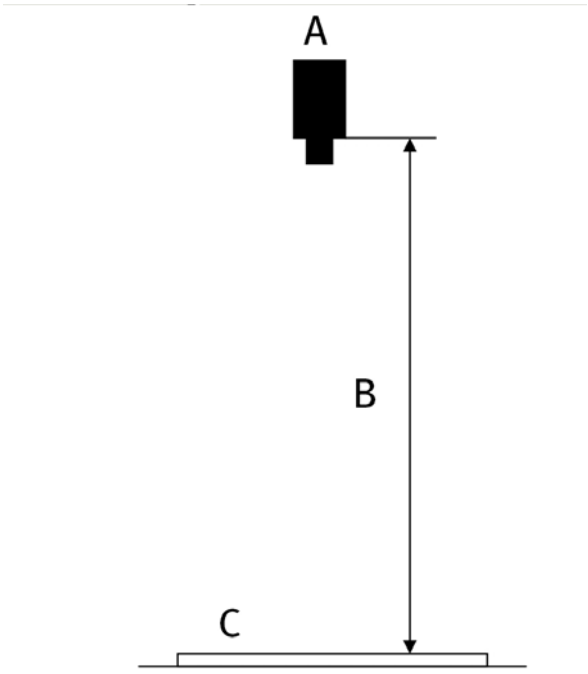
7.2.1 2D sensor
Continued

General Settings

The correct camera height must be entered in the system to ensure that the system sends the right coordinates to the robot. The camera height is measured in mm from the edge of the camera to the calibration plate, see the image below.



A: Camera, B: Camera height, C: Calibration plate

Perspective Correction

Perspective correction is always used to take account of the different edge heights of details above the calibration plate. From the camera's viewpoint, details that are in the same location but have different edge heights appear to be in different locations in the field of view (known as parallax error). PickMT, therefore, has built-in perspective correction that automatically compensates for this effect.

The perspective centre, the point in the field of view where the camera is looking vertically down on to the conveyor, must be specified in order for automated correction to work. There are three ways of finding the perspective centre:

- Place a mirror on the conveyor underneath the camera. Look for the camera lens in the image (a dark round spot). Right-click on the image and select 'Show cursor position', followed by 'Position in pixels'. Point at the middle of the camera lens spot and note the X and Y coordinates. Enter these coordinates as 'Perspective center X' and 'Perspective center Y'.
- Fit the calibration device to the robot, move it directly above the picking area and tilt it so that its tip can clearly be seen in the camera image. Then move the robot tip up and down in camera co-ordinate system, while you watch the tip in the camera image. Try to find a position in the X and Y axes where the robot tip does not appear to move in the camera image as the tip is moved up and down. Enter these co-ordinates as 'Perspective centre X' and 'Perspective centre Y'.

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- There is an option for automatically inputting the position of the perspective centre with PickMT. This is described separately in the accompanying instructions.

Normalization

Normalization can be used if you have an image that is unevenly lit, i.e. when the centre of the image is light but the corners are dark. Normally there is no need to use normalization; it is only likely to be needed when you have a large field of view and a light background.

There are five parameters to set for normalization.

Center X and Center Y

These two parameters must be set for the point you deem to be the lightest in the image. The current X and Y co-ordinates are displayed as you move the cursor over the image.(Right-click on the image and select ‘Show cursor position’, followed by ‘Position in pixels’). Move the cursor to the lightest point, read the coordinates and enter them.

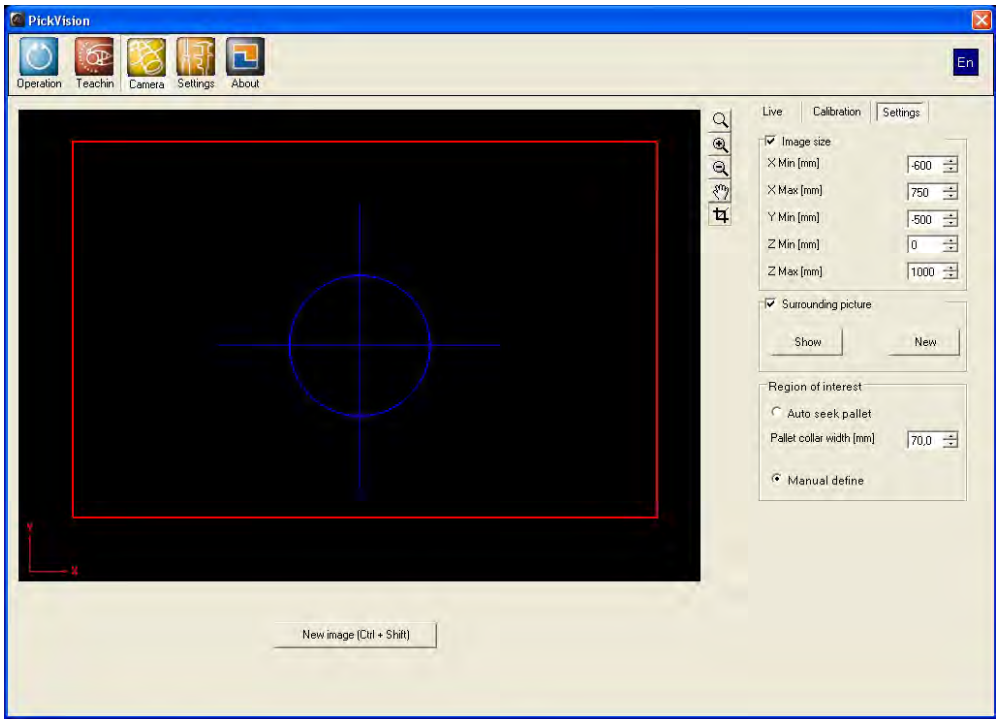
Correction curve

The correction curve has a value between 0 and 10. This value is used to adjust the correction at the edges of the image. A low value gives a correction that tails off towards the centre of image. A high value gives a stronger correction at the edges, but hardly any correction closer in towards the centre. Usually the correction curve should be set around 1.

Correction factor X and Correction factor Y

These two parameters control how large the correction should be in the X axis and Y axis, respectively. A high value gives a large correction for each axis, while a low value gives a smaller correction. Usually the correction factor should be between 0. 5 – 0.9.

7.2.2 3D sensor



A 3D sensor differs from a normal 2D camera. The image that comes into PickMT is rectified, which means that it does not have any perspective faults. The grey scale corresponds to the height so that it is possible to find the z coordinates.

Some settings must be made in order for PickMT to search in an efficient way.

Resolution

Depending on the application the interesting area for detail search can vary quite a lot. Here it is possible to determine exactly which area, i.e. what volume, must be displayed and analysed by PickMT.

It is important that the measurement volume is slightly larger in the x- and y-axis than the actual pick volume. For a pallet it is important for example that the whole pallet collar is always visible in the image.

The lowest height value (Z min). mustWhen operating without interlayers, this value shall be given so that the floor or bottom of the pallet is not includedshown in the image. The image for PickMT must always contain enough that the last level with details can be found but not the surface that they are lying on.

In contrast, when operating with interlayers, the lowest height value shall be adjusted so that the floor or bottom of the pallet is shown in the image.

The highest height value (Z max) must be given so that the highest detail always lies below this height. The defined area is always square which means that the max value for Y is calculated automatically in PickMT.

Observe that all values for the measurement volume are measured in the robots coordinate system (wCamera1).

Continues on next page

Surroundings image

The surroundings image is used for the automatic pallet search function, see below. If this function is not used then surroundings image is not required.

The image must show an empty pallet location, no details and no pallets. In other words, the surroundings of the picking area. When 'New image' is pressed a new surroundings image is created and with 'Display' the relevant image that has been saved previously is displayed.

Search area

The search area is a very important parameter when using a 3D sensor. When PickMT starts to search for a detail the highest point is identified first. Then PickMT searches until the detail is located or as far down as is set for the detail analysis depth.

When searching for the highest point the pallet collar must not be included. Therefore there is a search area which determines within which area PickMT will search. Note that details that are not inside the search area will not be included in the search for the highest point. The search area should lie just inside the pallet collar.

If there is no pallet collar or other edges or guides for the details then a search area that is large enough for the whole area where the details are to be found must be drawn.

Autosearch pallet

If 'Autosearch pallet' is selected PickMT will calculate a new search area at each image capture. By using the surrounding image an image can be produced that only contains the pallet. Based on this the outer contours of the pallet collar can be established.

Because the pallet collars must not be part of the search area, the pallet collar width must also be stated. It should be a little wider than reality so that no part of the pallet collar is visible in the search area.

When 'New image' is clicked, at the same time that Autosearch pallet is activated, the calculate search area is drawn in the image. The automatic function can be tested in this way.

Define manually

The user draws the search area in the image. First click 'New image' so that the area can be drawn inside the pallet collar. Remember that the next pallet entered into the cell may end up slightly differently. Therefore it is important that there is a little extra margin between the pallet collar and the search area. Note that it will be the same search area for all types of details.

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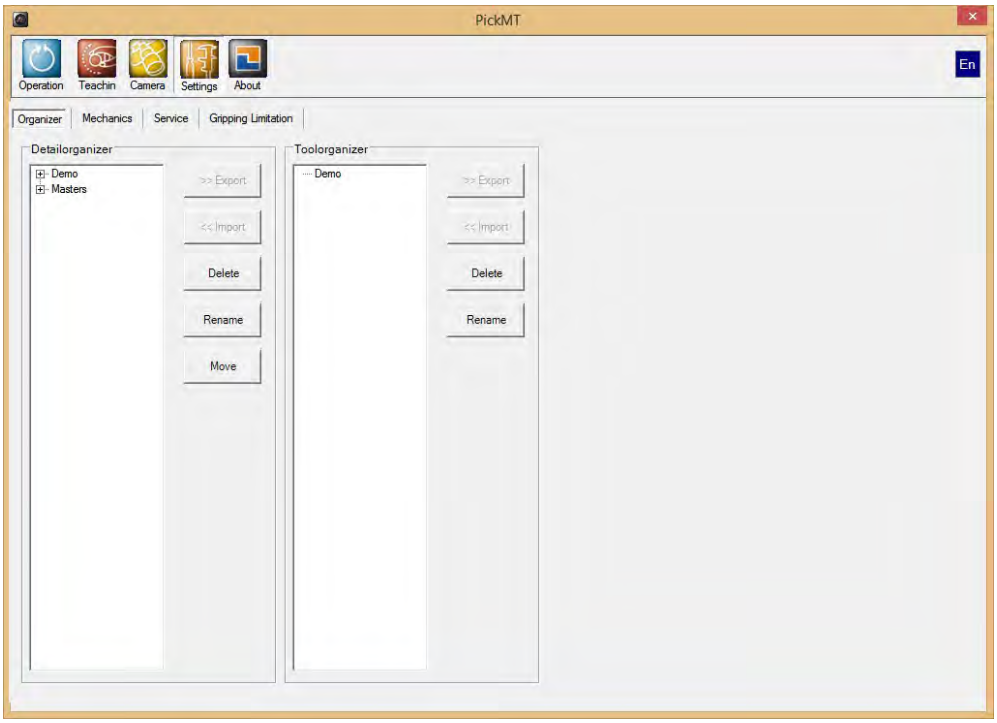
8 Settings

8.1 Organizer

The Organizer tab allows you to manage the details and tools in the database.



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8.1.1 Detail organizer

Underneath ‘Detail organizer’ you can see the groups that have been created in the system. Clicking on the + sign next to each group opens up the group and shows the details that have been taught in that group.

Export

Details that have been taught in a system can easily be moved between different systems by marking the desired detail or group and clicking on ‘Export’. All data associated with that detail is then saved to file. This can be very useful when you have several identical systems, or if you want to carry out the ‘Teachin’ process on another computer. However, please note that if the exported detail is to be used on another system it must have the same camera geometry and settings, i.e. the camera height, camera lens and aperture setting must be the same.

Import

Details that are exported from a system can easily be imported by clicking on ‘Import’. The details will be imported to the same group and have the same names as they did before they were exported.

Delete

A marked group or detail can be deleted by clicking on ‘Delete’.

Rename

You can give a marked group or detail a new name by clicking on ‘Rename’.

Move

A detail can be moved from one group to another group by clicking on ‘Move’.

8.1.2 Tool organizer

Underneath ‘Tool organizer’ you can see the tools that you have defined in the system. Note that predefined system tools are not visible underneath ‘Tool organizer’.

Export

Tools you have defined can easily be moved between different systems by marking the chosen tool and clicking ‘Export’. All the data that belongs to the tool is then saved to a file. This can be very useful if you have several systems with identical tools. However, please note that if the exported tool is to be used on another system it must have the same camera geometry, i.e. the camera height and lens size must be the same.

Import

Tools you have defined that are exported from a system can easily be imported by clicking on ‘Import’.

Delete

A marked tool can be removed from the system by clicking on ‘Delete’. If the tool is used for one or more teachin details you will be asked to confirm that you want to delete the tool. If you delete the tool anyway, you will then need to define a new tool for the details that used the deleted tool before the system can run those details again.

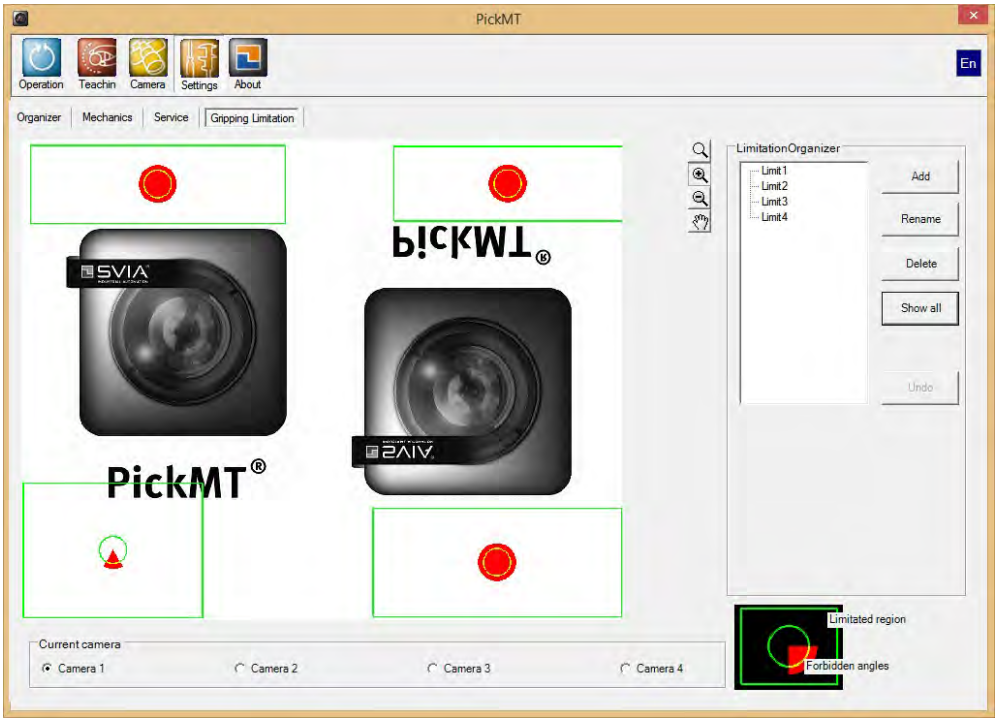
Rename

You can give a marked tool a new name by clicking on ‘Rename’.

8.2 Gripping Limitations

In some cases external circumstances can make it undesirable to pick or handle certain parts and/or certain orientations in the field of view. For example, you may wish to avoid picking or handling parts that have a tendency to roll at certain angles if they are lying at these angles.

Grip limitations can be used to define an unlimited number of limitations for the system. The limitations that you want to apply to a given detail can then be activated when following the ‘Teachin’ process for that detail.



On the right in the image above you can see the limitations that are currently defined for the system.

Click on ‘Add’ to add a gripping limitation for the system.

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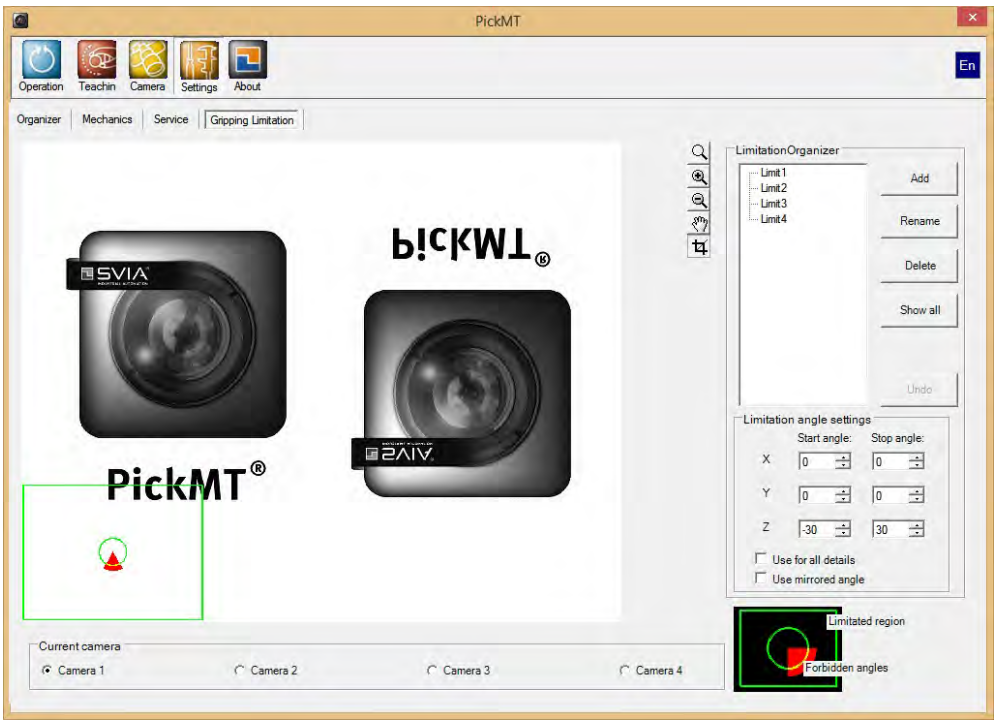
First enter a suitable name for the limitation.



