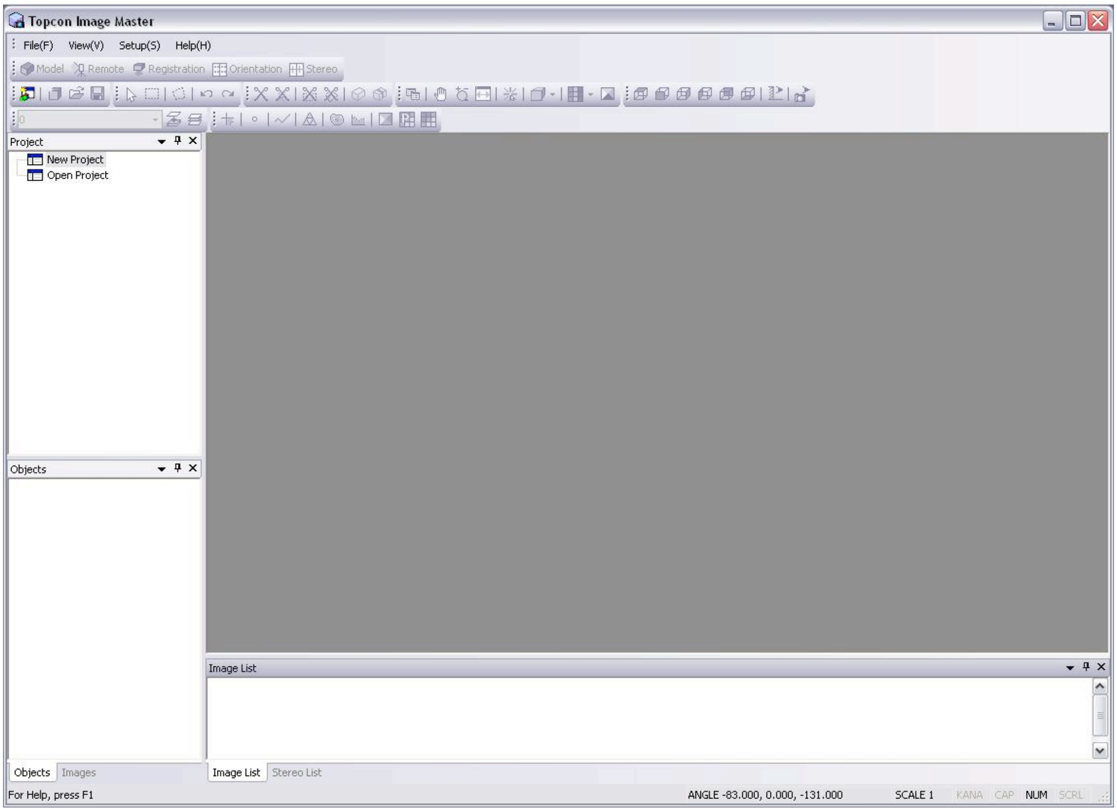
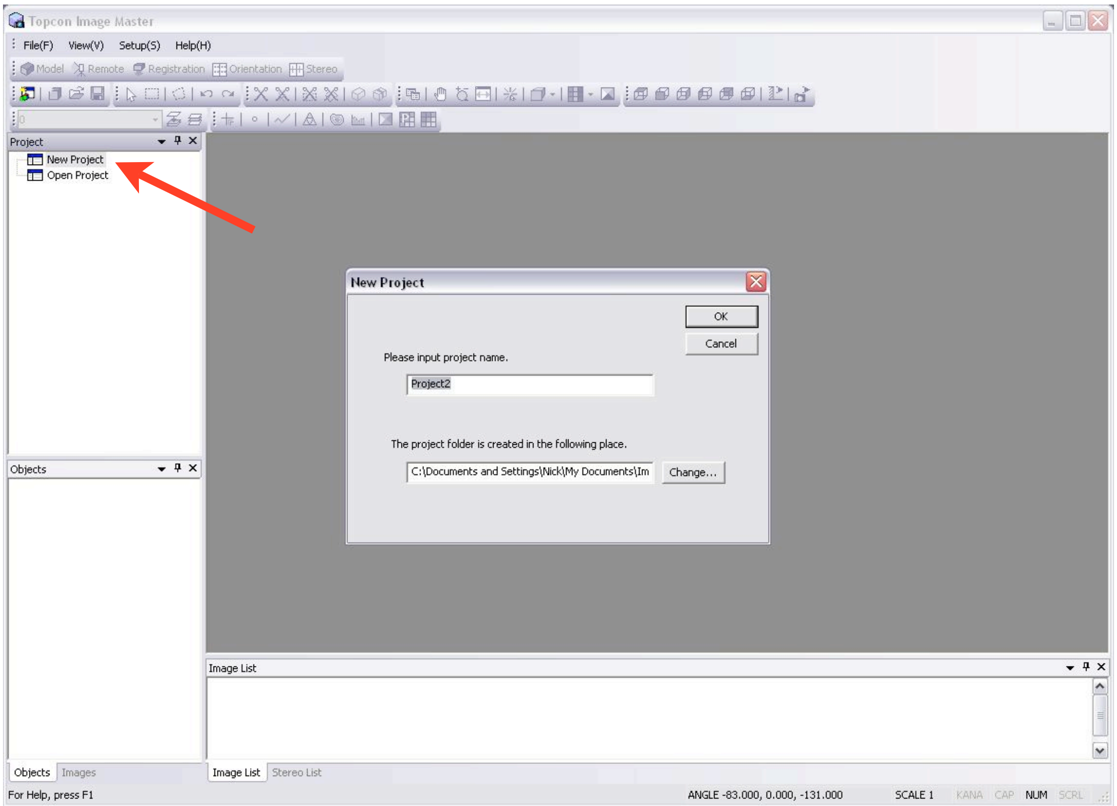
Imagemaster Pro Quick Start Training Guide

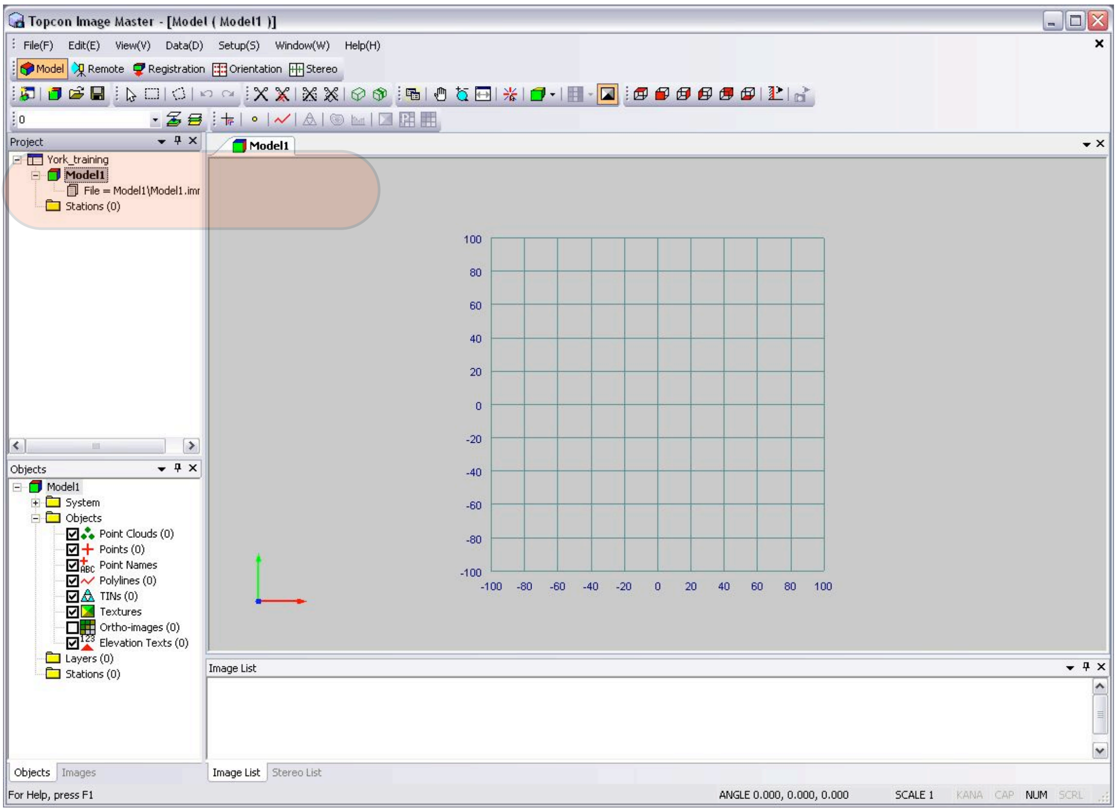
1. On starting the Imagemaster Pro software, a blank screen is displayed as below:



2.



Click <New Project> and enter a location on your hard drive. A subdirectory will be created with the project name.



3. This is the Model Screen showing the workspace where our 3D model will be displayed / measured. To the left is a tree of models (Imagemaster allows more than one model to be open at once), and below that is a panel for controlling the various attributes of the project including layers, survey points, polylines etc. The lower window is empty for now and is where our raw photographs are displayed.

Along the top, below the menus are five buttons for controlling the various stages and facilities of Imagemaster Pro.

Model - the model screen described above

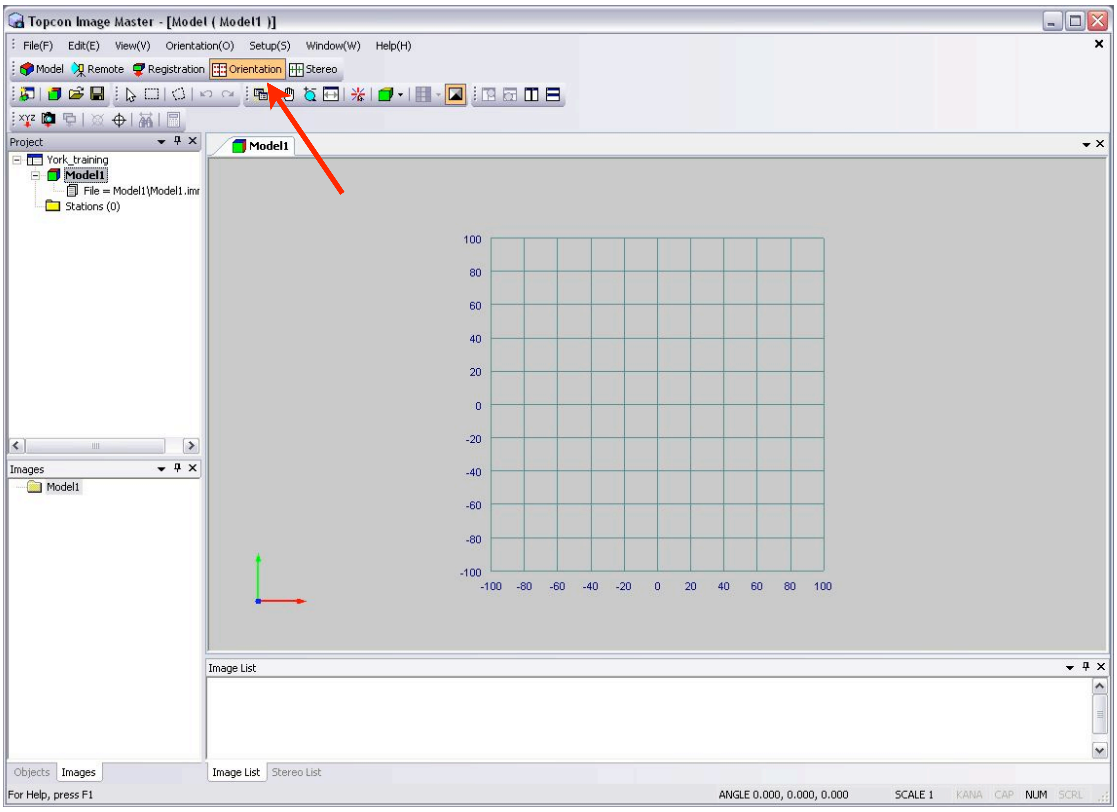
Remote - used for remote control of the IS robotic total station and is NOT used for photogrammetry