Then use the drawing tools to define a box around the area where you want the limitation to apply. By using the start angle and stop angle settings for the X, Y and Z axes you can specify that limitations only apply to certain angles within the selected area.

The Z angles that are limited are marked in red, see image above. The section available for each defined tool may not be shown in the red area. At the bottom right of the image there is also explanatory text regarding the angles.

If several different limitations are defined for the system you can show individual limitations by clicking on their name in the field on the right. If you want to see all defined limitations, click on ‘Show all’.

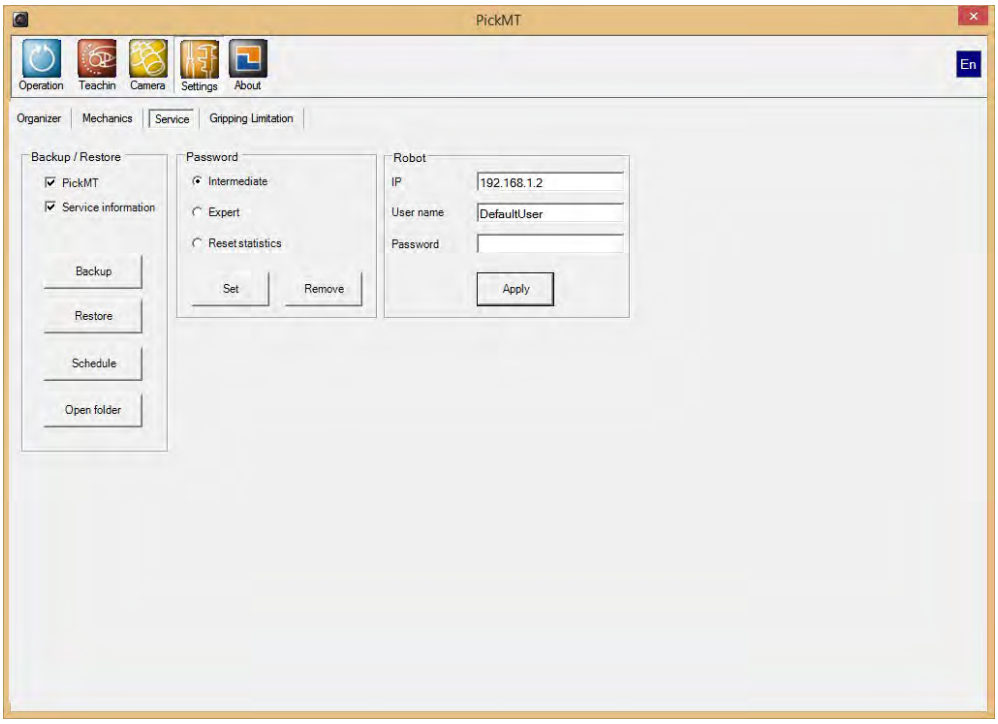
The ‘Rename’ button can be used to change the name of a limitation.

To remove a limitation, click on the ‘Delete’ button. Note that if you delete a defined limitation that has been enabled for one or more details, it will cease to apply to all those details. You will still be able to run the detail in the system, but without the deleted limitation. If a defined limitation has been enabled for one or more details you will be asked for confirmation before it is deleted.

The check box ’Use for all details’ activates the selected limit for all details in the system. Note that as long as it is checked it is not possible to deselect the limit of a single detail.

If 'Use reflected angle’ is checked the limited area will also contain a reflection of the limited angle. The reflected section of the limitation will also be drawn in the image so that it is easy to understand what is covered.

8.3 Service

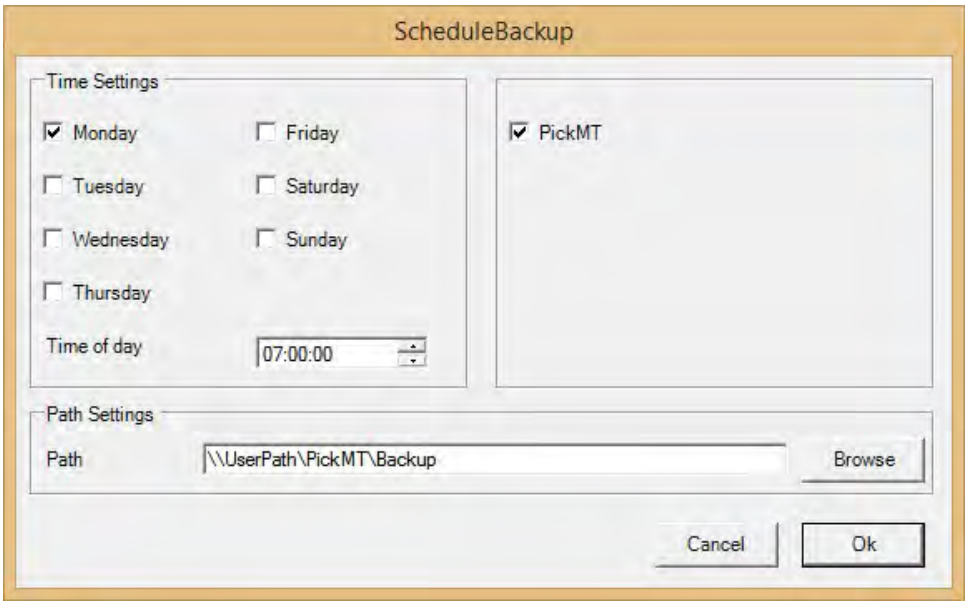


Backup / Restore

Backup of the system includes all files associated with PickMT. Backup of robots is not included in this backup and should be carried out regularly manually. Clicking on ‘Backup’ executes a backup. You can also enter the path to the backup.

A backup procedure can be restored by clicking on ‘Restore’. PickMT must be started for the restored values to apply. If the backup cannot be restored automatically, a manual restore is possible.

Clicking on ‘Schedule’ allows you to choose a time for regular backup.



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Backup can be scheduled so that it is carried out up to once a day. Tick the box for the day and select the time of day for backup. Select the units you want to include in the backup process from the ‘Backup Options’ box. Under ‘Path Settings’ enter the path for the folder where you want to save backups.

In the image above, the schedule is made so that PickMT is backed up every Tuesday and Thursday at 00.00. The backups are saved in the folder ’C:\PickMTBackup’.

Click on ‘OK’ to use these settings.

Password protection

It is possible to protect certain system functions with a password.

If ‘Teachin’ is password-protected then a password must be given in order to view the ‘Teachin’ tab.

If ‘Expert’ is password-protected then a password must be given in order to view the ‘Settings’ tab.

To change a password, choose the desired level and then click on ‘Change password’.

Enter the old password and then enter the new password twice.

Click on ‘Delete" to delete the password for the chosen level.

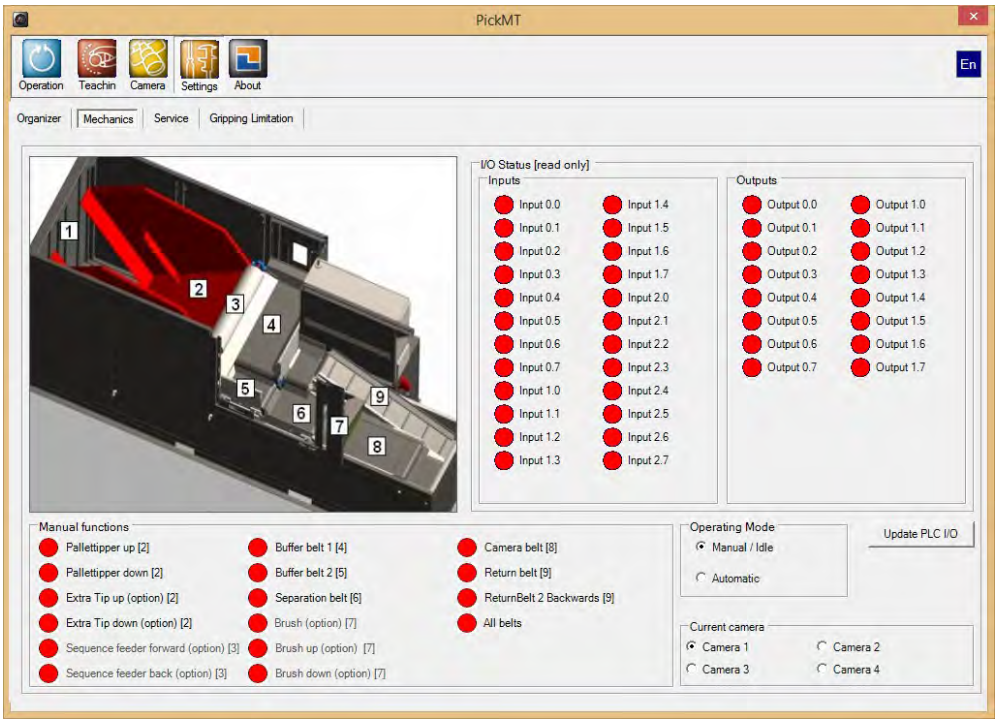
Robot IP address

For robot types where the robot’s IP address must be known, the address can be changed here. Enter the new IP address and press ”Apply”. PickMT must be restarted for the new address to be activated.

8.4 Mechanics

What you see under the Mechanics tab depends on the type of machine that PickMT is used with. If PickMT is not used in a Multiflex or Miniflex system this tab will not be available at all.

Multiflex



For more information please refer to the Multiflex product manual.

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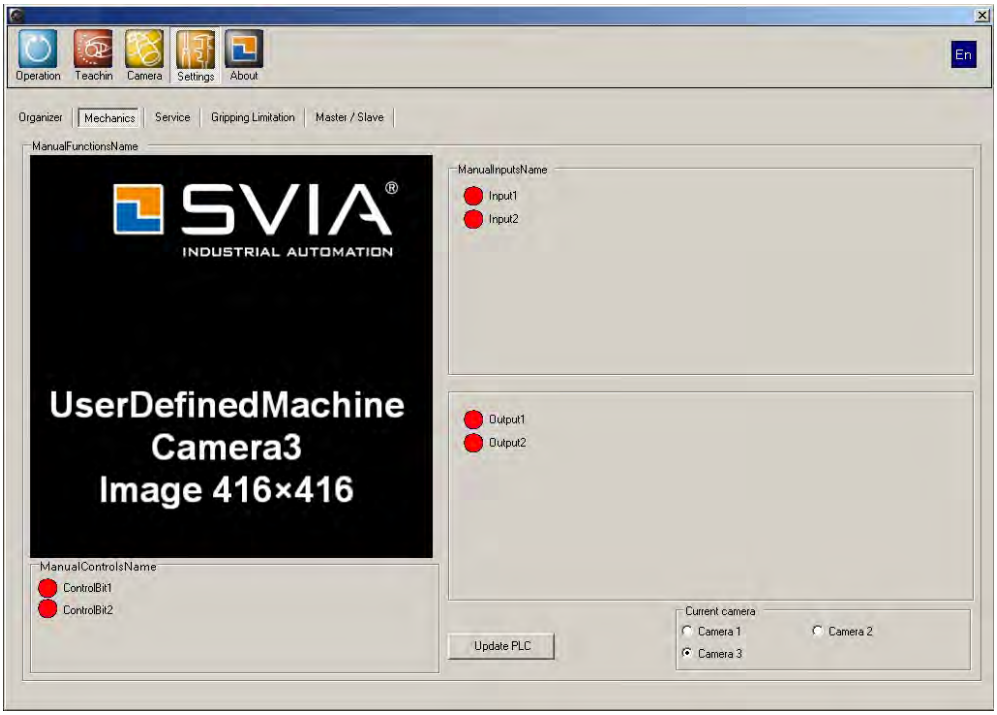
User defined mechanical equipment



The display for user defined mechanical equipment varies per machine. For an explanation refer to the product manual for the user defined equipment.

8.5 Master / Slave

If required, PickMT can communicate with surrounding equipment as Slave. As Slave part of PickMT's functionality is controlled via commands from external equipment. A number of parameters must be set, depending on the connection type and communication type, as described below.

Continues on next page

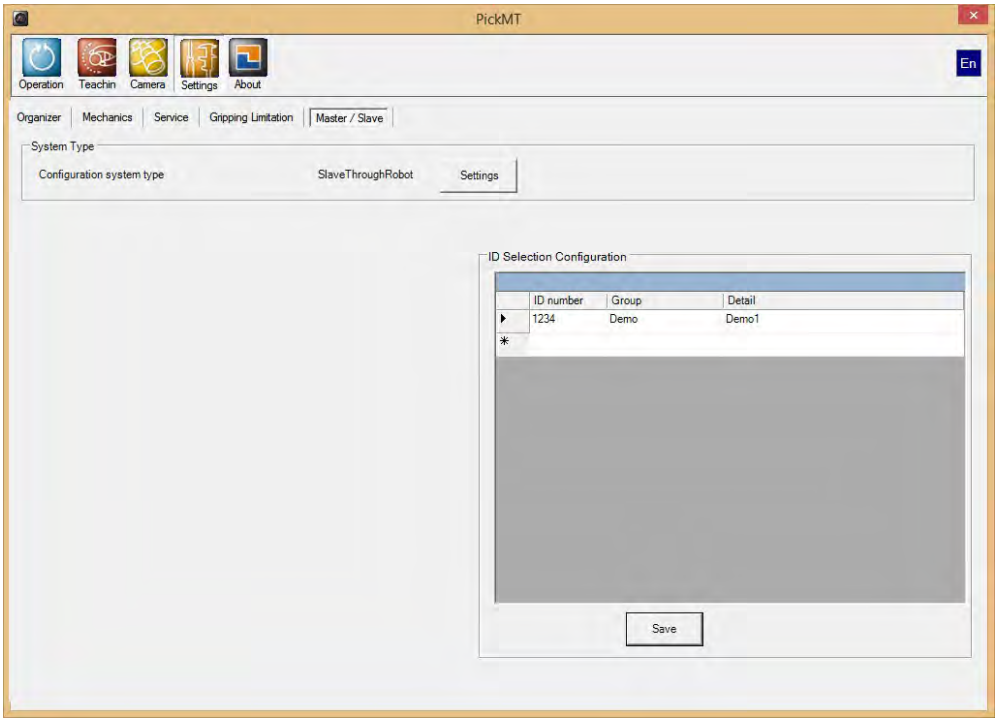
8.5.1 Master

Implementation of a Master function is preferably done in the robot program belonging to the actual detail. Communication with the surroundings then occurs via the robot's I/O system.

8.5.2 Slave

PickMT communicates using one of the robot's I/O units, for example through a Profibus-Slave card with Master equipment.

The Slave through robot settings are used to set translation between ID number and PickMT detail. The Master equipment can choose one of PickMT's teachin details for operation according to a translation table that links the ID number of the Master equipment to a group and a detail in PickMT. This is done by entering an ID number in the ID Selection Configuration, choosing a group from a drop-down box in the group column, and then choosing one of the available details from the drop-down box in the detail column.



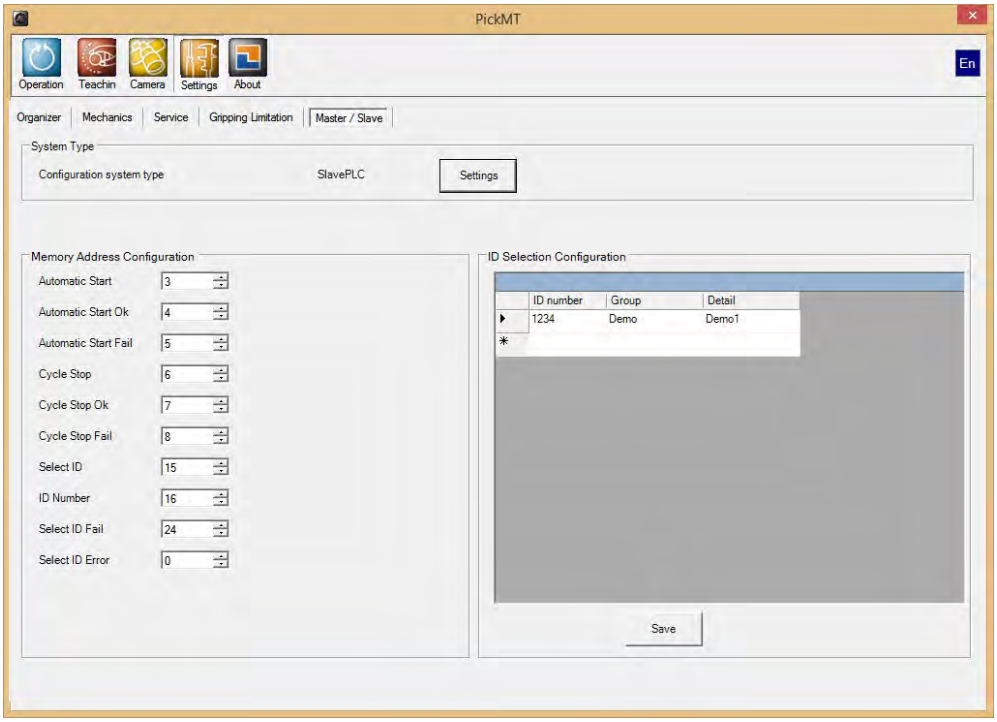
For communication with the Master control system, special signal names in the robot must be used.