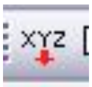
Registration - for tieing together point data projects, again NOT used for photogrammetry

Orientation - for image orientation and bundle adjustment (the first stage of photogrammetric processing)

Stereo - for the second stage of photogrammetry processing where linework can be digitised on the stereo images, points can be added and polylines drawn for automated surface model (DSM)

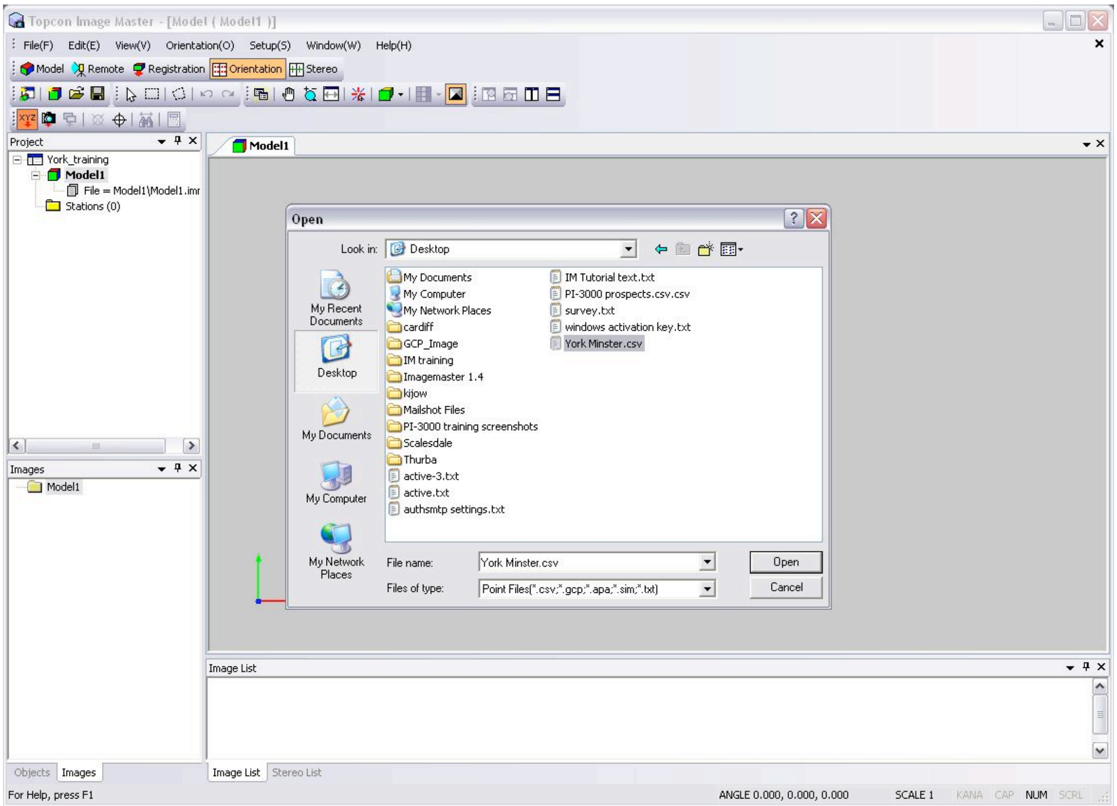
4. The first stage is image Orientation. Click the orientation button and the menus change to show new icons described below.





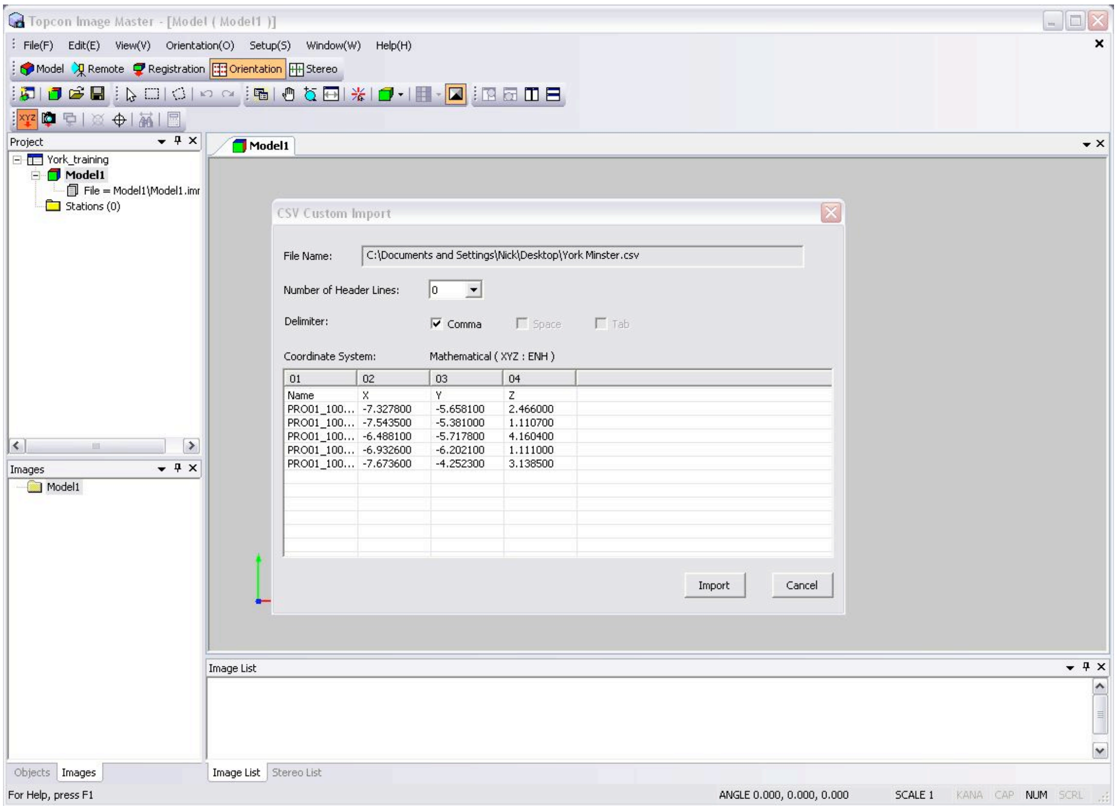
Our first stage is to read in our survey control from a GPS or total station dump, saved as a comma delimited .csv file. Click the XYZ button and specify the place for your survey cooridinate file.

NOTE: IT IS NOT MANDATORY TO LOAD SURVEY CONTROL AS THIS MAY NOT ALWAYS BE AVAILABLE. IT IS POSSIBLE TO LOAD CONTROL DATA AT A FUTURE TIME AND CONTINUE WITH THE PROCESSING STAGES BELOW ASSUMING A MODEL SPACE WITH ARBITRARY UNITS.

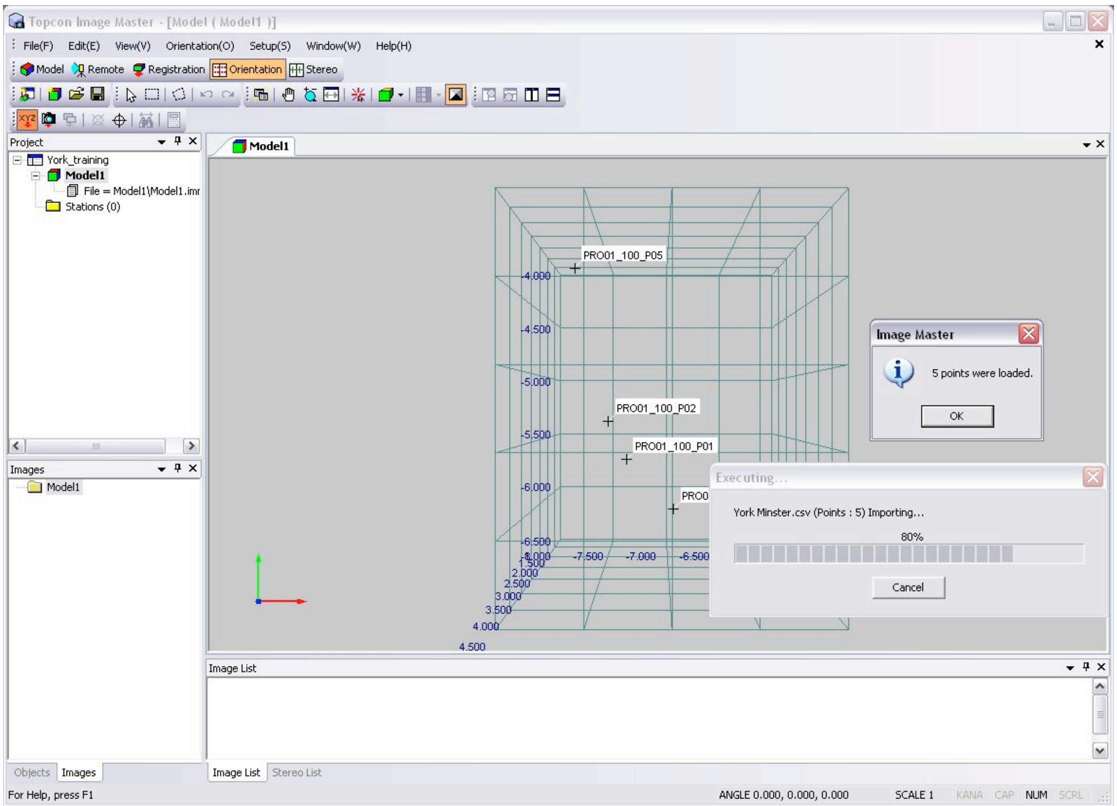


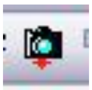
5. (above) the load csv file dialogue box