8.5.3 Slave (PLC)

PickMT communicates via the network with a Master PLC (Siemens S7).

The Slave-PLC settings are used to set translation between ID number and PickMT detail, and to set communication parameters.

The Master equipment can choose one of PickMT's teachin details for operation according to a translation table that links the ID number of the Master equipment to a group and a detail in PickMT. This is done by entering an ID number in the ID Selection Configuration, choosing a group from a drop-down box in the group column, and then choosing one of the available details from the drop-down box in the detail column.



The communication settings for PLC can be set by pressing the 'Settings' button. IP address for the PLC to be used must then be entered.

To communicate with the Master control system, the PLC memory locations must be entered for each command, together with the associated confirmation signals. The memory locations are assumed to be "bytes" (8-bit memory locations), with the exception of a selection of ID-Numbers and ConfirmIDs, both of which are "double word" (32-bit memory locations).

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9 Fault tracing

9.1 Problem with gripping accuracy

Problem with grip accuracy can be caused by many different reasons: Problem with teachin, problem with calibration, problem with the robot, problem with leaving details. Several fault sources and remedies are described below.

General poor accuracy when gripping without visible pattern

- Faults up to +/-1mm in Multiflex are quite possible and do not constitute a fault. Correspondingly large faults in FeedLine system with large image fields can occur.
- Poor grip accuracy can depend on settings in the mechanical tab in the machine. If the details can roll easily the image delay parameter needs to be increased. The belt must have stopped and the images must be stationary when the image is taken.
- Are the gripper fingers correct? Are they parallel? Does the gripper open and close smoothly? Is the gripper secured? Are the guide pins in position?
- Check that the teachin for the detail is correct: Good light contrasts and good corresponding of the red lines with the edges of the detail. Settings of parameters especially requirements, requirement model, speed, timeout and accuracy.
- Check that the perspective centre and camera height are correct.
- Carry out the calibration of PickMT and the robot. Check that the data for the calibration pattern is correctly given. To prevent the calibration plate from moving during calibration it can be taped to the camera belt. Check that the dot for co-ordinate 0,0 is really visible at the bottom left of the screen. Also check that robot calibration has been carried out correctly, see the robot manual and the PickMT robot integration manual.
- Check that the robot's TCP is correctly defined. Read the robot manual for further information about this.
- Verify that the motor parameters (calibration offset) are correct and valid.
- If you load a backup in the robot you must carry out a new camera calibration if the camera calibration has been carried out after the backup was made.
- If you have moved the camera a new camera calibration must be carried out.
- Check that the camera and the lens are secure. Also any mountings.
- The robot must be properly bolted into place, likewise the robot base and also the channel. Expander bolts can creep up out of their holes if the floor is poor.
- Check that Multiflex and its pallet tip are secure, tighten the expander bolts. If the operator changes pallets in the pallet tip violently the machine can move.
- If the robot has collided or been exposed to movement in the processing machine there is a risk that the robot's mechanics are changed so much that the calibration no longer corresponds. Read the robot manual for further

Continues on next page

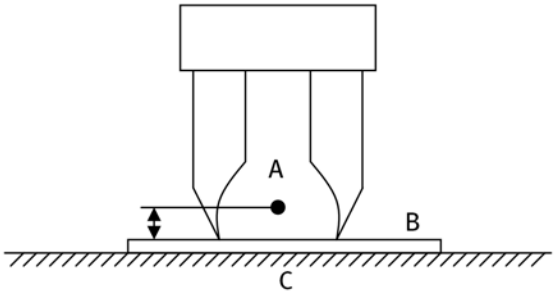
information about what to do to check and remedy this. Also note that it is unusual to have to perform a fine calibration.

The robot grips details approximately correctly, although always offset

- Note in which position the fault occurs. Check that the grip point is correctly set in just that part of the detail.
- If the grip point is correctly set the calibration between the robot and image processing system can be offset. Recalibrate according to the above.

The robot is positioned slightly wrong when gripping

- Check that the camera is perpendicular to the pick area. This is very important for the system.
- Check that the camera's height (in mm) over the pick area corresponds with the given value, otherwise change the value so that it corresponds with reality.
- Check that the robot's co-ordinate system by the camera is correct. This is done by using the robot and jogging to a point on or just above the belt. The Z-value given in the co-ordinate system for the camera must then be 0 (or close to 0).



A: TCP, B: Calibration Plate, C: Camera belt

- Check that there is not to intensive ambient light that falls in the picking area so that the detail casts strange shadows. If so, screen off the light.
- Position four details out in the corners of the picking area according to the diagram below (so that they can be gripped by the robot). Place all the four details in the same position but rotated by a quarter turn. If the robot grips slightly differently wrongly on all these details, it is a sign that TCP for the gripper is incorrect in the x and y axes. A new calibration of the tool should be carried out.

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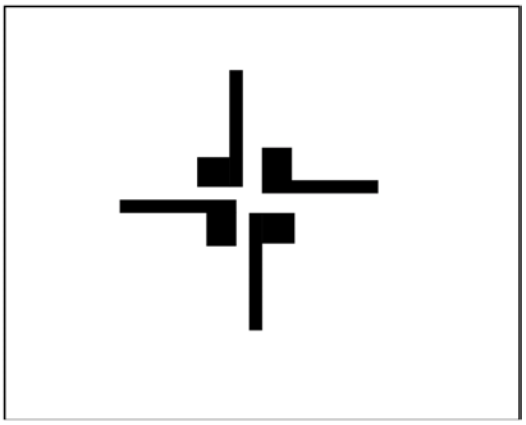
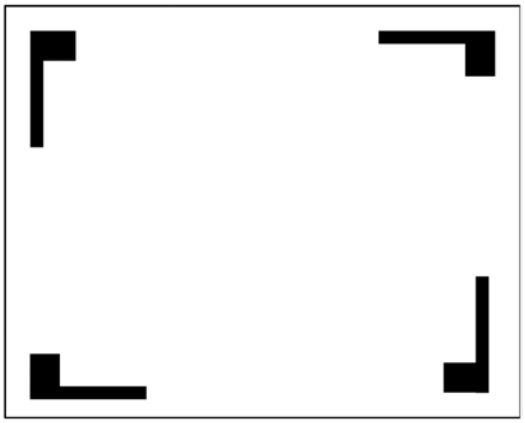


- Position four details out in the corners of the picking area, according to the diagram below. Try to grip these details. If this leads to faults in the positioning it may be an indication that the camera is crooked according to the above or that the set camera height or machine height is incorrect.



9.2 Identification problem

Image processing system does not find any details.

- During operation: Check that the correct detail is selected.
- During Teachin: If the detail is too light or shiny it can be difficult for the system to separate the detail from a conveyor that is light in colour which can result in no detail being found. The same problem can occur if the detail is dark and a black conveyor is installed in the machine. To test if the detail is too light a matt black disc or similar can be temporarily placed under the camera and a new teachin carried out. If this works the problem can be solved by replacing with a dark conveyor. Note that details with previous teachin may not function with the new conveyor.

Image processing system identifies incorrect position.

- Redefine the identification surface. Try to find an identification surface of the present position that markedly differs from other positions.

9.3 Communication problem

9.3.1 PickMT PLC

Alarm “PLC could not be initialised” is displayed at start up.

- Check that the PLC can be reached via the network: Run ”ping 192.168.1.5” (adjust the IP address to the relevant system settings) in a command window. If the PLC does not respond check the network wiring and switch.
- In ConfigurationEditor check that the IP-address for PLC is correct.

9.3.2 PickMT robot

PickMT has no contact with robot

- Check that the robot can be reached via the network: Run ”ping 192.168.1.2” (adjust the IP address to the relevant system settings) in a command window. If the robot does not respond check the network wiring, switch, network settings robot.
- Check that the robot has any necessary options and hardware installed to communicate via the network.
- Check that Windows firewall is off.

Messages about missing robot signals

- Check if the named signal is defined in the robot.

9.4 Camera problem

The camera image is completely missing /or completely blank

- Check that the cable to the camera is secured at both ends. Check that the cable to the camera is connected in the correct camera terminal at the rear of the computer.
- Check that the cable or connections are not damaged.
- Check the lighting.
- Check that the camera can be reached via the network: Run ”ping 192.168.2.2” (adjust the IP address to the relevant system settings and desired camera) in a command window. If the camera does not respond check the network wiring, switch, network settings camera.

The camera image is far too light or too dark.

- Go into the image settings and check the settings for contrast, brightness and gain.
- If the image is still too light or too dark, adjust the aperture. Do not forget to recalibrate the robot and vision system to each other after you have adjusted the camera.

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10 Appendix A: Installation

10.1 Installation PickMT

A number of programs must be pre-installed on the computer in order to run PickMT. All the programs are included on the PickMT installation CD. The following programs are required:

Basler Pylon Driver (for configuration and advanced setting of the camera)

If necessary Software for other camera types (e.g. 3D sensor)

Matrox Imaging Library

If necessary Software for robot communication (depending on robot make)

PickMT

The programs must be installed in the order they are listed above. Each of the folders on the installation disc has a number before its name that shows the order in which it must be installed.

In the installation instruction below, examples for Basler Pylon Driver v2.2.0v4.2.0 and Matrox Imaging Library v9.0v10.0 are used. In certain cases newer versions may be available on the installation disc, alternatively provided by SVIA. WhereIn possiblethis case, use the newer versions. If instructions for installation of newer versions differ substantially from the following instructions, new instructions are supplied with the new files.

Insert the disc in the CD-ROM drive and follow the instructions below to ensure correct installation.

Please note that the PickMT SmartCamera setup is running with Basler Pylon Drivers v2.3.5 and Matrox Imaging Library v9.0. This will be updated to the above configuration in future releases.

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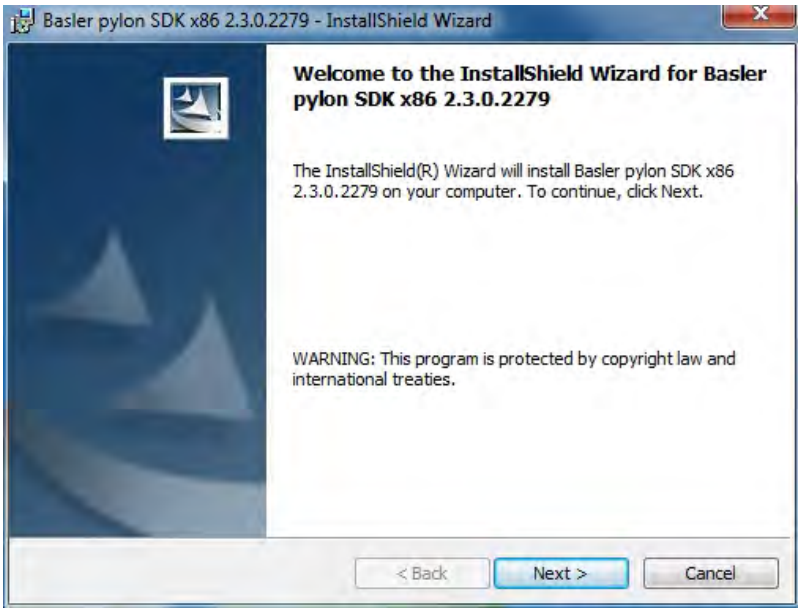
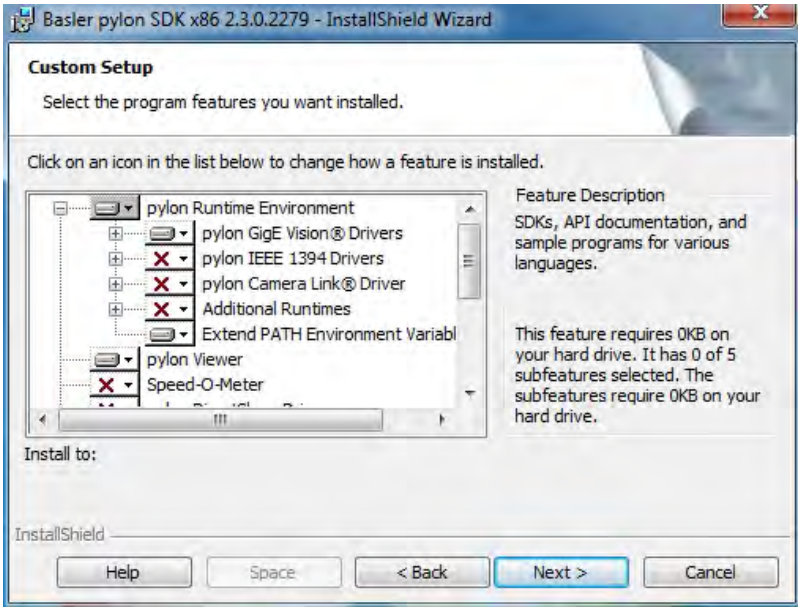
10.1.1 Basler Pylon Package

Run the setup file in '<CD-ROM:>\2 – Basler Pylon Package\'. CD-ROM: should change to the device name for the CD-ROM drive in the relevant computer.

Click on through the installation, accept the user conditions, enter user data, and accept the suggested installation folder. Then select the following option.The installation is preconfigured and is executed by starting the UseMe_InstallBaslerDriver batch file.

The following installation instructions apply to Basler Pylon Package v2.3.0, which should be used together with MIL 9 R2 (build 1950) or later. Systems with MIL 9 (build1475) or earlier should be used together with Basler Pylon package v2.2.0 or earlier.





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Only the three shown components need to be installed. After confirmation, the driver will be installed. Note that one of the connections to the network will be temporarily interrupted.

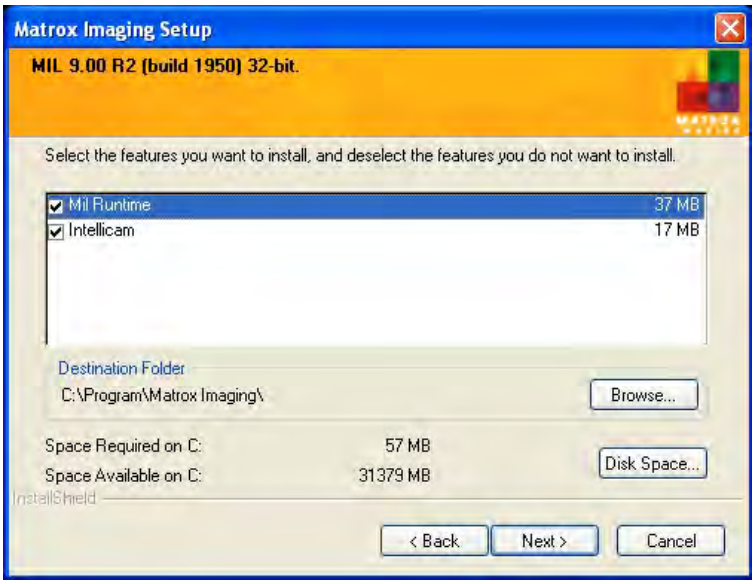
10.1.2 Software for camera communication

If a camera type other than Basler GigE is used, extra software is usually required for the computer so that it can communicate with the camera. An extra program may also be required to make camera settings. See the separate camera integration manual for the relevant camera.

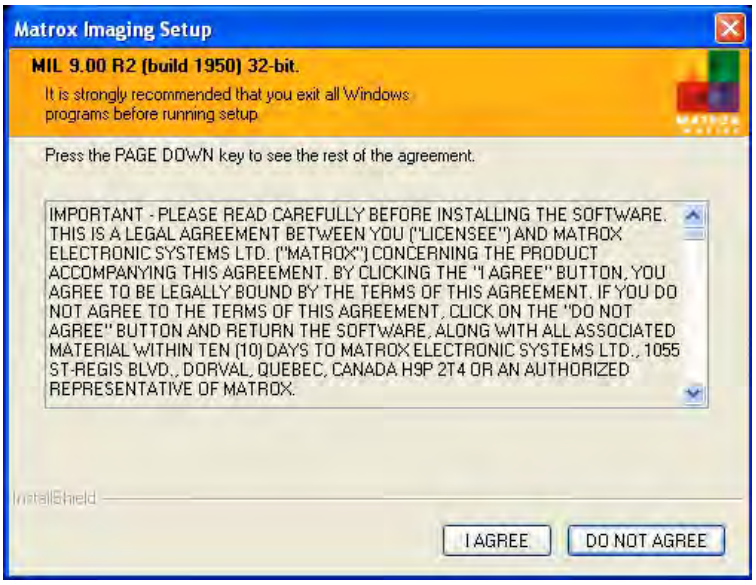
10.1.3 Matrox Imaging Library

Run the file '<CD-ROM:>\4 – Matrox Imaging Library\Setup.bat' by clicking 'Start' in Windows and selecting 'Run'. CD-ROM: should change to the device name for the CD-ROM drive in the relevant computer.

At the start of installation the following information will appear on the screen.The installation is preconfigured and is executed by starting the setup.bat batch file.



Select 'Mil Runtime' and 'Intelicam'. Click on 'Next >' to continue.