6. The contents of the csv control file will be displayed. Click IMPORT to load the points

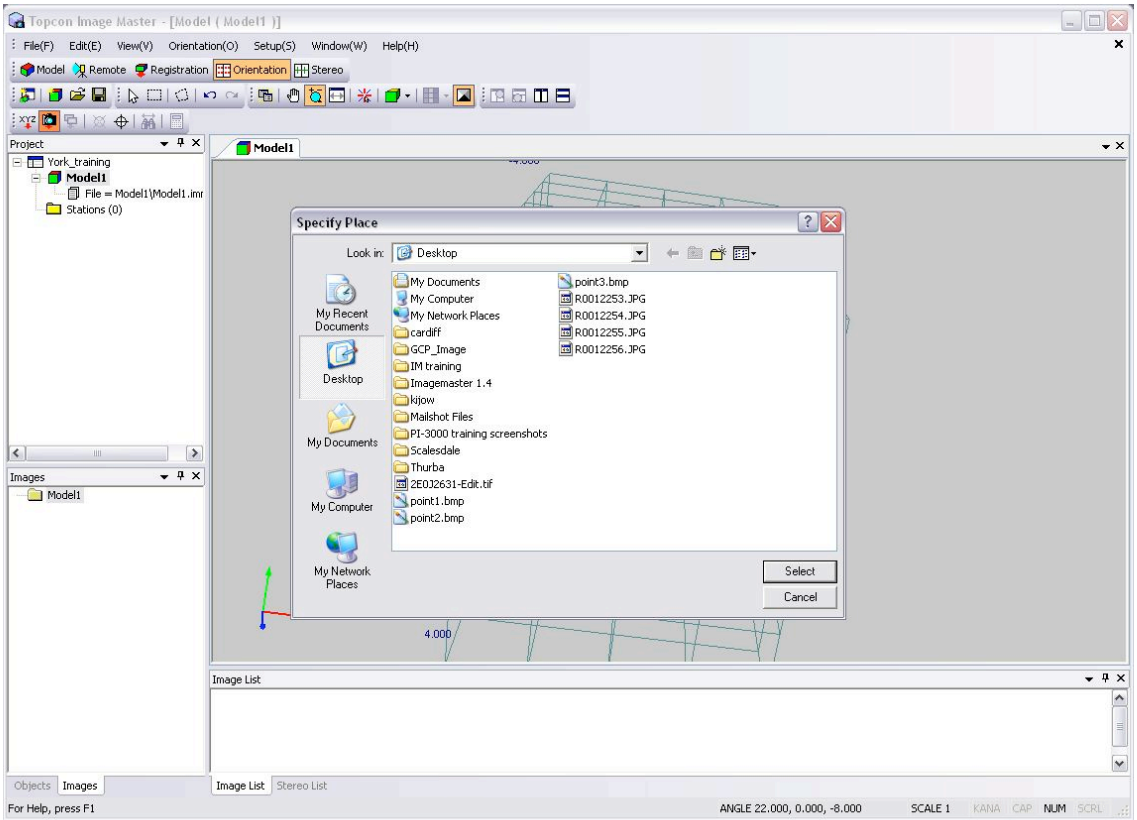


7. The model screen now changes to relate to a 3-dimensional representation of the control points. After clicking OK the model space can be rotated by holding down the mouse right button and moving the mouse and zoomed via the scroll wheel.

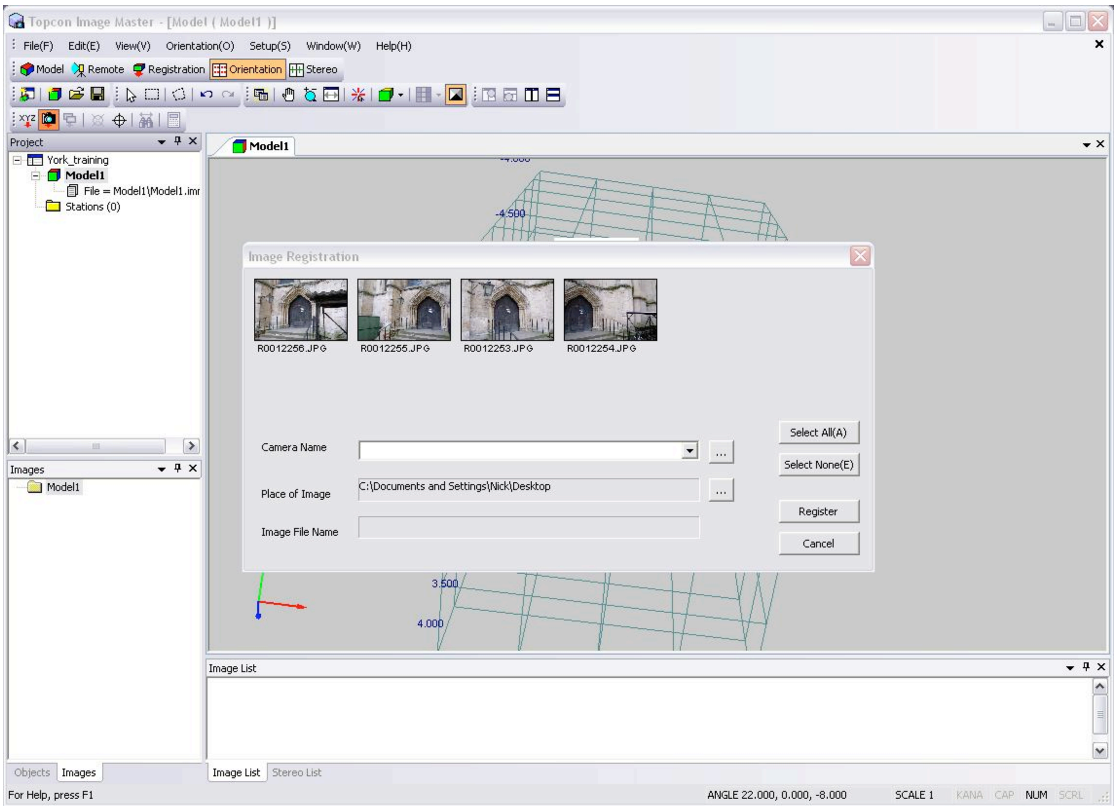




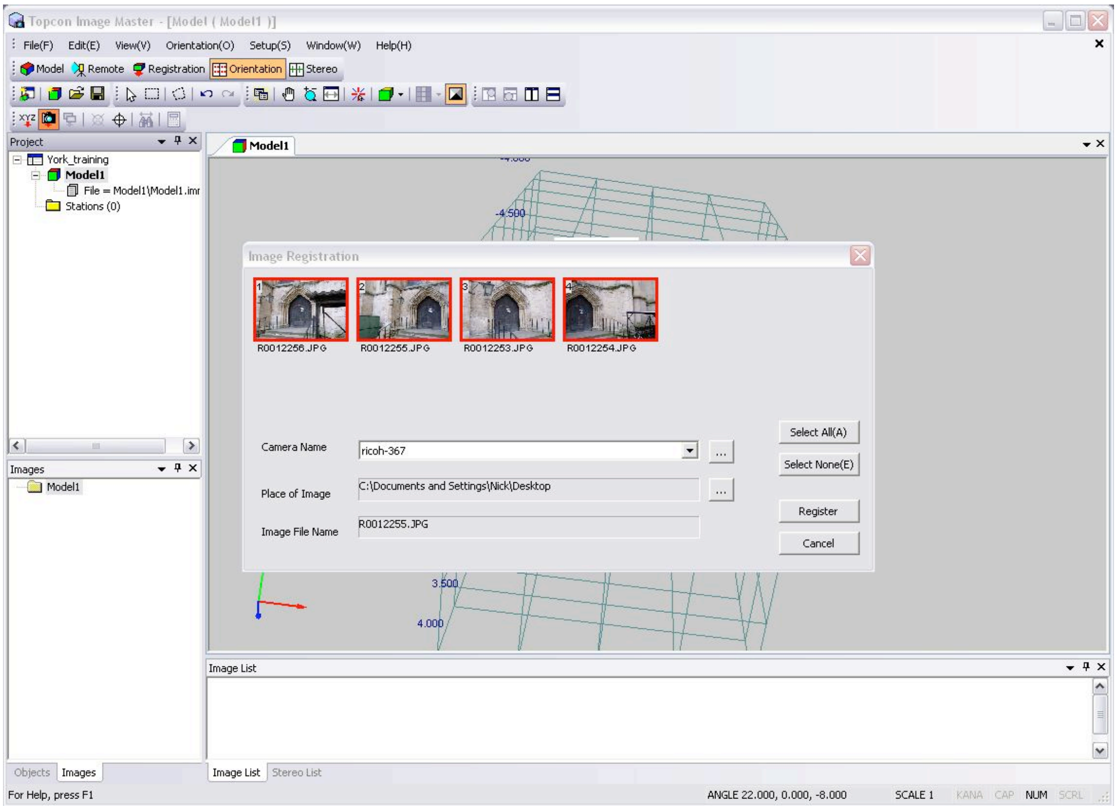
8.Click the camera icon to load the raw photographs. Specify the place where they reside which may be a directory on a hard drive or a memory card reader.



Here we only specify the directory and do not have to select the individual images. The raw images are displayed horizontally. Select ALL or select only the ones you wish to import by clicking on the thumbnails in turn.

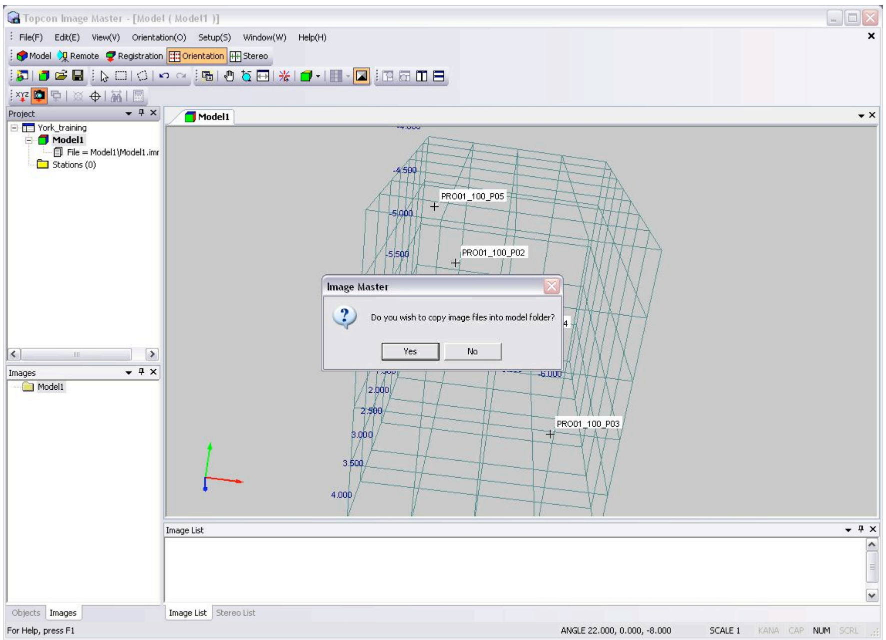


9.

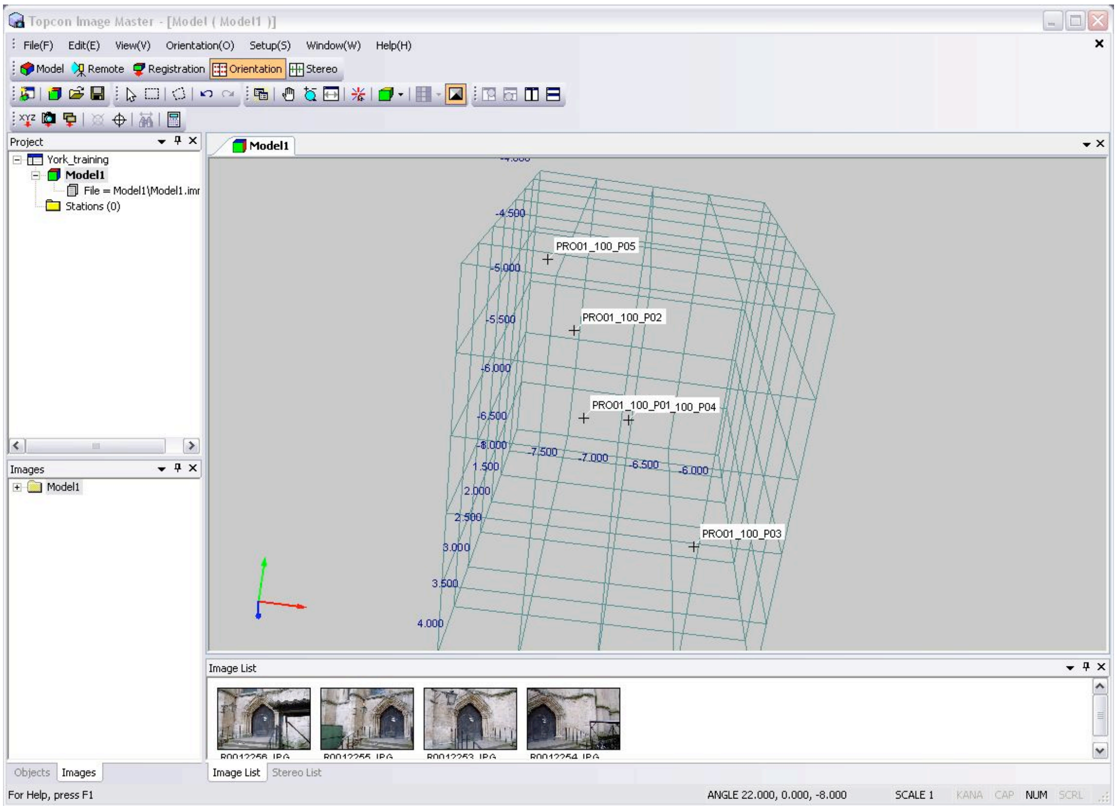


The next important stage is to load the calibration file specific to the camera / lens used to acquire the images for our project. This is saved as a .CMR file and can be loaded by clicking the *three dots* button to the right of the Camera Name entry field.

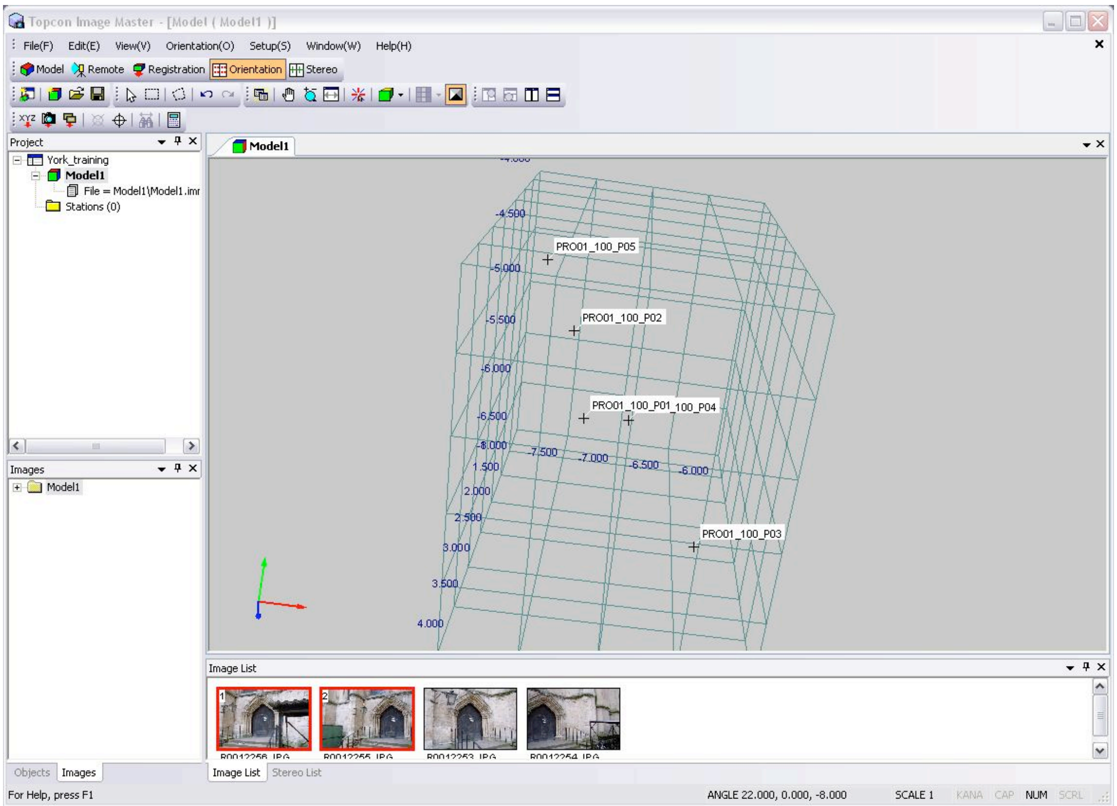
10. Once the required images are selected, and the camera calibration file loaded click the REGISTER button. [NOTE: it is possible to load more images into a project at any future stage of a project. It is also possible to load images acquired with a different camera or lens provided a .cmr file is available.]



11. The images are loaded and now fill the lower horizontal space of the Imagemaster window.

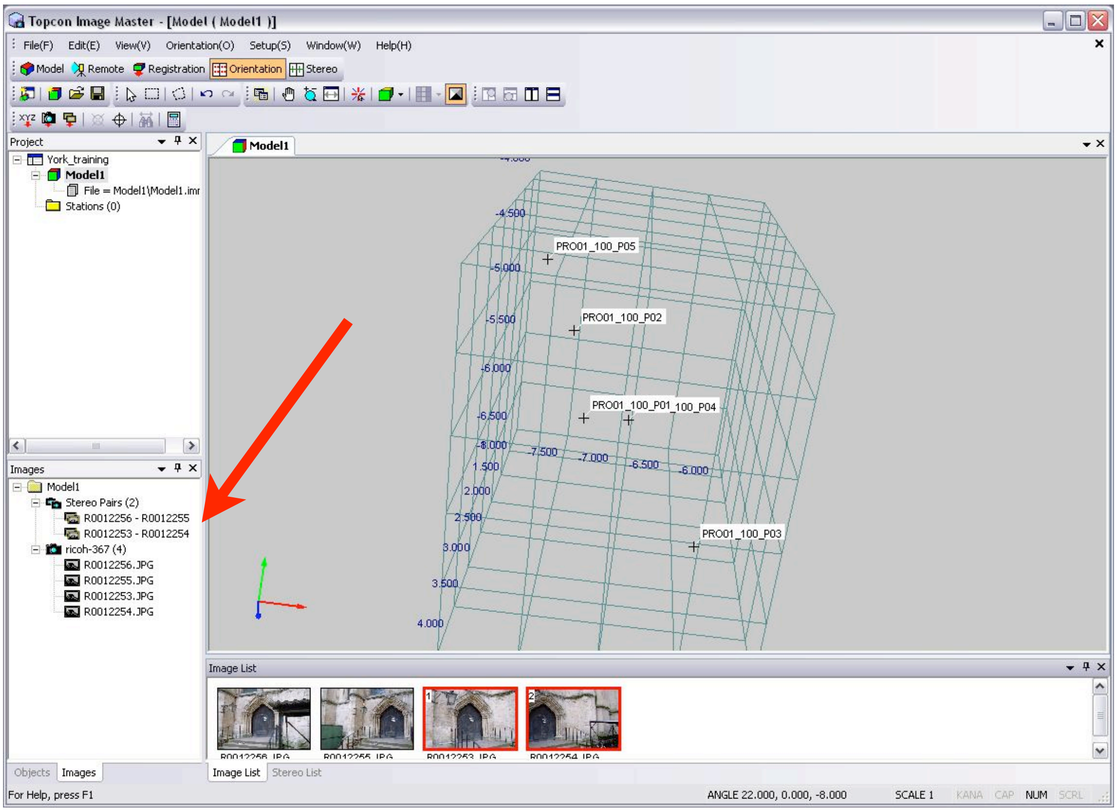


12. The next stage is to assign pairs of images as stereo pairs. It is useful to maintain the convention of working from left to right (as with the field acquisition of images) during the Imagemaster workflow. That way sequential image file numbers make correct assignment of stereo pairs much easier.



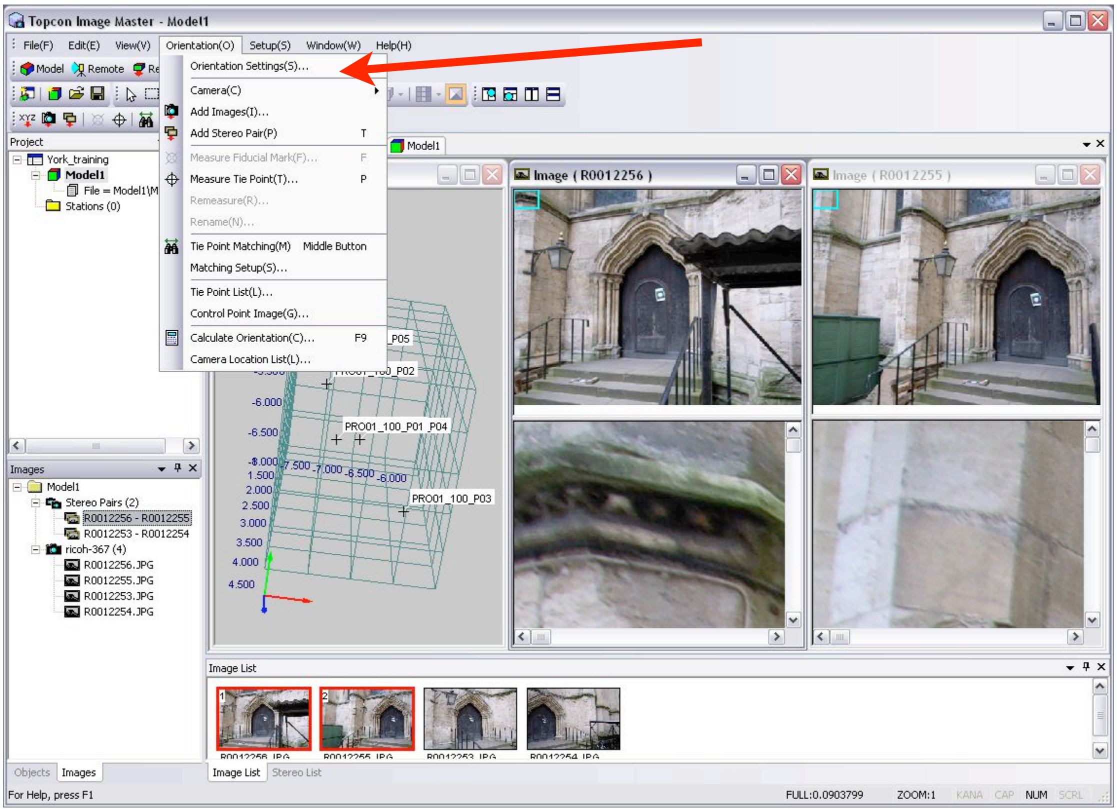
Whilst holding down the Ctrl key, click on the left and then the right images of a pair in the lower horizontal thumbnail list. Each thumbnail will be outlined in red and displayed with a number 1 and 2 in the top left as shown on the above image.