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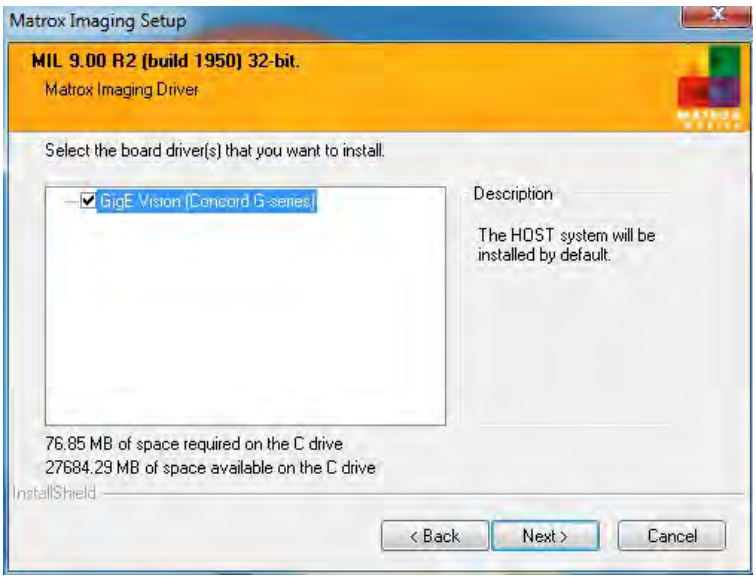
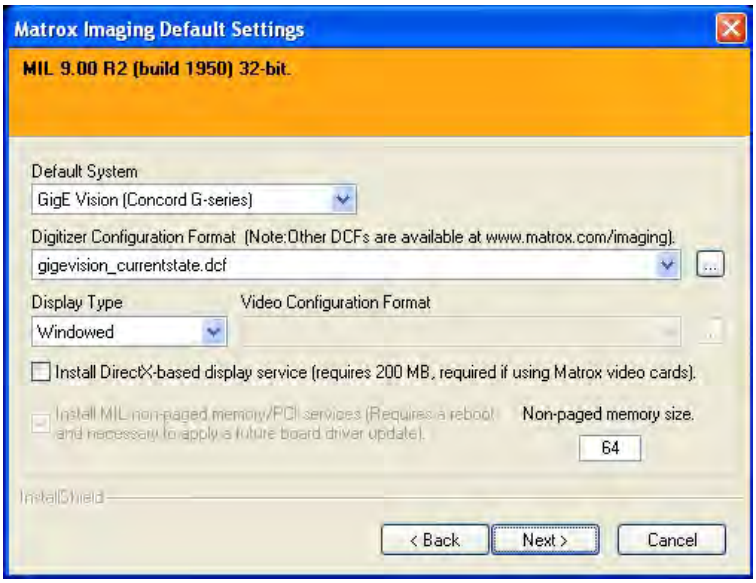
10.1.3 Matrox Imaging Library
Continued

Click on ‘I Agree’ to continue.



Select settings as illustrated. Click on ‘Next >’ to continue.

If the system is run with an analogue camera the suitable systems should be ticked, mainly applies to Meteor II or Morphis. Both can be ticked for safety’s sake.



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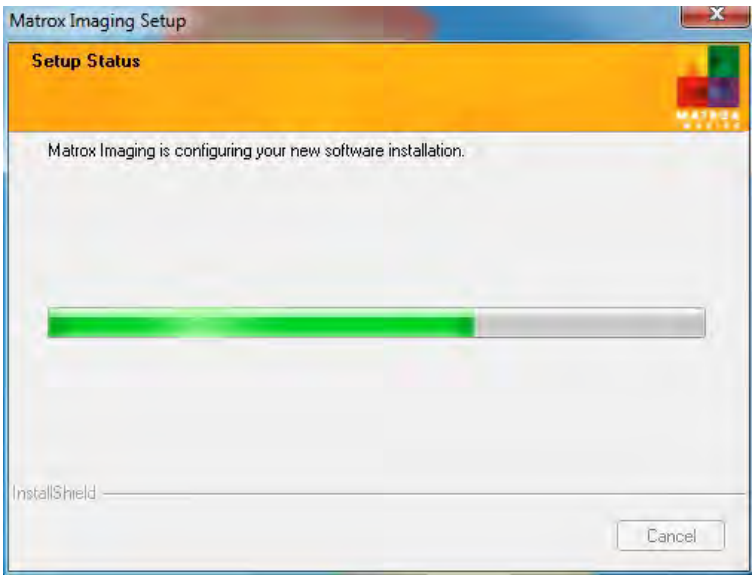
Select settings as illustrated. Click on ‘Next >’ to continue.



Before the installation process can continue you must restart the computer; click on ‘Yes, I want to restart my computer now’, and click on ‘Finish’ to restart the computer.

Updates for MIL are installed automatically during the installation phase.

10.1.4 Software for robot communication

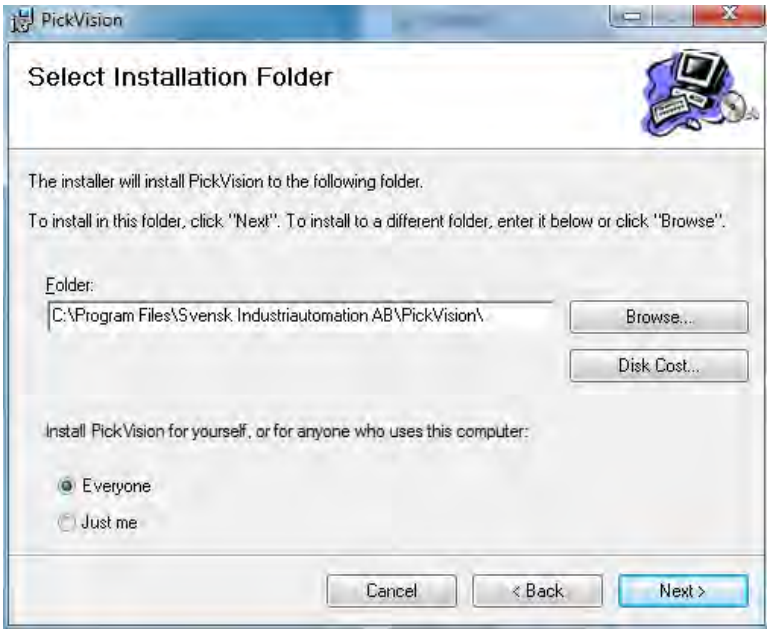
Depending on the type of robot, extra software may be required for the computer so that it can communicate with the robot via the network. See the PickMT robot integration manual for the relevant robot.

10.1.5 PickMT

Run the file '<CD-ROM:>\5 – PickMT\Setup.Exe' by clicking on 'Start' in Windows and choosing 'Run'. CD-ROM: should change to the device name for the CD-ROM drive in the relevant computer.

At the start of installation the following information will appear on the screen.

Click on 'Next >' to continue.



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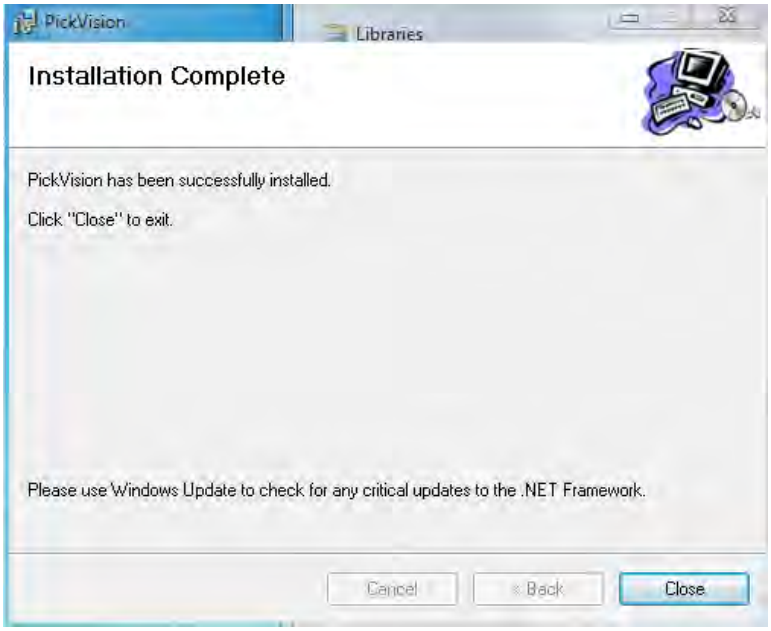
10.1.5 PickMT
Continued

Click the box for 'Everyone' and click 'Next >' to continue. Information about the ongoing installation will be displayed. When installation is complete the following dialogue box will appear.



Click on 'Close' to exit the installation program.

Installation of all the necessary software is now complete.

10.2 Upgrading

10.2.1 Upgrading PickMT

The version numbering system for PickMT follows the Major.Minor.Revision pattern, e.g. PickMT 3.0.1 indicates that 3 is a ‘Major’ upgrade, 0 is a ‘Minor’ upgrade and 1 is a ‘Revision’.

If the upgrade just involves a ‘Revision’ to the current version, all you need to do is replace PickMT.exe. This file can be found in PickMT’s bin directory, normally ‘C:\Program Files\Svensk Industriautomation AB\PickMT\Bin’ unless specified otherwise when PickMT was installed.

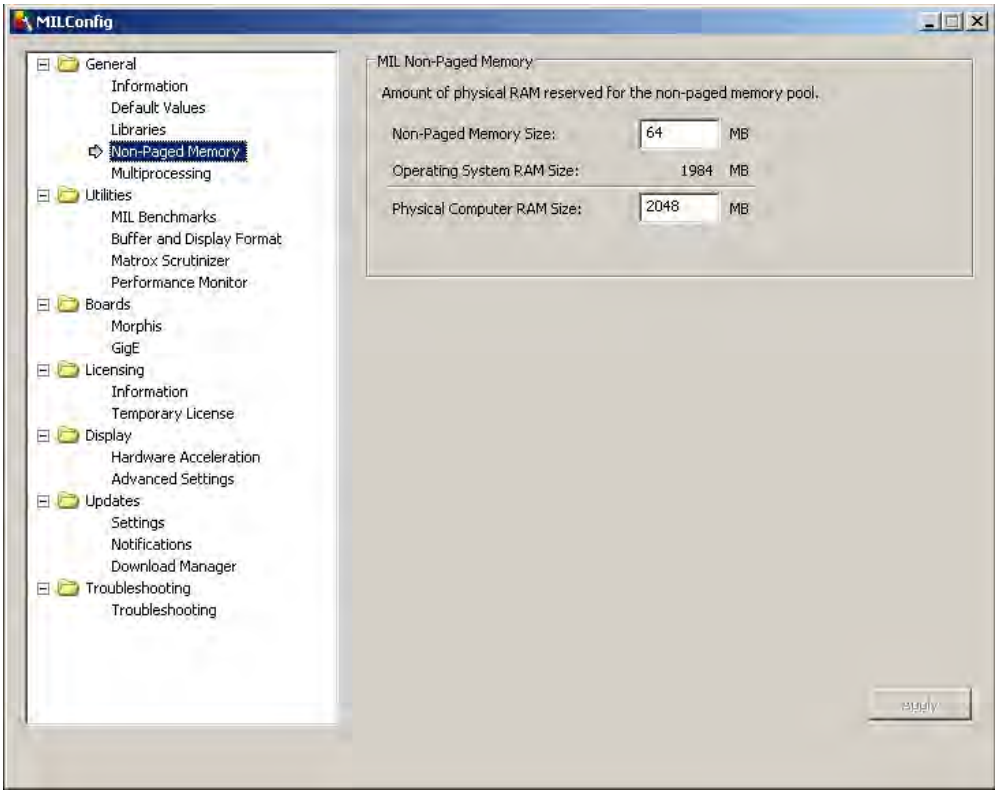
In the case of ‘Major’ and/or ‘Minor’ upgrades, the database and configuration file must also be updated. In most cases, however, a full new installation is required, which can also mean that the details must be taught again. For details of this see PickMT’s version history.

Always remember to make a complete backup before carrying out any upgrades!

10.2.2 Upgrading hardware

When enlarging the computer memory, the Matrox Imaging Library must be reconfigured. This occurs by starting the program MilConfig which is as standard in the directory C:\Program Files\Matrox Imaging\Tools.

When the program is started, select the 'General\Non paged Memory' tab.



Specifies the memory size. Click 'Apply'. An invitation to restart the computer is displayed.

In newer versions of MIL, this is changed automatically. This is seen by it not being possible to change the memory size.

Click on 'OK' to continue by restarting the computer.

10.3 Restoring Backup

Resetting backup for PickMT occurs from within PickMT, on the tab ’Service’, on the page ’Settings’ on the tools page. The ’Restore’ button is clicked and the search path to the backup is entered. After reading backup, PickMT must be restarted.

If PickMT cannot be restarted at all the contents in the backup directory must be copied directly to the PickMT directory in an emergency.

Resetting of robot backup occurs via the robot’s operator panel.

10.4 Settings

10.4.1 Network configuration

Before the system can be operated its IP addresses must be configured. All units must have permanent IP addresses. Systems supplied by SVIA use the following standard settings.

The network connection to robots and PLC should be named ”Robot”. The following standard settings are used. Note that Gateway must be left blank.

Computer: 192.168.1.1

Robot 1: 192.168.1.2

PLC camera 1: 192.168.1.5

PLC camera 2: 192.168.1.6

PLC camera 3: 192.168.1.7

PLC camera 4: 192.168.1.8 etc

Subnet-mask: 255.255.255.0

Gateway:

The network connection to the cameras should be named ”GigE”. The following standard settings are used. Note that Gateway must be left blank.

Computer: 192.168.2.1

Camera 1: 192.168.2.2

Camera 2: 192.168.2.3

Camera 3: 192.168.2.4

Camera 4: 192.168.2.5 etc

Subnet-mask: 255.255.255.0

Gateway:

These IP addresses are not compulsory, i.e. it is perfectly possible to set other IP addresses if the system is to be part of a local network. However, all IP addresses must remain static. Contact your local network administrator for information and instructions on alternative IP addresses.

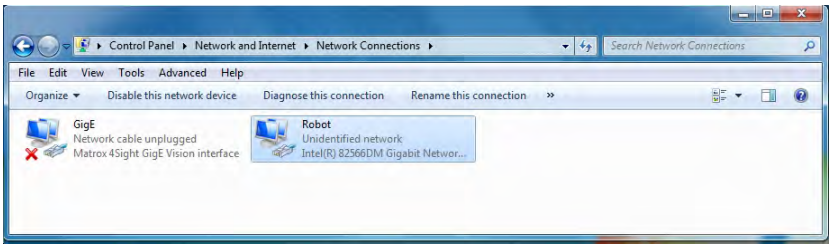
10.4.2 Settings for robots

IP addresses must be set for all robots. For further information about the relevant robot, read the PickMT robot integration manual.

10.4.3 Settings for PC

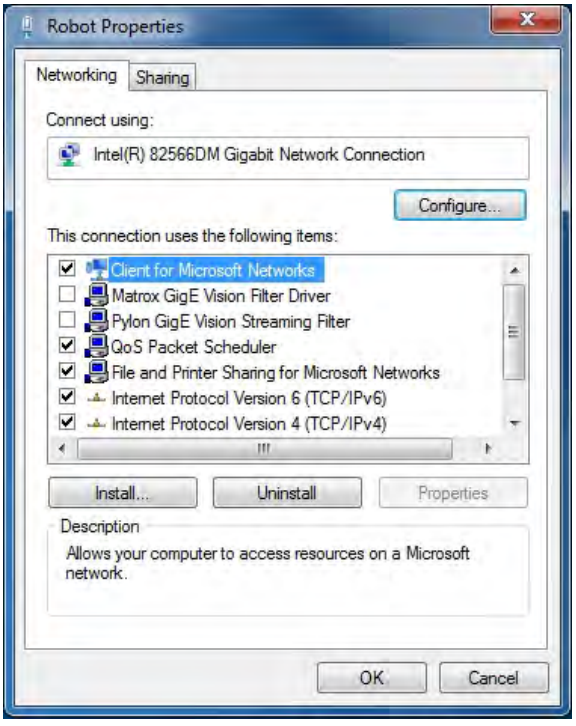
The following instructions assume that SVIA's standard IP address settings are used. The same steps must be followed if alternative IP addresses are to be used, the only difference is in the addresses that must be entered.

Open the 'Network and remote connections' folder by clicking on 'Start' in Windows and choosing 'Control panel, followed by 'Network and remote connections'.



Name the camera's network connection "GigE" and the robot's network connection "Robot", so that these can be clearly distinguished.

Right-click on 'Robot' and select 'Properties'.



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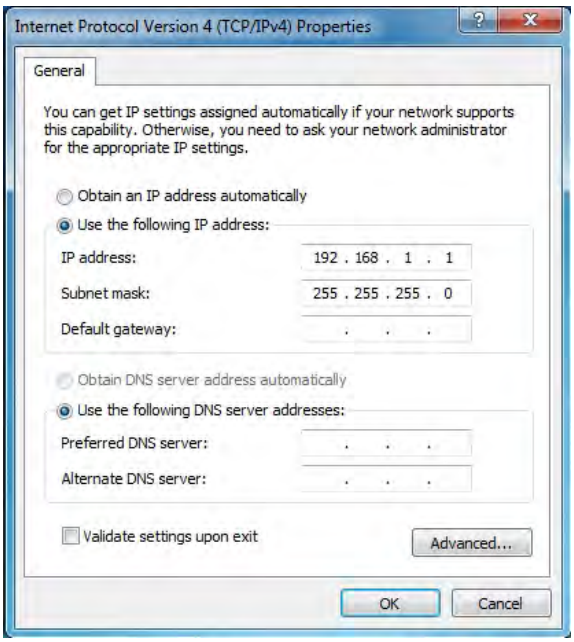
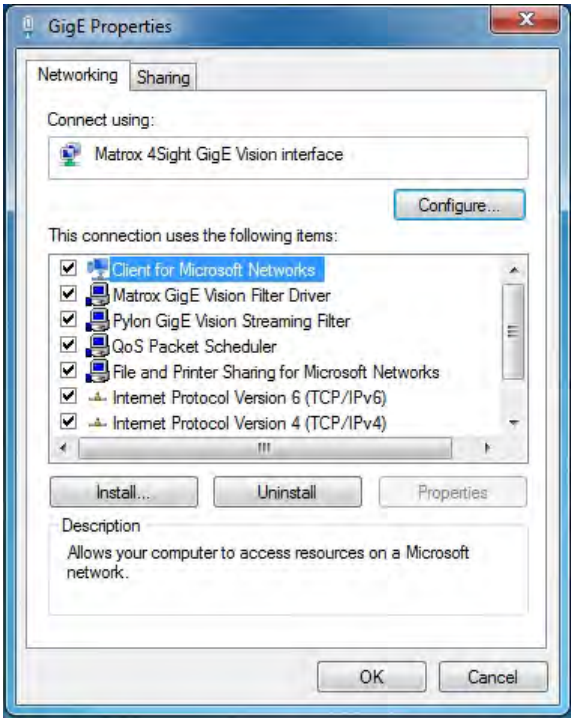
Select ‘Internet Protocol Version 4 (TCP/IP)’ and click on ‘Properties’.