14. To register a stereo pair, click the register icon. The pair of photographs selected and outlined in red will be displayed on the Stereo Pairs tree in the left margin.

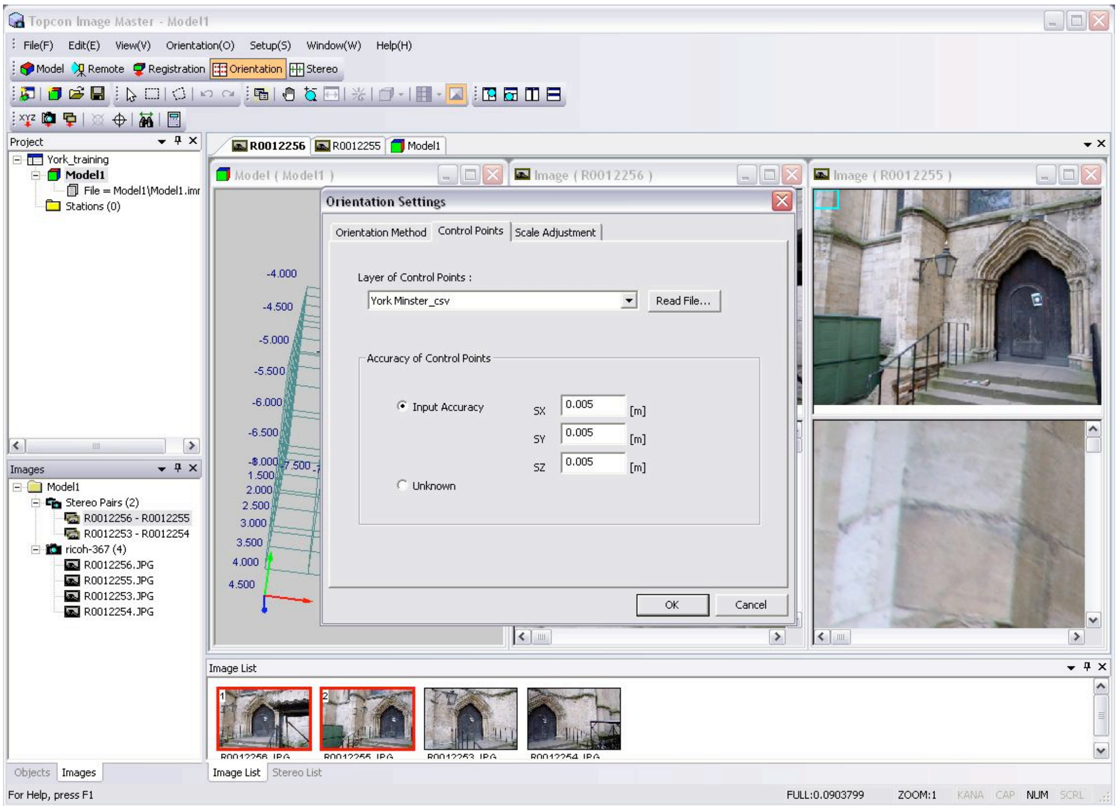


15. Repeat the above step for any subsequent pairs of images in the project.

16. Before we move on to picking control points we need to setup our orientation settings. On the top menu click Orientation >> Orientation Settings as per the image below



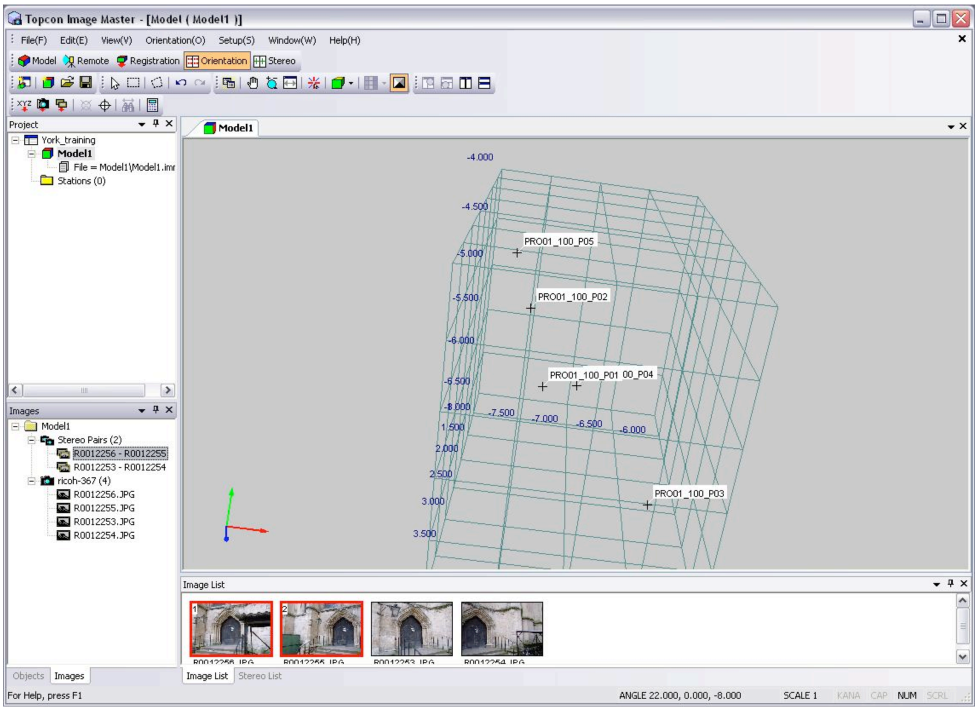
17. The first tab "Orientation Method" should be left at its default [Bundle Adjustment]. Click the centre "Control Points" button. Here we can see the control points that were imported from the .csv file in step 5 above are assigned to their own layer.



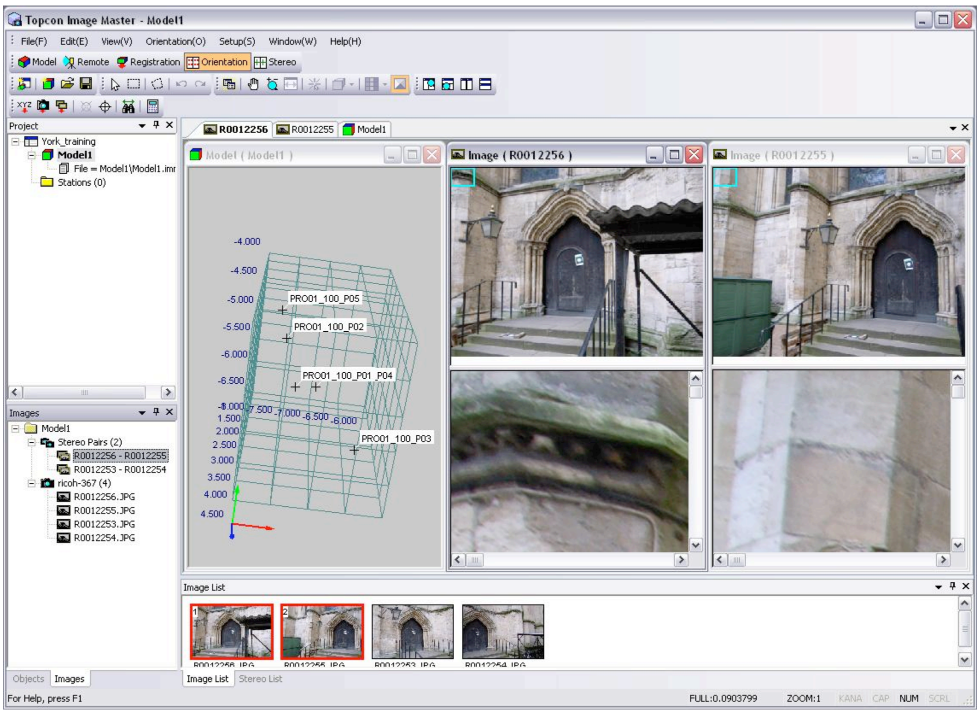
It is now possible to set the Accuracy of the control points. This is either the accuracy of the total station used to acquire the control (in this case a 5 second instrument), or an average of the positional precisions of a GPS unit, if used. When done click OK.

NOW IS A GOOD TIME TO SAVE THE PROJECT BY CLICKING THE SAVE ICON

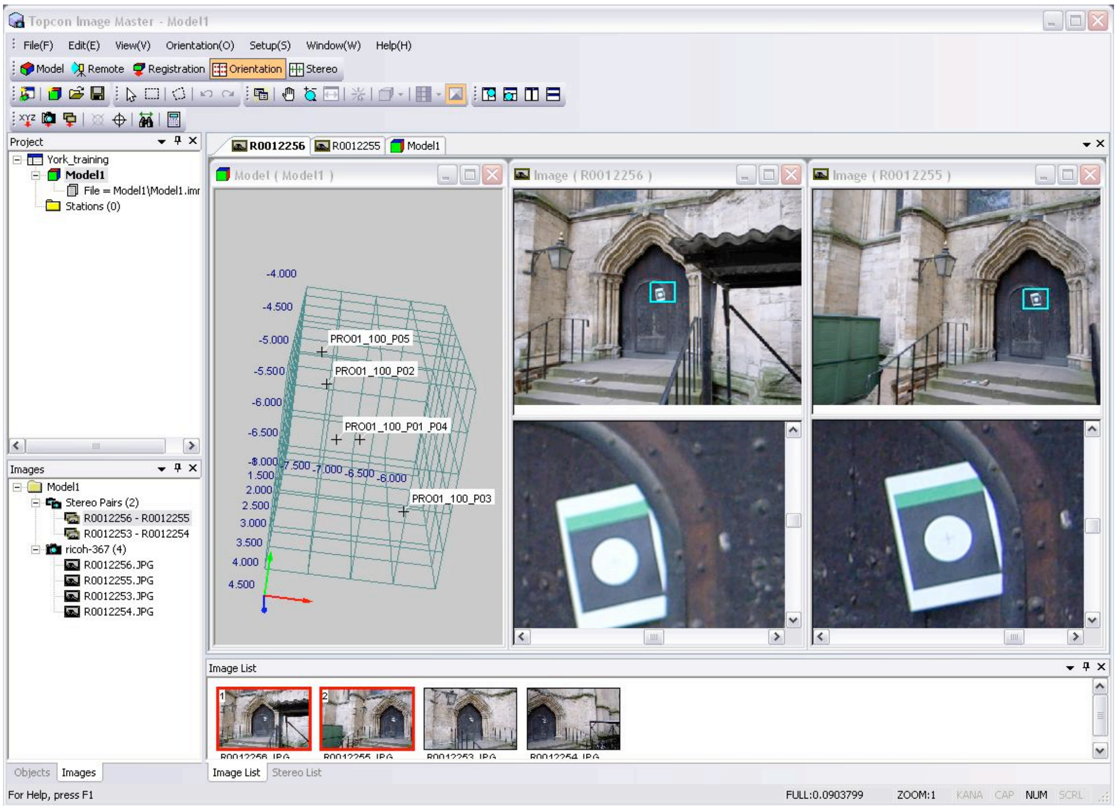
18. We now move on to picking control (tie) points on the first pair of images. With the orientation mode still selected, double click on the first stereo pair in the image tree.

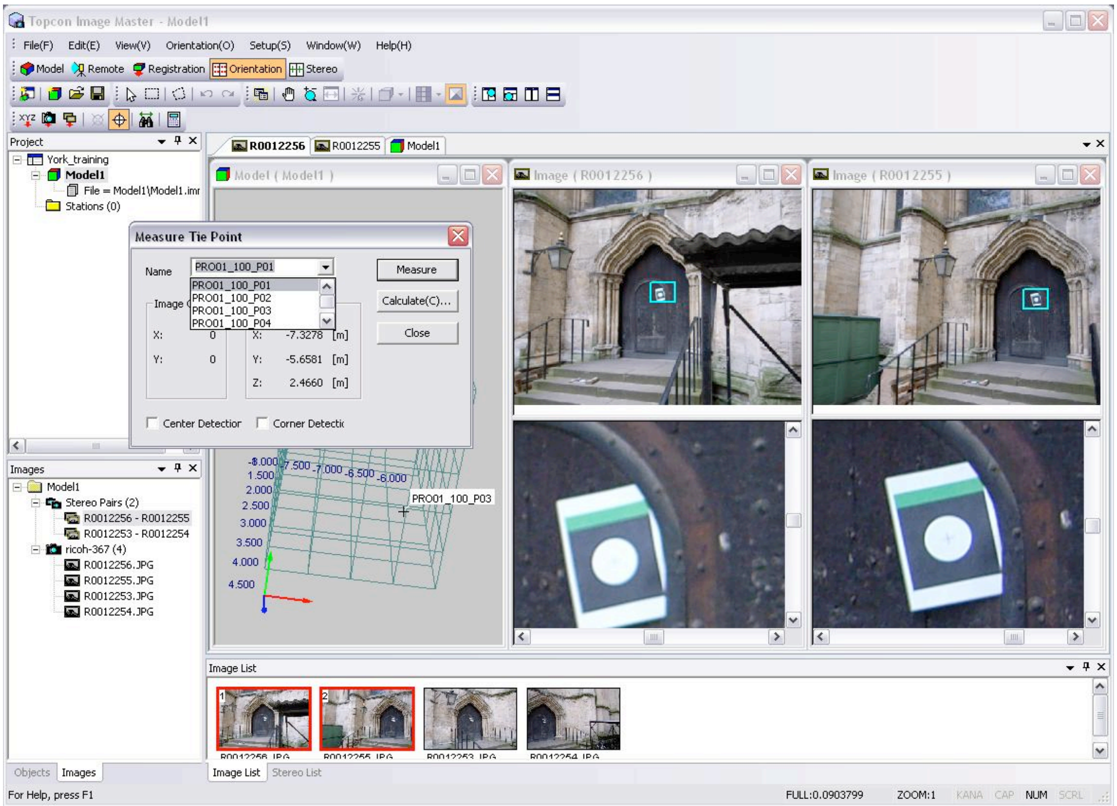


19. The two images from the first stereo pair are displayed as a wide view in the upper window and a zoomed in view in the lower window. The zoomed-in view can be changed by clicking anywhere on the upper window of the image display.

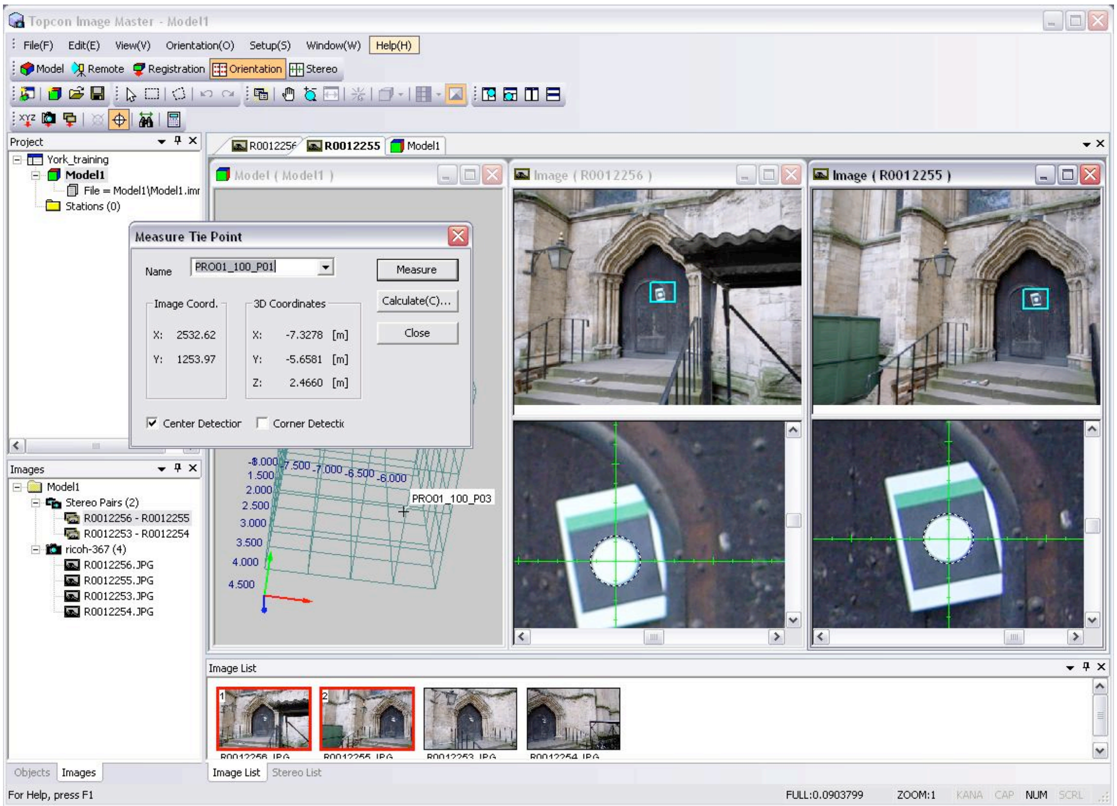


20. Move the zoom window on each pair of images onto the circular target in the centre of the door.





21. To enable the "Measure Tie Point" dialogue, either click Orientation >> Measure Tie Point on the upper menu, or right click on the zoom window. The pulldown menu on the measure tie point dialogue is filled with the names of the control points imported from the .csv.



In the training dataset, the circular target is called PR001_100_P01. By selecting this point from the Name pulldown menu the xyz coordinates of this control point are displayed.

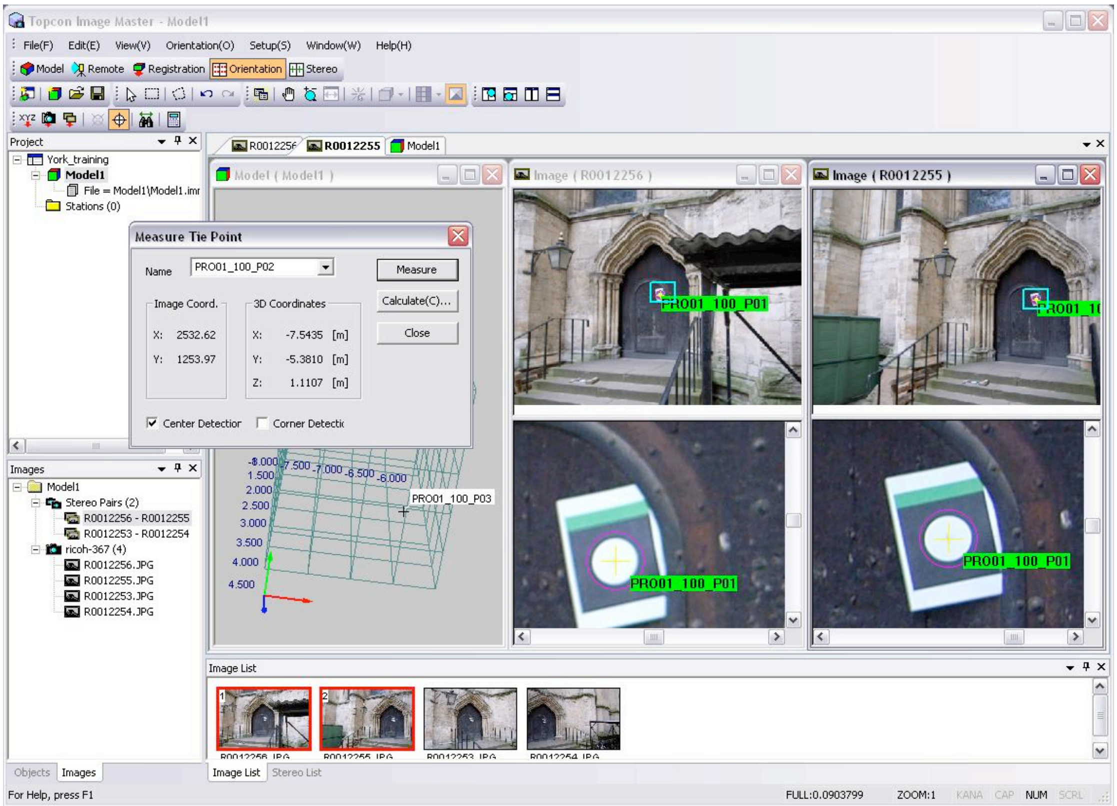
NOTE: IF NO SURVEY CONTROL IS AVAILABLE, MAKE UP A SYSTEM OF ARBITRARY CONTROL POINT NAMES. THE SOFTWARE AUTOMATICALLY INCREMENTS THE NUMBER E.G. A, A1, A2, A3 ETC.