Select ‘Use following IP address:’ and enter the settings as shown in the image above, or according to the instructions from your local network administrator. Click on ‘OK’ to use the new settings.

Windows firewall must be deactivated to allow communication between robot and PickMT. In addition, you must log in as administrator.

Right-click on ‘GigE’ and select ‘Properties’.



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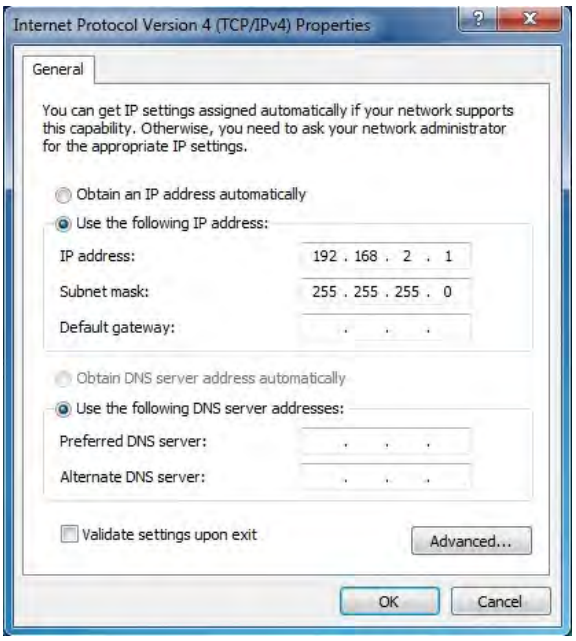
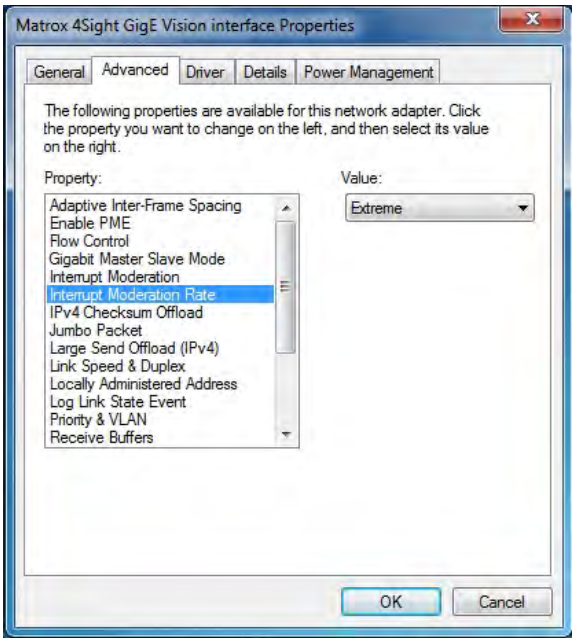
10.4.3 Settings for PC
Continued

Select ‘Internet Protocol Version 4 (TCP/IP)’ and click on ‘Properties’.



Select ‘Use following IP address:’ and enter the settings as shown in the image above, or according to the instructions from your local network administrator. Click on ‘OK’ to use the new settings.

Then click ’Configure’ to adjust the network settings to operate with the network camera. Select the ’Advanced” tab in the window that opens.



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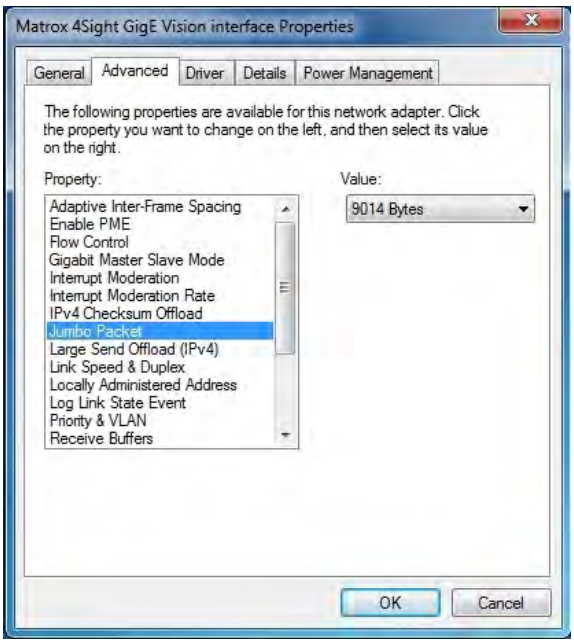
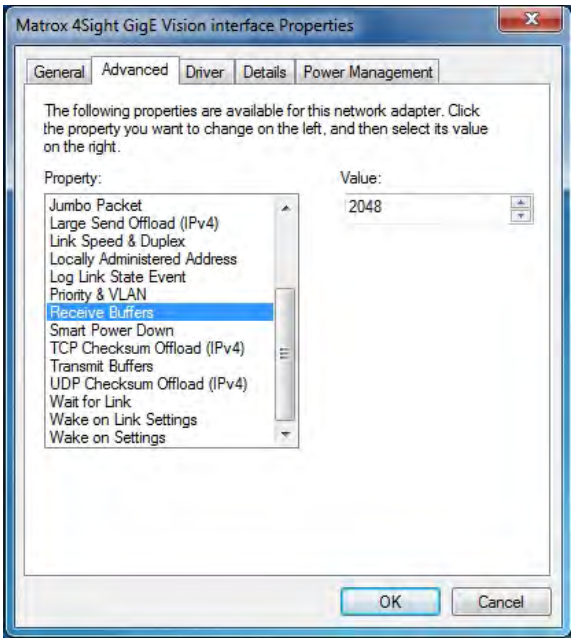
Select 'Interrupt Moderation Rate' and set the value to the maximum value.



Select the property 'Jumbo Packet' and set the value to the maximum value.



Select 'Receive Buffers' and set the value to the maximum value.

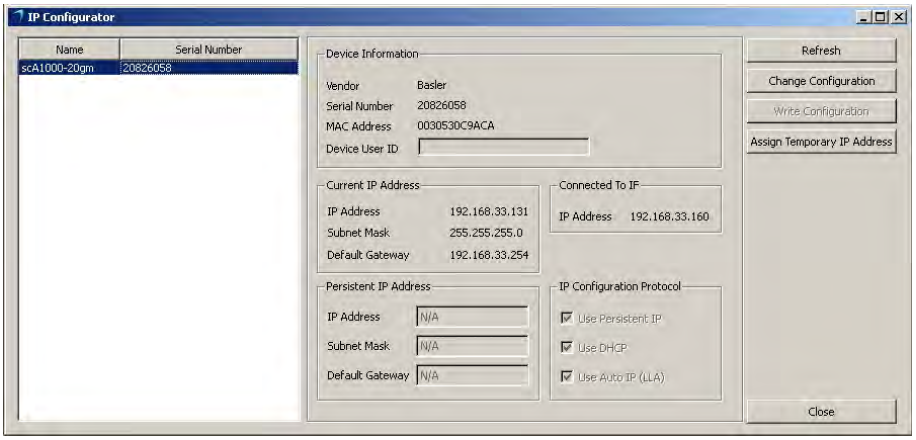
Click on 'OK' to use the new settings.

10.4.4 Settings for Basler GigE cameras (Scout & ACE)

10.4.4.1 Network setting for camera

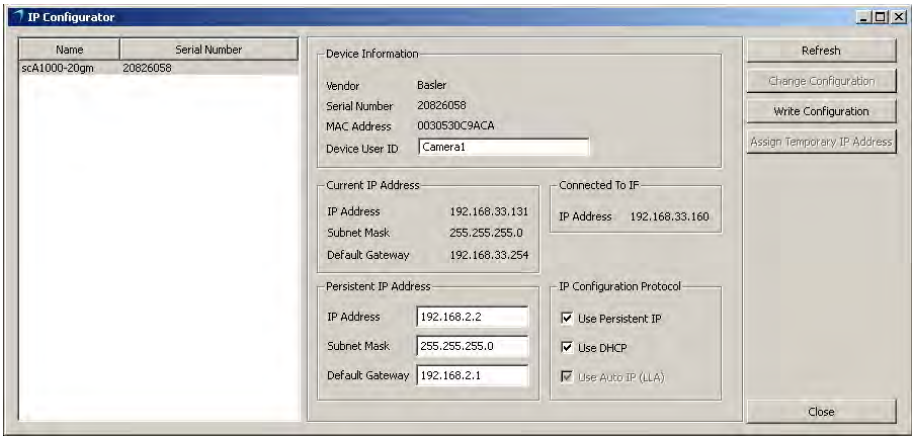
The following instructions assume that SVIA's standard IP address settings are used. The same steps must be followed if alternative IP addresses are to be used, the only difference is in the addresses that must be entered.

First connect the camera to the computer. Start Pylon IP Configuration Tool and check that a connected camera can be seen. Mark it.



Click 'Change Configuration' so that the camera properties can be changed. You may be prompted to assign the camera a temporary IP address, if so, do this (e.g. 192.168.1.240).

Tick 'IP Configuration Protocol' according to the image below. Specify the correct 'Device User ID' (Camera1, Camera2, Camera3, Camera4 for the respective camera) and correct data for 'Persistent IP address' (Camera1 192.168.2.2, Camera2 192.168.2.3, Camera3 192.168.2.4, Camera4 192.168.2.5, Subnet Mask 255.255.255.0, GateWay 192.168.2.1) as below.

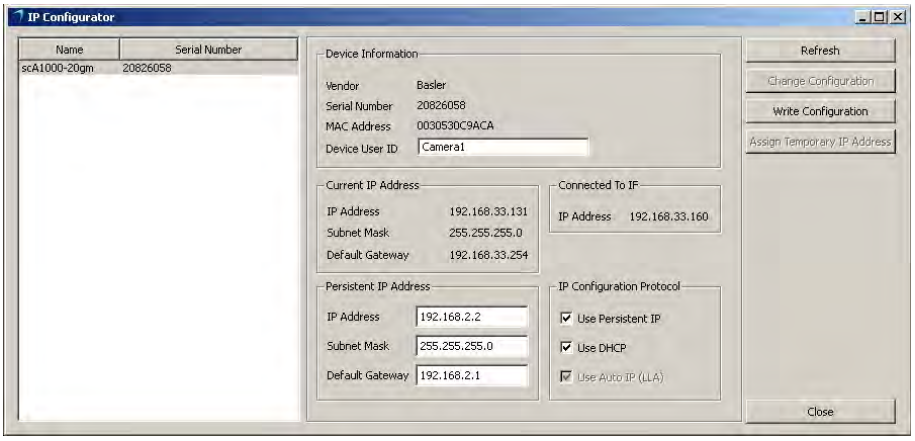


Then click on 'Write Configuration' and wait for the camera to be detected again.

If another camera has been connected to the computer previously, the driver may retain a link to the previous camera. If so, start the program "MilConfg" from the Start menu (Start -> Matrox Imaging -> Tools -> MilConfig).

Continues on next page

Select Boards->GigE, tick ”Use Camera Discovery Service”, and click ”Launch Matrox GigE Vision camera Discovery And Configuration Assistant”. Then click ”Perform Discovery” in the window that appears.



10.4.4.2 General information about camera settings

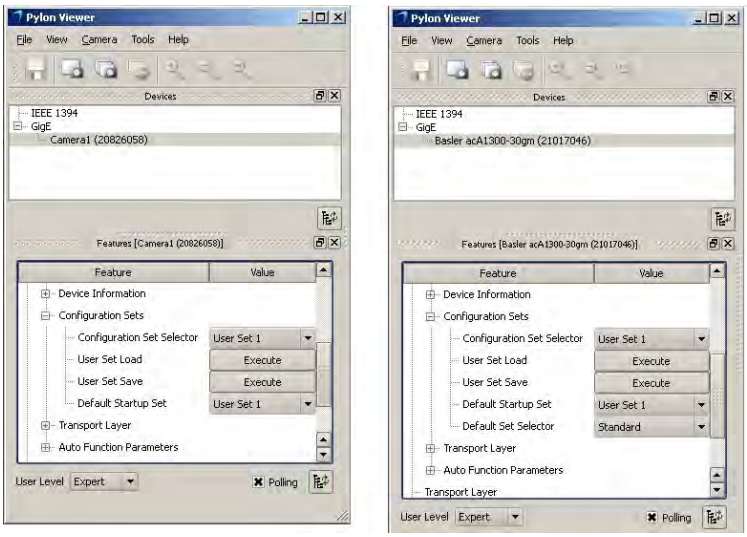
Camera settings should first be made via settings options in ’Pylon Viewer’, but can also be programmed in Matrox’s own software ’IntelliCam’.

Note that settings can differ slightly for different camera models and in newer versions of the software. Also note that there are several advanced settings options for the image field's size, image preparation etc. These options should only be used by specially trained personnel.

Start the ’Pylon Viewer’ and select the correct camera. Specify ’Expert’ or ’Guru’ as ’User Level’ and open ’Configuration Sets’ in the parameter tree. Set ’ConfigurationSetSelector’ to ’User Set 1’. The changes are then made in this configuration setup so that the camera’s standard values are saved.

Also specify ’User Set 1’ as ’Default Startup Set’.

After making the desired changes to the configuration the changes must be saved in the camera’s fixed memory. The settings are even saved in the event of a power cut. To save to the camera memory, click ’User Set Save’ ’Execute’.

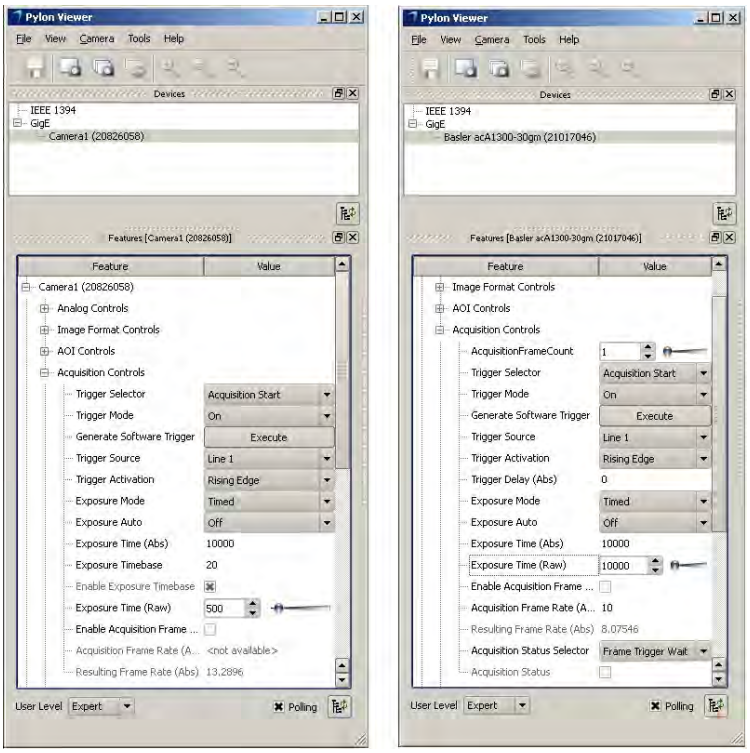


Basler Scout (left) and Basler ACE (right)

10.4.4.3 Camera settings for Conveyor-Tracking

During conveyor tracking the taking of images is controlled by an external trigger pulse to the camera. The trigger pulse is connected to input ’Line 1’ in the camera and starts taking images. ’Output 1’ from the camera is used to generate synchronising pulses that inform the rest of the system when an image is actually being taken.

Start the ’Pylon Viewer’ and select the correct camera. Specify ’Expert’ as ’User Level’ and open ’Acquisition Controls’ in the parameter tree. Specify the values as follows to get the camera to trigger externally on input ’Line 1’.