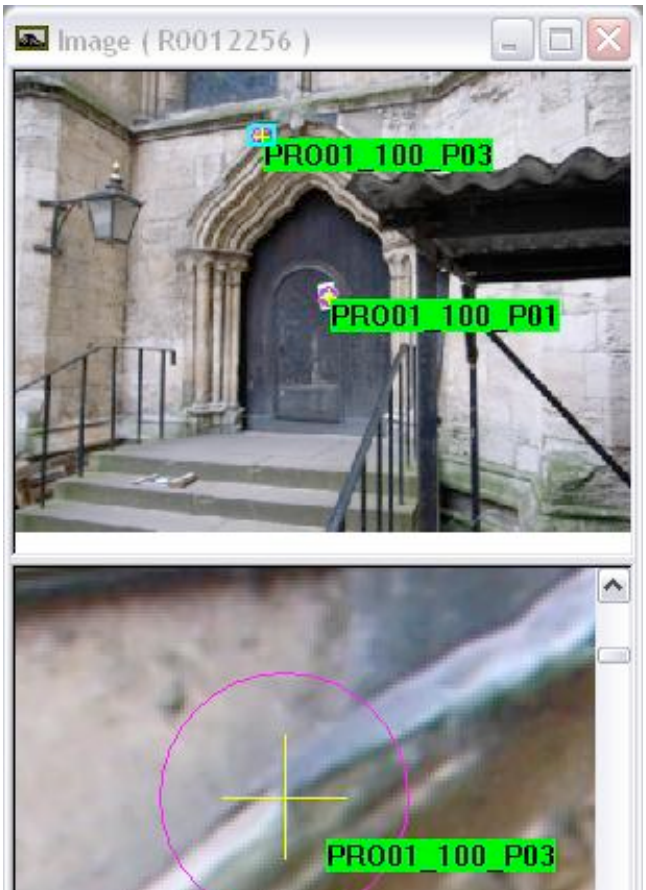
22. The fastest and by far the most accurate way to pick control points is using the Center Detection method which is why it is recommended to use as many targets as possible when taking the photographs.

Click the Center Detection box on the Measure Tie Point dialogue and then click anywhere on the centre circle of the targets. If centre detection is successful, a dotted circle and green crosshair will focus on the centre of the target as per the image above.

23. When satisfied that the correct control points have been selected click the MEASURE button on the Measure Tie Point dialogue. This will register the tie point on the image and display its ID in green.

A pink circle around the yellow cross denotes the fact that the tie point has geographical coordinates.

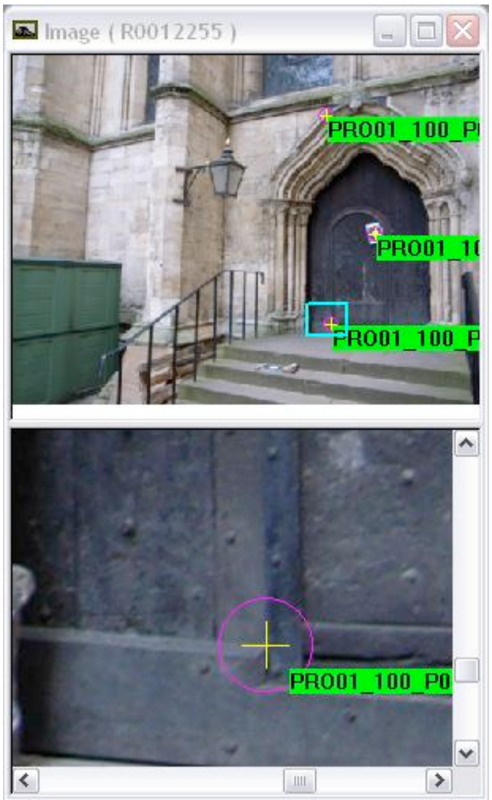




24. Repeat the above step for two more coordinated control points. To help with naming and locating them, use the images taking care to use the same control point nomenclature.

Uncheck the Centre Detection box for control point PR001_100_P03 (the corner of the lead flashing). Here we introduce another useful tool - pixel matching, that can greatly speed up tie point identification.

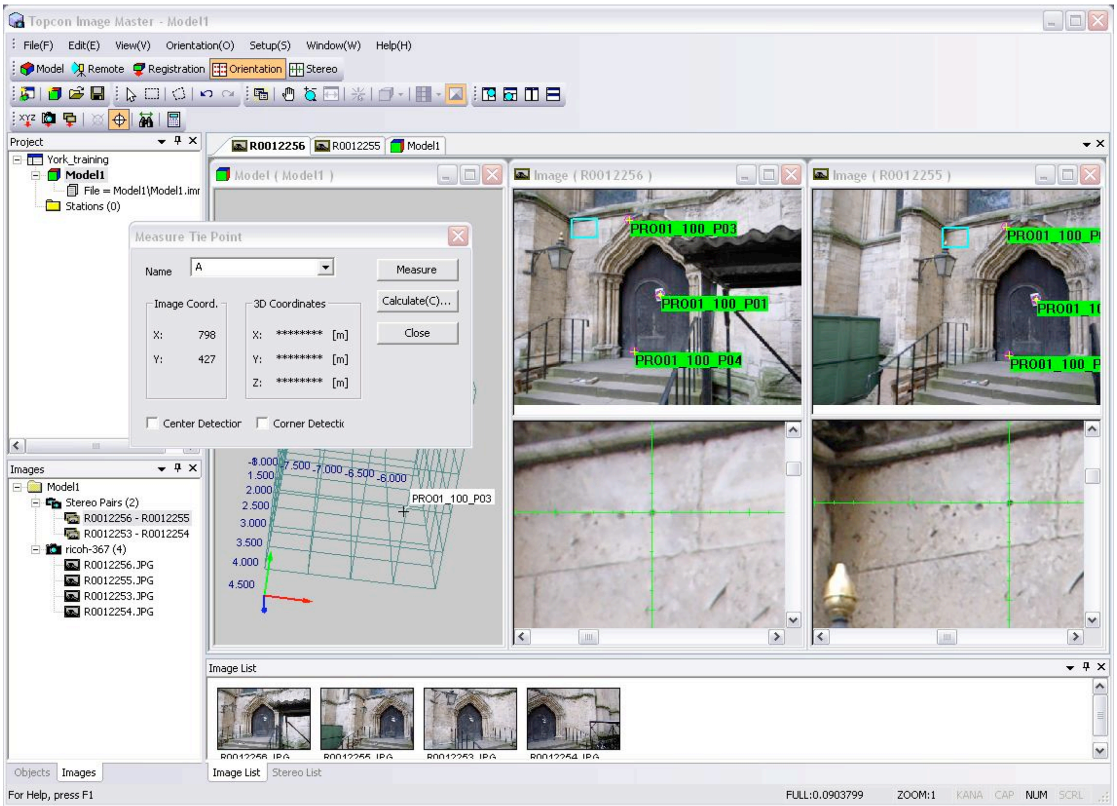
Use the zoom (magnifying glass) icon on the top menu, find a comfortable magnification level for the left and right images. On the left image, click as accurately as possible on the control point.



Assuming you have the same area of the survey scene visible in the detail zoome windows, either click the mouse centre scroll button OR click the binocular icon to initiate a least-squares pixel correlation that should automatically identify the control point on the right image. Click <Measure>

NOTE: the image correlation is not foolproof so always check that the correct point is selected. If it fails (usually for reasons of poor contrast or lack of texture) it is possible to manually pick "by eye" the tie points.

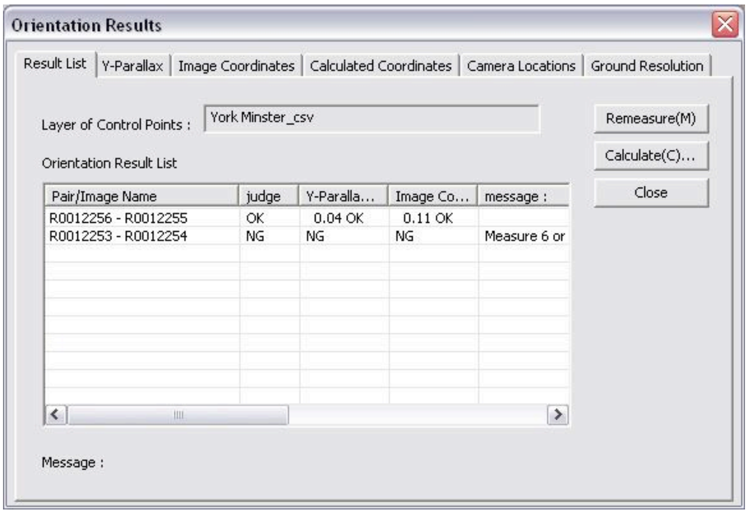
25. Repeat the above step for control point PR001_100_P04 as shown (left) on the corner of the door frame. We now have the required minimum of three coordinated tie points per pair of images. Imagemaster requires a minimum number of tie points per pair (i.e. coordinated and arbitary) of 6.



26. Use the zoom / pan tools to find distinct marks that can be used as arbitrary tie points. We could of course have used more circular targets that would make the process much faster. Give the new tie point a unique name and remember that you cannot use the same tie point name in another pair of images, unless it is the same target!

NOTE: BY DEFAULT IMAGEMASTER CREATES THE STEREO PAIR USING THE RANGE OF THE TIE POINTS. IT IS THEREFORE IMPORTANT TO HAVE A GOOD SPREAD OF TIE POINTS OVER THE REGION OF THE SCENE TO BE MAPPED IN ORDER TO AVOID CROPPING AT THE STEREO IMAGE CREATION STAGE

27. Once the tie points have all been measured, click CALCULATE on the Measure  Tie Point dialogue. This will initiate bundle adjustment and display a the result shown below.

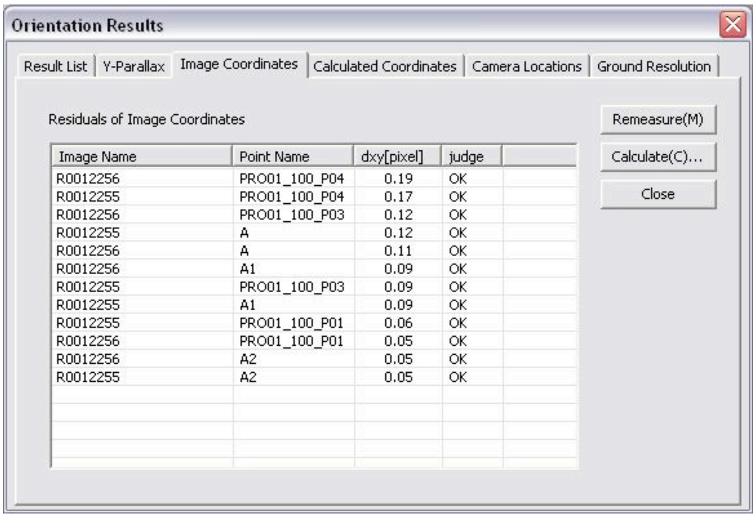


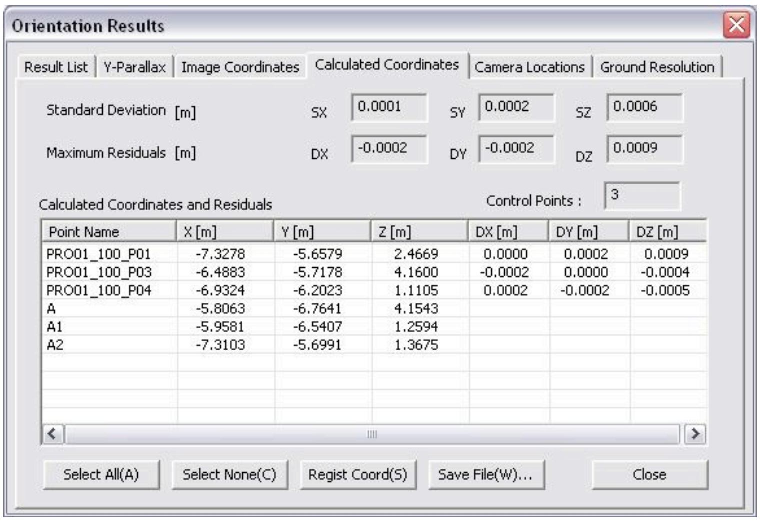
An "OK" in the judge column means that the calculation was successful. The result in the Y-Parallax and Image Coordinates column should be LESS THAN 1 (pixel) and also flagged OK.