Basler Scout (left) and Basler ACE (right)

Then open ’Digital I/O Controls’ in the parameter tree to configure inputs and outputs. Specify the values as follows for input ’Line 1’. It is recommended to

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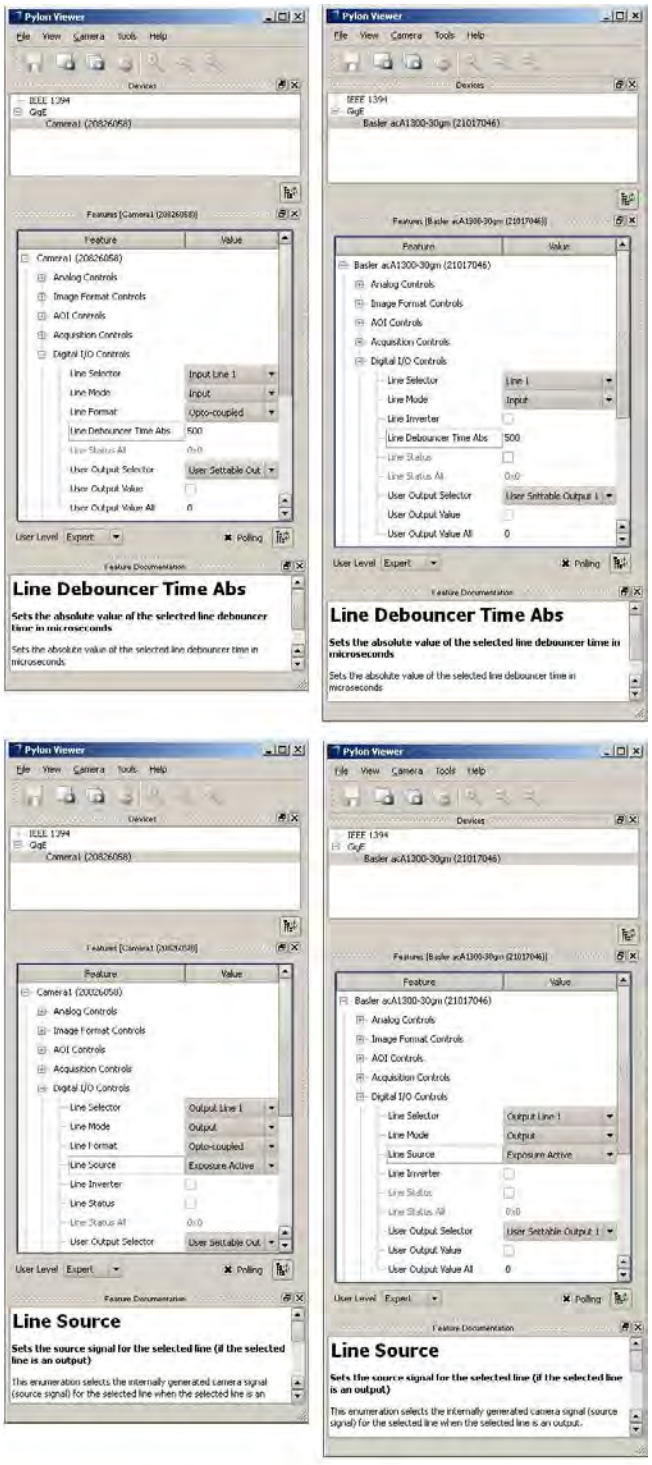
10.4.4.3 Camera settings for Conveyor-Tracking
Continued

specify 200µs - 500µs as 'Line debouncer time Abs' to prevent electrical interference. Also specify the values as follows for output 'Output 1'.



Basler Scout (left) and Basler ACE (right)

The above configuration generates a synchronising pulse when the images are being taken.

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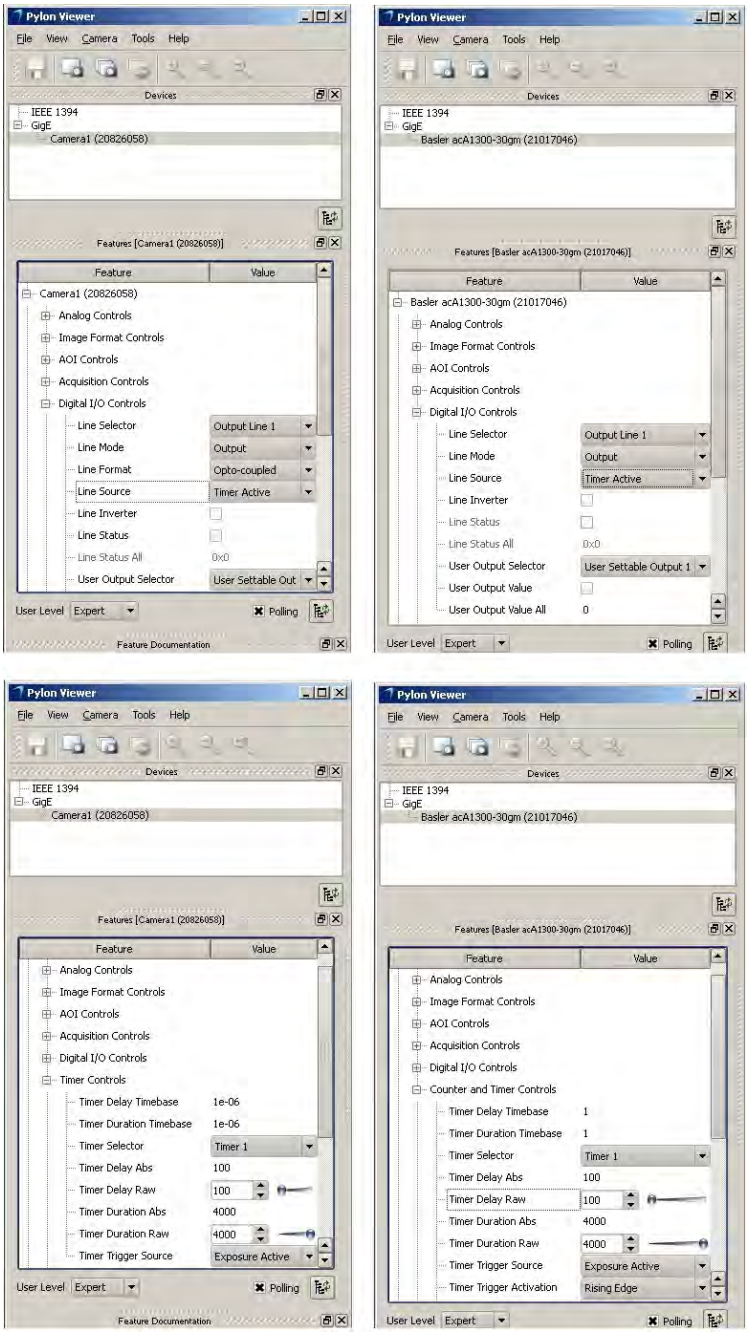
If the synchronising pulse, for any reason, is to be delayed an built-in timer in the camera (’Timer 1’) can be used, which, for example, can be configured as follows.



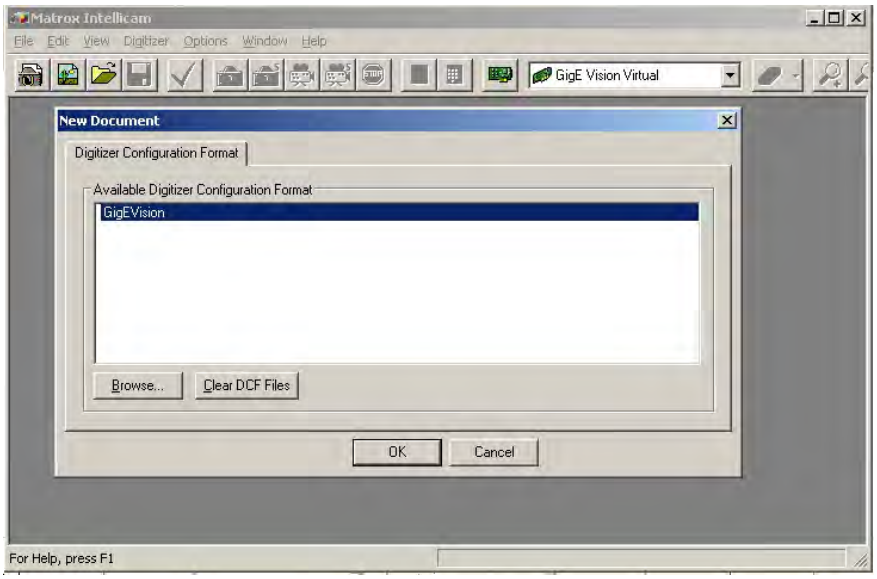
Basler Scout (left) and Basler ACE (right)

10.4.4.4 Troubleshooting

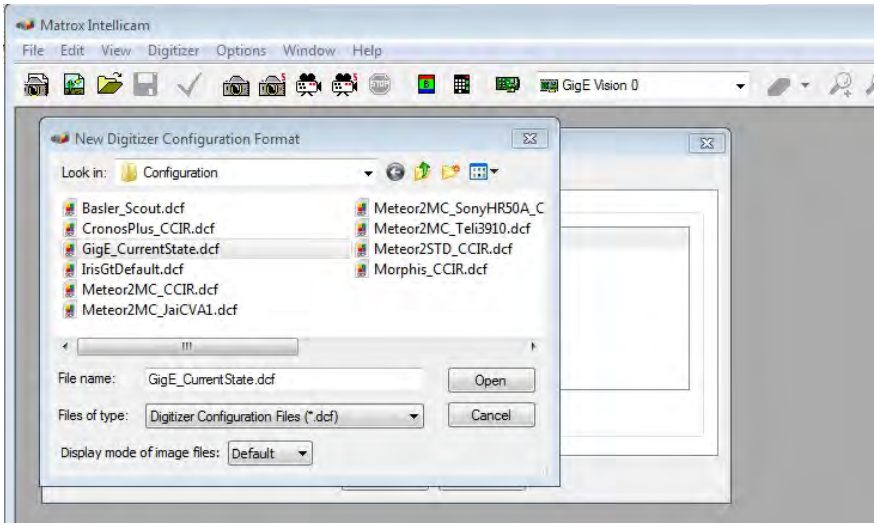
If the camera is not detected by PickMT, this may be due to several circumstances. First check the configuration of the IP settings for both the computer and camera.

If the camera shows images in Baslers Pylon Viewer, but PickMT still does not detect the camera rectify as follows:

Start Matrox Intellicam (Start -> Matrox Imaging -> Tools -> IntelliCam). Click on File -> New, select ”GigEVision” and click ’Ok’.



Click File -> Save as ... and save the camera configuration file as follows in PickMT’s configuration folder.



Close IntelliCam and restart PickMT. Check that the camera is detected correctly and shows images in PickMT.

10.4.5 Settings for other types of camera

See separate manual for information about non Basler Gig-E scanners and cameras.

10.4.6 Licensing Matrox Imaging Library

Licensing for Matrox Imaging Library occurs via USB dongle provided with the system. No other license codes are necessary. For licensing of previous versions see section 14.4.1.

The USB dongle is on an internal USB port inside the computer.

It is also possible to license PickMT without a USB-dongle and use a software license key instead.

10.4.7 Licensing PickMT

In order to run PickMT, a valid configuration file, and a USB hardware licence (option) is required. The configuration file provides all the necessary data for configuring and licensing PickMT. The configuration file is called ‘PickMT.cfg’ and must be placed in PickMT’s configuration folder. PickMT’s configuration folder is normally found at ‘C:\Program\Svensk Industriautomation AB\PickMT\Configuration’, unless specified otherwise when PickMT was installed.

Contact SVIA to obtain a configuration file.

10.5 Configuration user defined mechanical equipment

Overview

The concept of user defined equipment provides a variety of setting options for a complete integration of another piece of equipment with PickMT. Communication can occur between PickMT PC and an S7-PLC 1200 series (also 300 and 400 series). All data is written to datablock 1.

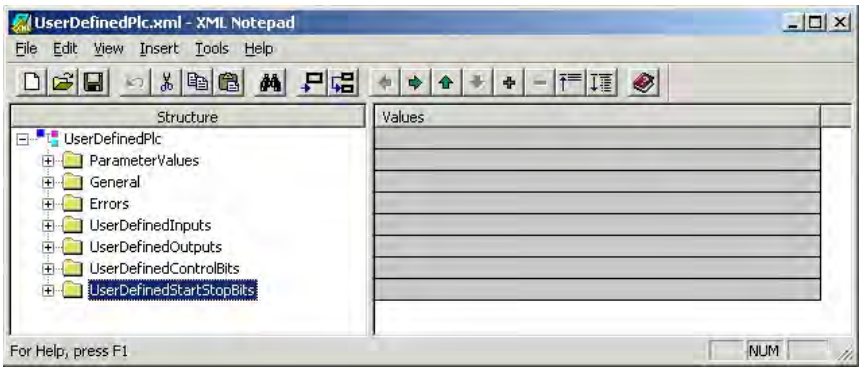
All parameters are configured in an xml file, UserDefinedPLC.xml. The following examples are taken from configuration via software ”XML NotePad”. Any XML editor can be used.

As an option the user defined parameters can be sent to an ABB robot with IRC5 control system. In this case, the first parameter must be defined as type 9 (see below).

Note, however, that no inputs or outputs can be configured in this case.

Parameters

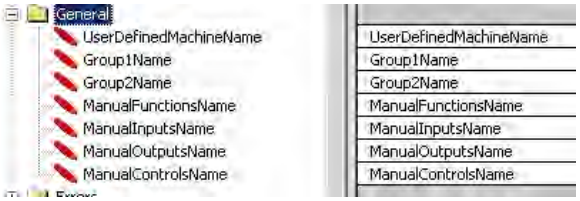
The following parameter areas can be configured:



- General data, designation in PickMT interface among other things
- Up to 32 parameters that can be sent to PLC at each start-up
- Up to 64 error messages that are connected to PLC
- Up to 16 user defined inputs
- Up to 16 user defined outputs
- Up to 8 memory cells that can be used for manual control of the equipment
- A start and stop bit for synchronised starts and stops between PickMT and PLC

General data

Here principle text is configured that is then shown on PickMT’s user interface.



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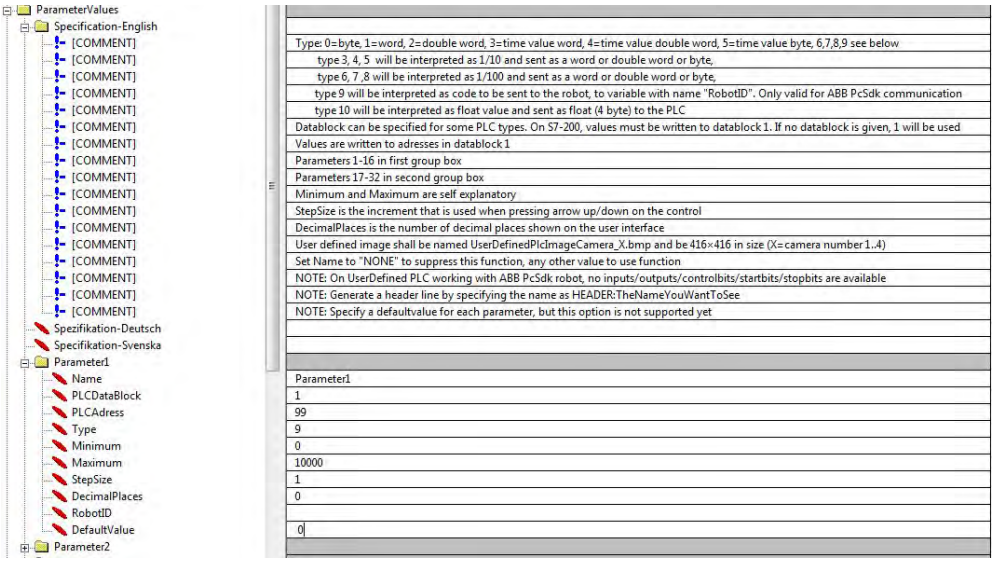
In the mechanics tab, during teachin and during servicing, the image UserDefinedPlcImage.bmp, is shown, which should be 416×416 pixels in size.

User defined parameters

Each parameter that should be managed via PickMT can be configured fully according to the user's requirements.

- Name: The text that is shown on the mechanics tab for this parameter. Must be set to "NONE" if the parameter is not used. If the text starts with "HEADER:" the parameter is interpreted as a header. Text after "HEADER:" is in bold and the input field for parameter data is hidden in PickMT.
- PLC-Address: Memory address in the PLC memory.
- Typ.:
  Gives the size of the variable and how the sent value is to be interprete.:
  0 = integer as byte, 1 = integer as word, 2 = integer as double word, 3 = 1/10 value as word, 4 = 1/10 value as double word, 5 = 1/10 value as byte, 6 = 1/100 value as word, 7 = 1/100 value as double word, 8 = 1/100 value as byte, 9 = value sent to robot. (NOTE! Only ABB IRC5, 10 = floating point value (4 byte). E.g.:
  Type=8, PickMT shows 1.23 and sends the value 123 in one byte..:
- Minimum: Minimum value that the user is permitted to set in PickMT.
- Maximum: Maximum value that the user is permitted to set in PickMT.
- StepSize: Change in the value that occurs when the user presses the arrow up/down.
- DecimalPlaces: Number of decimals shown in PickMT.
- RobotID: Indicates the name of a robot variable that the value is written to.
- DefaultValue: Start value for the parameter.



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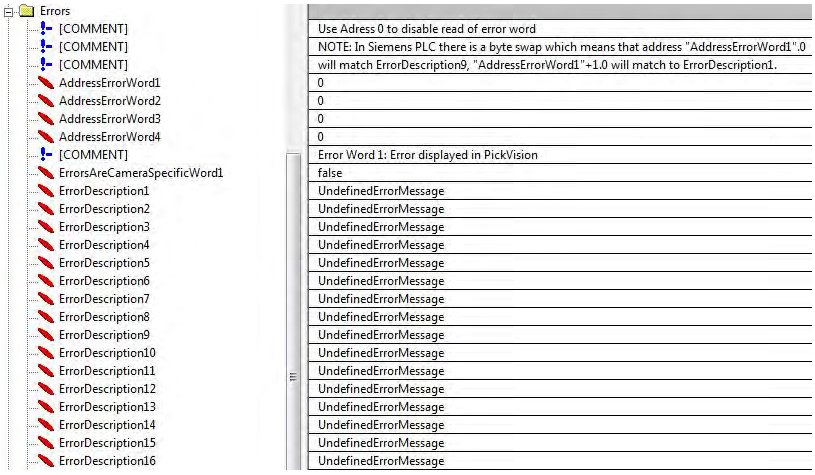
10.5 Configuration user defined mechanical equipment
Continued

Error management

Errors are read as single bits from up to four word memories in PLC. It is possible to select whether the alarm for each word memory is to be camera specific or not. If they are camera specific, the text ”camera X” appears in the alarm text. Also note that in a Siemens PLC, a byte swap occurs, which means that the start address for the word in the PLC corresponds to ErrorDescription 9. Other bytes in the PLC’s word memory start at ErrorDescription 1.

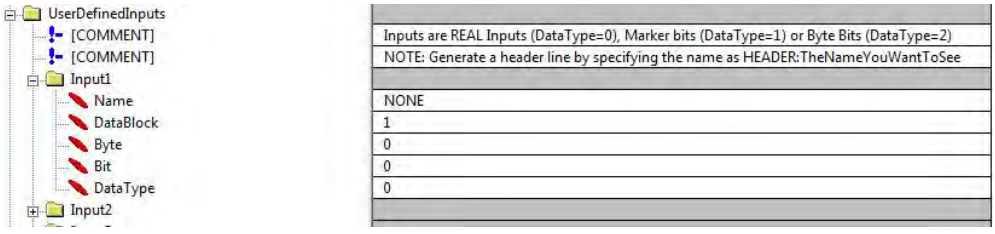
- AddressErrorWord1: Enter memory location for error messages 1-16. Enter 0 if this address is not to be used.
- AddressErrorWord2,3,4 as above, but for error messages 17-32, 33-48, 49-64.
- ErrorDescptionX: Text that is shown if corresponding bit in corresponding AddressErrorWord is 1.



User defined inputs

PLC inputs that are to be shown for the user are defined here. There are up to 16 user defined inputs, which can be freely defined. These are used to show the status of the equipment in PickMT. Inputs can also be defined as memory bites or datablock memories (datablock 1) in the PLC.

- Name: Text that appears on PickMT’s user interface. Enter ”NONE” if the input is not used.
- DataBlock: If DataType is set to 2 (ByteBits) the number of the datablock is given here.
- Byte: Byte for the physical input
- Bit: Bit for the physical input
- DataType: Determines whether PickMT is to write actual PLC inputs (0), memory addresses in PLC (1) or datablock memories in PLC (2).



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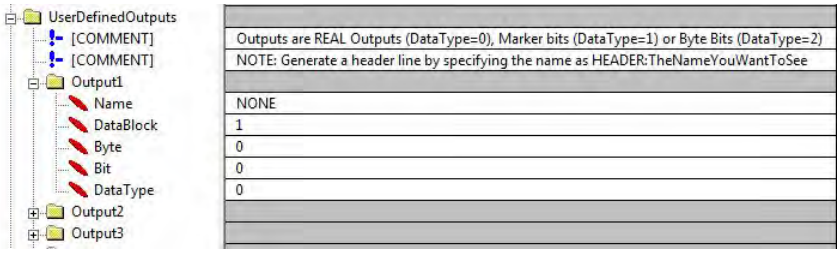
User defined outputs

PLC outputs that are to be shown for the user are defined here. There are up to 16 user defined outputs, which can be freely defined. These are used to show the status of the equipment in PickMT.

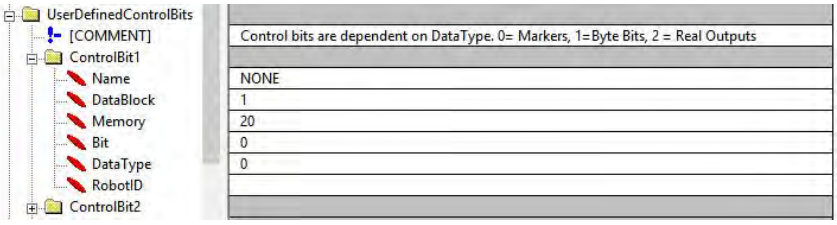
- Name: Text that appears on PickMT's user interface. Enter "NONE" if the output is not used.
- DataBlock: If DataType is set to 2 (ByteBits) the number of the datablock is given here.
- Byte: Byte for the physical input
- Bit: Bit for the physical input
- DataType: Determines whether PickMT is to write actual PLC outputs (0), memory addresses in PLC (1) or datablock memories in PLC (2).



General control bits

PLC cursors that are to be shown for the user are defined here. There are up to 8 user defined cursors, which can be freely defined. These are used to allow manual control of the equipment from PickMT.

- Name: Text that appears on PickMT's user interface. Enter "NONE" if the function is not used.
- DataBlock: If DataType is set to 1 (ByteBits) the number of the datablock is given here.
- Byte: Byte for the physical input
- Bit: Bit for the physical input
- DataType: Determines whether PickMT is to write memory addresses in PLC (0), datablock memories in PLC (1) or actual PLC outputs (2).
- RobotID: Indicates the name of a robot variable that the value is written to.



Start, stop and stopreset bit

PLC cursors that are used at start and stop in PickMT are defined here. These are used to synchronise the equipment with PickMT.

- Name: Text that appears on PickMT's user interface. Enter "NONE" if the function is not used.

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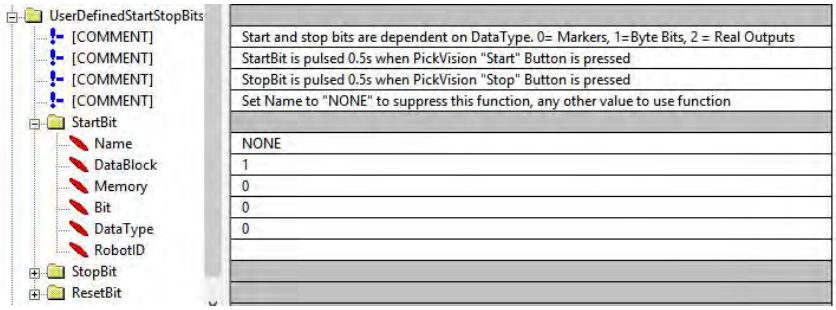
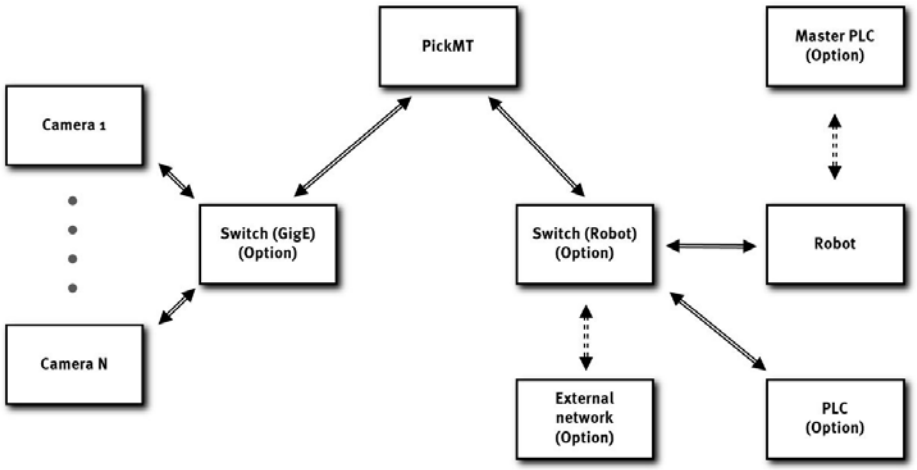
- DataBlock: If DataType is set to 1 (ByteBits) the number of the datablock is given here.
- Byte: Byte for the physical input
- Bit: Bit for the physical input
- DataType: Determines whether PickMT is to write memory addresses in PLC (0), datablock memories in PLC (1) or actual PLC outputs (2).
- RobotID: Indicates the name of a robot variable that the value is written to.



11 Appendix B: Communication

The following image shows the basic communication between PickMT and surrounding equipment.



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11.1 Communication Master-Slave

The master function is not currently available in PickMT. In most cases this function can be achieved through programming in the robot

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11.1.1 PickMT is Slave

11.1.1.1 Signal definitions

The following commands can be used:

Master		PickMT	Description
AutomaticStart byte{0;1}	>		Starts the system. Reply with either AutomaticStrtOk or AutomaticStrtNok. Handshaking see diagram below.
	<	AutomaticStrtOk byte{0;1}	System is started.
	<	AutomaticStrtFail byte{0;1}	Error when starting system.
CycleStop byte{0;1}	>		Stops the system. Reply is either CycleStopOk or CycleStopNok. Handshaking see diagram below.
	<	CycleStopOk byte{0;1}	The system is stopped.
	<	CycleStopFail byte{0;1}	Error when stopping system.
SelectID SelectIdCam1..4 byte{0;1}	>		Choice of new ID number. Reply is either SelectIdOk or SelectIdFail. Handshaking see diagram below.
ID-No. No. double word	>		ID-Value is locked by the SelectID command and must therefore be set beforehand.
	<	SelectIdOk byte{0;1}	Choice of ID successful.
	<	SelectIdNok byte{0;1}	Choice of ID unsuccessful.

Standard handshaking takes place as follows:

The command must be 0 before the sequence begins. The command is then increased to 1. The machine begins to carry out the desired operation, after which the reply is set to 1. To confirm the receipt of the reply the command must then be set back to 0, after which the reply is set to 0. Note that in most cases there are two alternative replies.

When the program is started all signals are reset to 0.

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11.1.1.1 Signal definitions
Continued

The handshake sequence is shown in the diagram below for AutomaticStart, CycleStop and SelectId.

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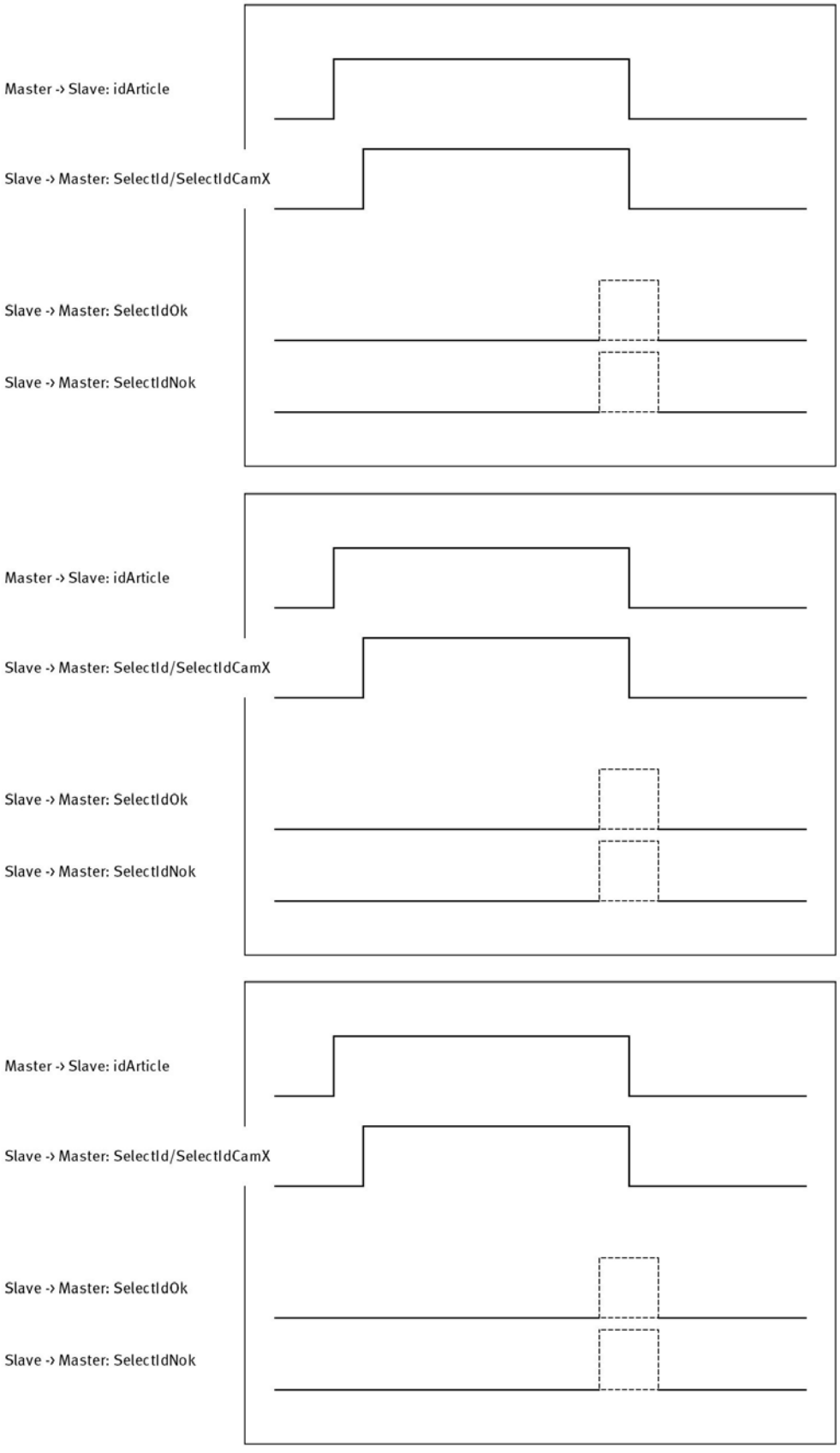

11.1.1.2 PLC

Communication between PickMT and Master is via network to special memory locations in the PLC. Communication consists of commands (such as start/stop/selection of detail), and some alarm monitoring. Information is located in the PLC memory through definition in PickMT's user interface. For types of memory cell in the PLC memory (byte, word, double word) see the table above.

11.1.1.3 Robot

For certain makes of robot PickMT can act as a Slave. Read more about this in integration manual for the relevant robot.

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12 Appendix C: Other technical information

12.1 File structure PickMT

Swedish Windows: C:\Program\Svensk Industriautomation AB\PickMTPickMT is usually installed in the following folder in a folder:

PickMT is usually installed in the Windows program folder in a folder called Svensk Industriautomation AB. What the program folder is called depends on what language the operating system uses.

English WindowsD: C:\Program Files\Svensk Industriautomation AB\PickMT

The installation folder for PickMT always contains the following folders:

German Windows: C:\Programme\Svensk Industriautomation AB\PickMT

For other languages in Windows the name varies accordingly.

Noted that if PickMT is operated with SmartCamera, it is installed on D: instead of on C:.

Exactly what folder PickMT is installed in can also vary because it is selectable on installation. However, it is recommended not to change the pre-selected folder to simplify future upgrades etc.

Backup, Bin, Configuration, Data, Database, Documentation

When naming folders they should always be named bin-folder, backup-folder etc. I.E. the whole search path, CD:\Program\Svensk\Program Files\Svensk Industriautomation AB\PickMT\Bin for the bin folder etc.

PickMT\Backup

This folder is the automatically preset file where backups must be located. NOTE: When one makes a backup it is usually inappropriate to keep the backup on the same computer, this folder should usually be empty.

PickMT\Bin

All the executable files required to operate PickMT are stored here. Such as PickMT itself (PickMT.exe), and a number of dynamic libraries (*.dll) and configuration files (*.xml). There is also the PickMT log file (PickMT.log), which can always give valuable information to SVIA if there are any problems.

When updating, some of these files may need to be replaced.

PickMT\Configuration

Many of the different configuration files required for PickMT are stored here. Such as the camera calibration files (*.cal), language file (Language.xml), master/slave control file (MasterSlave.xml), PickMT configuration file (PickMT.cfg), camera configuration files (*.dcf), and some system images (*.tif). The latest applicable configuration file (PickMT.cfg.LastGoodKnown), which can be used if there is a change in PickMT or a system crash has made PickMT.cfg unusable.

When updating, some of these files may need to be replaced.

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For special applications, parts of the language file can be replaced by user-supplied definitions. These modifications can be placed in the file Language.Override.xml.

If the option for user defined mechanical equipment is installed, the files UserDefinedPlcCamera_1.xml - UserDefinedPlcCamera_4.xml and UserDefinedPlcImageCamera_1.bmp - UserDefinedPlcImageCamera_4.bmp are also found. These contain the definition of the interface for the user defined equipment's PLC.

PickMT\Data

Details and tools are stored here. Tools are saved in the sub-folder Tools, while details are saved in sub-folders corresponding to the group name. There is a *.Detail file for each detail, and for each position an *.n.CollisionImage and an *.n.TeachinImage, where * represents the detail number and n represents the position number.

If the secondary search has been activated for a detail, there is also a *.Secondary.Detail-file.

If a 3D camera is used, there is also a *.HeightAnalysisArea-fil.

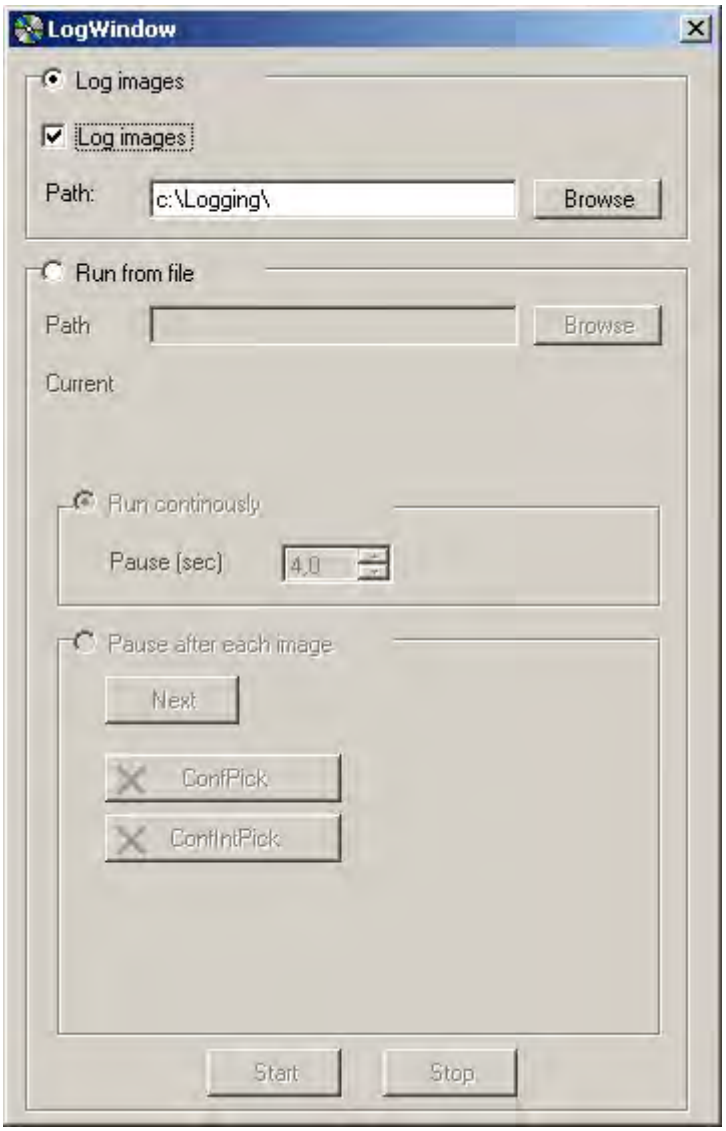
PickMT\Database

The PickMT database (PickMT.mdb) is stored here. When PickMT is run there is also a PickMT.ldb file.

12.2 Operation logging

Logging of images while running

In unusual cases there may be a need to log images while running, in event of very infrequent faults for example. A special log window must be activated to save each individual image to the hard disk during operation. This is done by first activating PickMT's main window (click on the blue title row at the top of the window) and then pressing Ctrl-L. The following window opens:



To activate logging tick "log images" and give the search path to the location where the images are to be saved. Then close the window and start operation in the normal way.

The images are saved on a rolling basis with a maximum of 19,999 images. Logging affects the cycle times, because saving to file takes time.

The image files are saved in the format CAMX_YYYYY.tif, where X is the camera number (0 .. 3) and YYYYY is a serial number.

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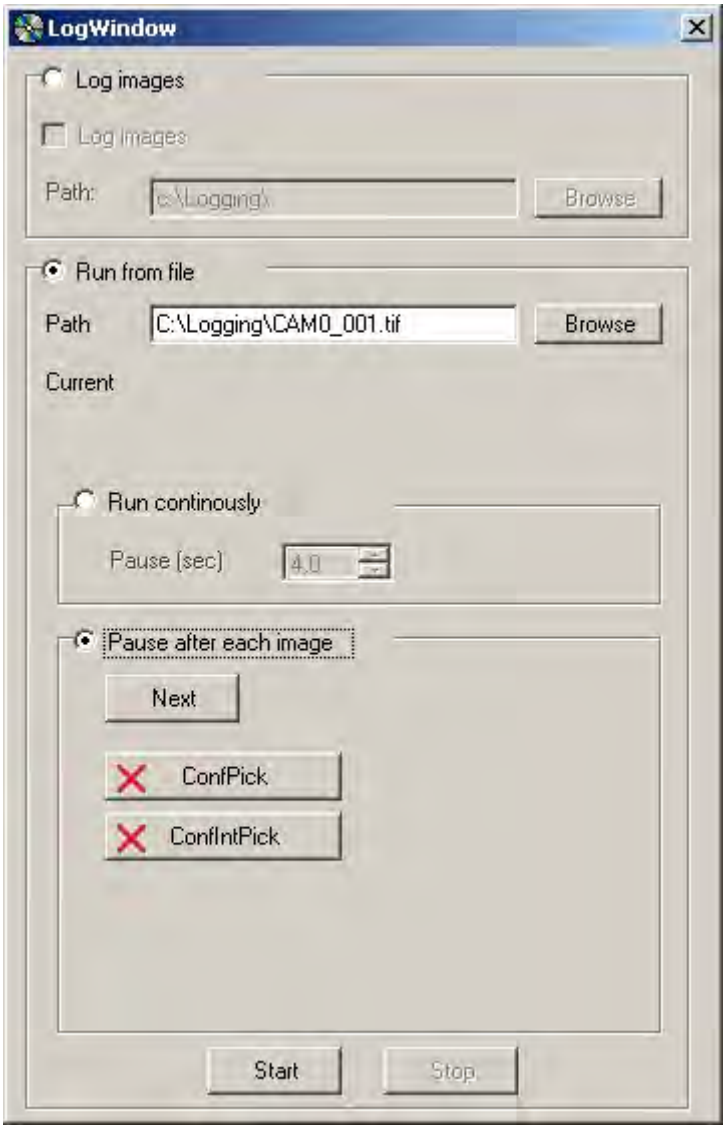
Operating with logged images (only 2D)

Images that were logged as above can then be used to run from file.

To run a detail with logged images the detail must first be selected in the usual way in the operating window. Then a special log window must be activated. This is done by activating PickMT's main window and then pressing Ctrl-L. Then mark "Run from file", the search path for the first image is given, and operation is started and stopped by pressing start and stop.



The slide show can either occur at a fixed interval (select "Run continuously") or by pressing the button (select "Pause after each image").

If the system is configured as PalletPicker2D, it may be necessary to send the signals ConfirmPick or ConfirmInterlayerPick manually by clicking on the corresponding buttons.

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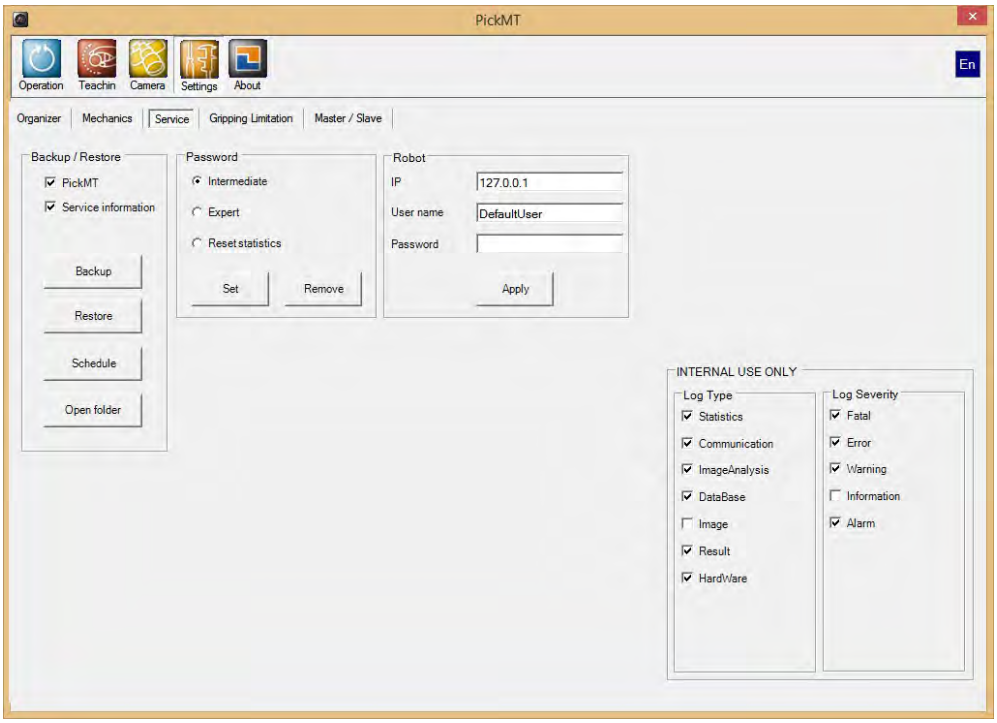
Operating with advanced information logging

Advanced operating information can be logged from inside PickMT and provide fault tracing information to SVIA's service personnel. Advanced logging of information should only occur on instructions from SVIA, the operating performance may otherwise suffer. Select advanced logging of information only during ongoing operation of PickMT and reset to normal level at the next program start.

Logging is accessible through the service tab in the Settings window. Activate the service tab by clicking it and then pressing Ctrl-L. Use the password "user", and the following image will be displayed.



Select logging according to instructions from SVIA's service personnel.

It is also possible to turn on extended logging by pressing and holding the Shift key during the PickMT application startup. During start, a message window informs that extended logging is enabled. As long as extended logging is active, the operator has to confirm extended logging on every PickMT start.

12.3 Manual restoring of backup

In certain cases, the automatic restore of a backup from the service window can be unsuccessful, for example if the files are damaged, or if the backup was created using a previous version. In these cases a backup can be restored manually. Note that errors during manual management make the system unusable and require remedial action from SVIA's side. The following procedure must then be used:

- Find the folder that contains the backup files. Then search for PickMT's program folder. Then search for PickMT's program folder. The folders "Database", "Data", and "Configuration" exist in both the backup folder and PickMT's program folder.
- Make a safety copy of the whole of PickMT's working folder.
- Copy the whole "Database" folder from the backup folder to PickMT's program folder. Overwrite existing files.
- Delete the whole "Data" folder from PickMT's program folder.
- Copy the whole Data folder from the backup folder to PickMT's program folder.
- Copy the following files from the "Configuration" folder to the "Configuration" folder in PickMT's program folder":
  - All calibration files (*.cal)
  - All configuration files (*.xml)
  - PickMT.cfg
  - All camera configuration files (*.dcf)
  - All image files (*.tif and *.bmp)

12.4 System requirements

Typical system requirements:

- Windows 8.1 Industrial Professional 32bit
- 4 GB RAM
- 16 GB harddisk
- 1 GBit LAN for GigE camera
- LAN for robot communication
- Screen resolution 1024×768 or better

PickMT can be run on Windows XP SP3 with reduced system requirements. This is mainly intended for system upgrades. In this case there are limitations regarding modern robot communication and features.

Windows 7 is not supported due to driver problems.

64 bit versions of Windows are not supported.

12.5 Standard users and passwords

Normally, a PickMT system has three standard users:

- Standard user for operation: User: PickMT, Password: PickMT
- Standard user for administration: User: AdminPickMT, Password: AdminPickMT
- Windows 8.1 default administrator
- Previous smart camera systems (Matrox Iris) use the following administrator login: User: Administrator, Password: Administrator

12.6 Licensing

By installing and using PickMT you agree to Microsoft and Matrox licensing agreements.

12.7 Safety

The user is responsible for all aspects of security regarding the PickMT system, in particular the handling of network connections, firewalls, and antivirus issues.

Under no circumstances shall SVIA or SVIA:s suppliers be liable for incidential or consequential damages arising from connecting the vision system / WAN port to other systems, e.g. external networks or storage media.

13 Appendix D: PickMT smart camera

13.1 Hardware connections

The PickMT smart camera has three connectors:

- Power connector
- Network connector
- VGA/USB connector

When connected by its standard cable, the following wires must be connectd for operation:

- Red & grey: +24V
- yellow/brown: GND

13.2 Maintenance

13.2.1 Regular restart

System power failure protection is achieved by write protection of the system harddisk. Ongoing system changes are written to the system memory instead of to the harddisk.

This leads to a very slow but increasing memory usage. Thus it’s recommend to regularly restart the system, e.g. once each month.

13.2.2 Write Filter (EWF)

The smart cameras system harddisk (c:\) is protected by a write filter against unwanted changes and damages due to power failure.

NOTE: If the user intentionally wants to change the content of the system disk (e.g. system upgrades, change in system settings, install of new programs), the write filter must be disabled.

Please follow the following steps to disable write filter:

- Power off the smart camera and let it reboot.
- Log of user “PickMT”svia” and log on as ”Administrator”.
- Start program ”xpconfig” and select tab ”Write Filter”.
- Click ”Disable” and reboot.
- If needed: Log of user “PickMT”svia” and log on as ”Administrator” .

Make all your desired changes to drive C:\.

Then enable EWF again by following the steps below:

- Make sure you are still logged on as user ”Administrator”. (Or log on as Administrator)
- Start program ”xpconfig” and select tab ”Write Filter”.
- Click ”Enable” and reboot.

Changes to drive D:\ can be done at all times. Please note that - being logged in as user ”svia”, the EWF status will not be reported correctly and is not changable when logged in as user “PickMT”.

13.3 Installation from PickMT Rescue USB

13.3.1 Base installation

To restore the contents of your flash disk to the factory-default configuration, using a bootable DVD drive or USB memory stick connected to your Matrox Iris GT:

- Start with your smart camera turned off.
- Connect the PickMT Rescue DVD drive or USB memory stick to the USB connector of your smart camera.
- Turn on your smart camera.
- Press F11 during Power-Up-Self-Test (POST) to access the Boot-Device Selection utility included in the BIOS.
- Using the Up or Down key to move the highlighting bar, select your device and press Enter.
- Upon booting, the Rescue utility is launched automatically. NOTE: This boot will take some time, be patient.
- Before restoring the contents of the flash disk, the Rescue utility will indicate the version of the XPe Rescue utility software. Press Next.
- Read and accept the software licensing terms when the dialog apperas, and click on the ”I agree” button.
- Before restoration begins, there is a prompt for confirmation.
    - Click on the ”Cancel” button if you want to cancel this procedure. The rescue operation will be cancelled and your smart camera will reboot.
    - Click on the ”Yes” button to proceed with the restoration of your flash disk. The Rescue utility will perform a byte per byte restoration of your flash disk.
      NOTE: ALL EXISTING CONTENT WILL BE ERASED.
    - Restore operation will take several minutes.
- Once the restoration is complete, press ”Ok” to confirm completion.
- Remove the Rescue utility USB and let the camera reboot with the restored operating system. Warning: If you reboot with the USB drive still connected, the D-drive will get a wrong drive letter. If this happens change drive letter in My Computer->Manage->Disk Management->Change Drive Letter).
- Upon completed start of Windows, it will notify you on some updated drivers and will ask you to reboot. Click ”Yes” to accept the reboot.

13.3.2 Further configuration steps

Some further steps have to be performed to prepare the smart camera for use with PickMT

- Upon next reboot, log of user “PickMT”svia” and logon as user ”Administrator”. Default password is ”Administrator”.
- Change the computer name to match the sticker on the camera (AutoNetName):
  - Open Windows Explorer
  - Select ”My Computer”, right click, select ”Properties”.
  - Select Tab ”Computer name”, click on ”Change”
  - Read the AutoNetName on the sticker on the smart camera, fill in this text as the computer name. Should be similar to ”IRIS0808D0”
  - Confirm that the smart camera must be restarted.
- On first time use, a valid MIL license code must be obtained and entered. Typically, this is done at factory and must not be performed by the end-user.
  - From the start menue, start MIL License Manager
  - Check packages Machine Vision and Geometric Model Finder
  - Press Generate, copy the Lock code, and send it to SVIA/Matrox for generation of a Software License Key.
    NOTE: While you are awaiting the Lock Code, you can activate a temporary license by means of the licensing section in the MilConfig Utility.
  - After you received the Lock Code, enter Software License Key and press Activate.
  - Internal instruction: Document license data and system data in appropriate document on server.
- Use PickMT Configuration Editor to edit license data. Typically, this is done at factory and must not be performed by the end-user.
  - Obtain current MAC address.
  - License name = ”PickMT Smart Camera”
  - License number: Enter Iris serial number (looks like A52416)
  - Machine Id: Enter Iris serial number (looks like A52416)
- Start PickMT once to check that everything is installed correctly.
- Reboot, and log on as Administrator.
- We strongly advise the customer to change the default passwords for the Administrator and svia account.
- Enable the C-Disk Write filter and reboot. This will protect your camera from damages due to sudden power failures.

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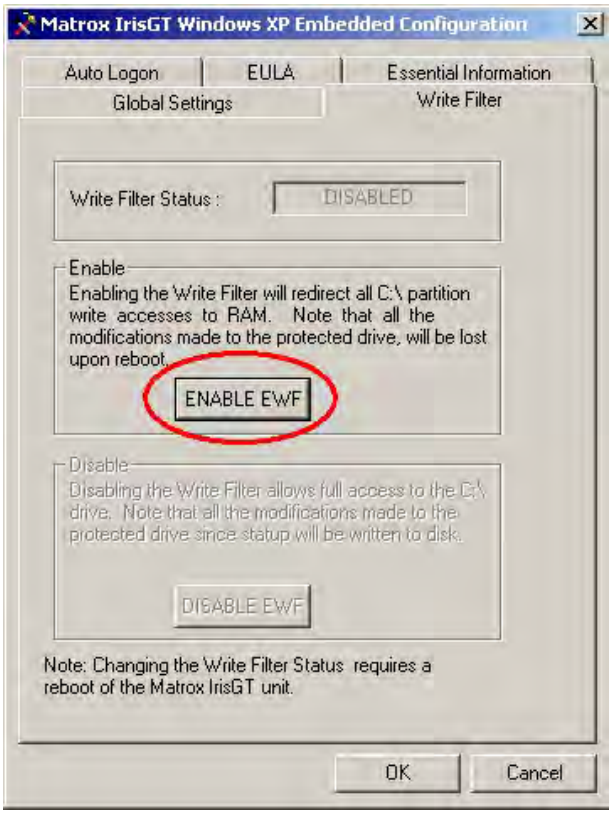
13.3.2 Further configuration steps

Continued



14 Appendix E: Own notes

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