If a result >1, or flag NG is displayed, there is a likely error in tie point picking, tie point naming, or the coordinate file of the coordinated tie points.

The Second pair of images in the list has a Judge:NG and the "Message" column gives the reason (specifically 6 or more tie points are needed and this pair has 0 points).

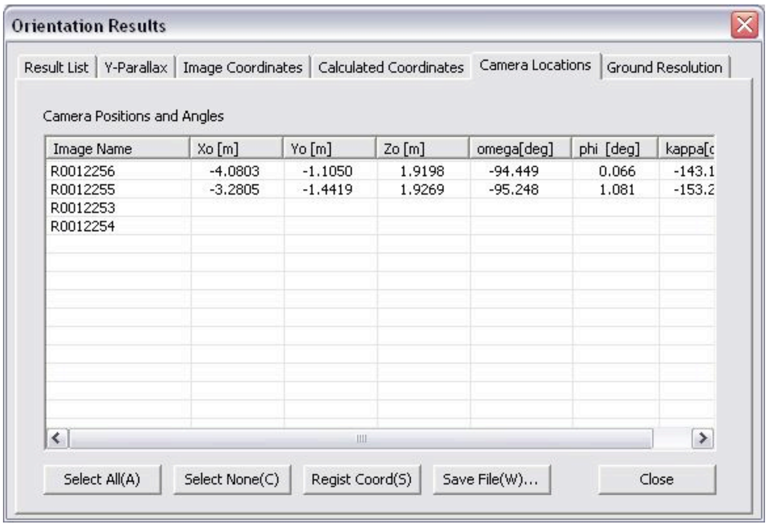
29. The Image Coordinates tab lists the tie points in order of increasing accuracy together with the Judge result. This is a useful place for diagnosing spurious control points. There is a facility for clicking on a bad tie point and clicking the REMEASURE to go directly to the image for fine tuning.

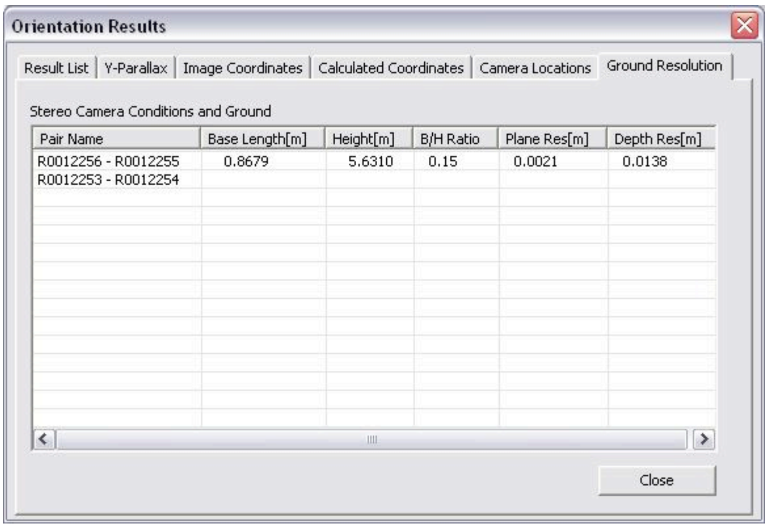




30. The Calculated Coordinates tab displays the true 3D coordinates of all the tie points created so far. Some residual information is available for quantifying the accuracy of the model, together with the error margins on tie points that have measured coordinates from a total station or GPS (i.e. the points imported in the .csv file having names PRO01...)

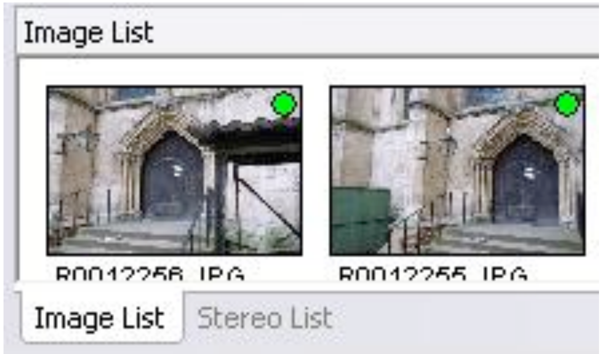
31. The Camera Locations tab lists the solved 3D coordinates (and rotation) of each camera position occupied to take each of the raw photographs.



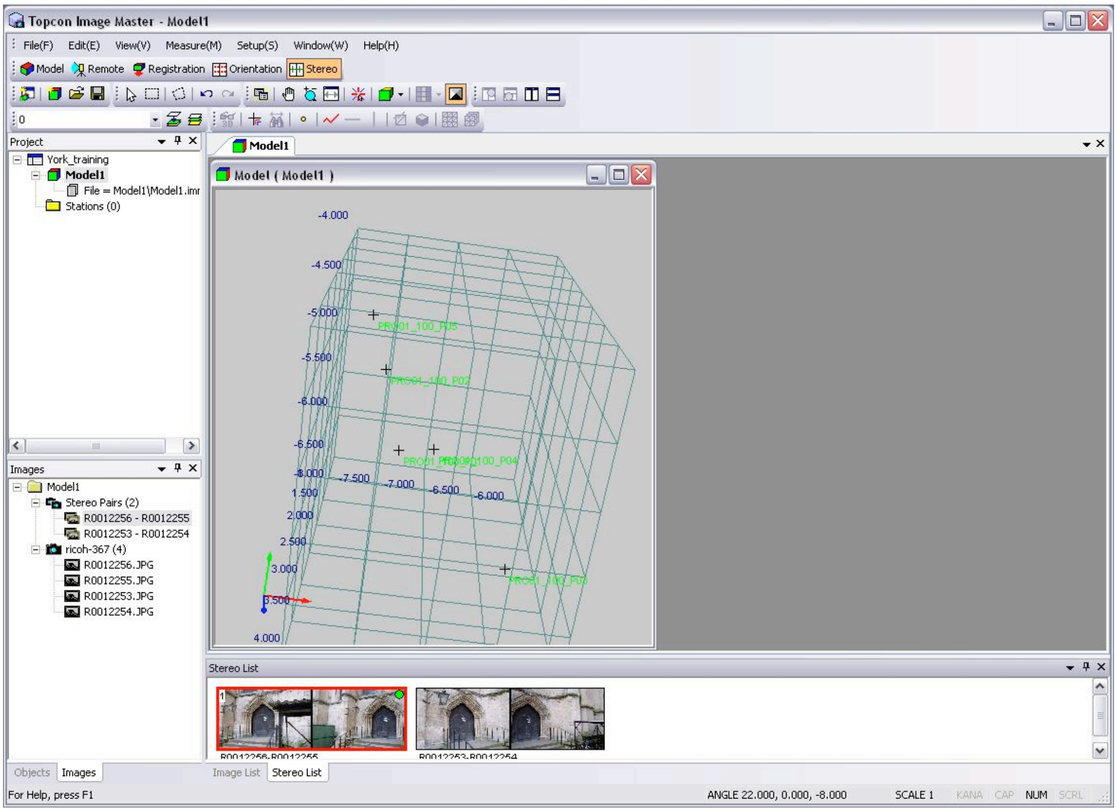


32.The Ground Resolution tab lists the base to height ratio for each pair of images. We are aiming for a B/H ratio of 0.1-0.4 as described in the field acquisition guide.

33. Once a pair of images has undergone successful orientation calculation, a green circle appears in the top right. Less than perfect results may result in an amber or red circle which can be useful for diagnosing bad pairs when several are present in a project.



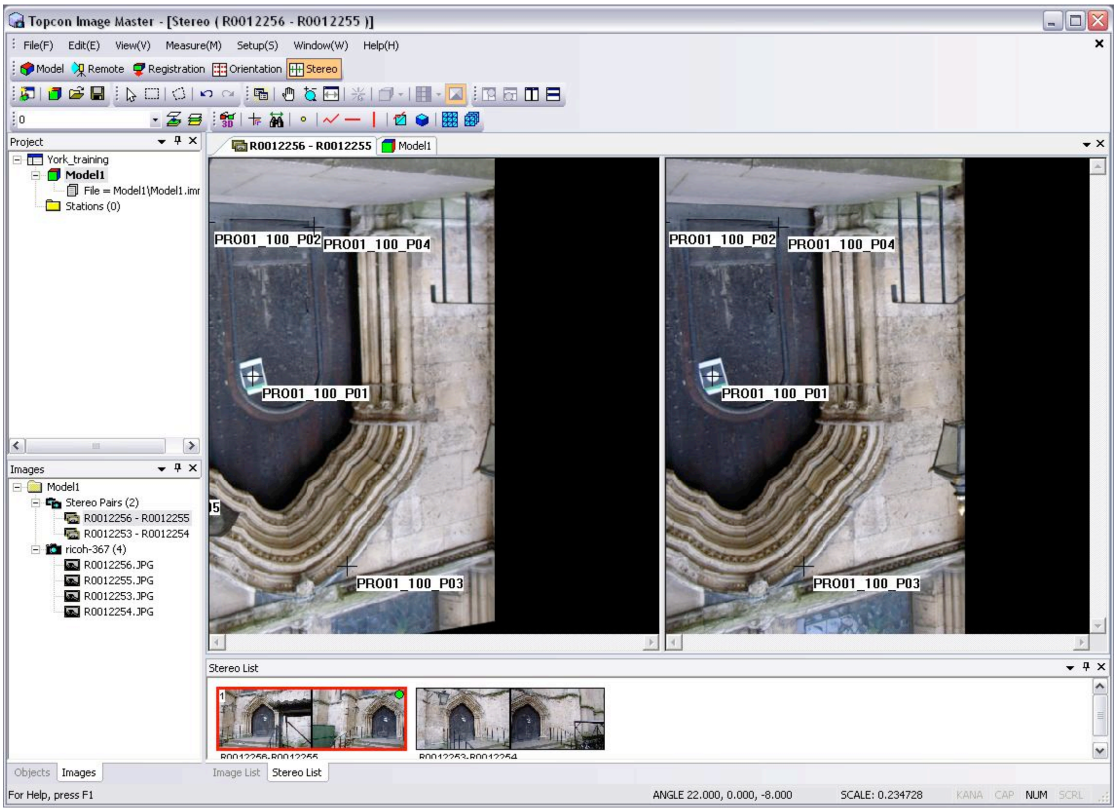
34. The next stage is to create the stereo image from the pair of raw photographs that have just undergone successful orientation. Click the STEREO button on the top menu and the lower horizontal thumbails will change to display the stereo pairs (below). Double click the first stereo pair with the green circle on it.



35. The result of the transformation to stereo image is displayed after a short wait for the calculation. Here we may see a very common error! The images are inverted because the left and right images were assigned in the wrong order during registration of raw images as stereo pairs back in step 13.

Luckily fixing this is trivial. A feature of Imagemaster that is useful to remember is that every time a tie point is measured, a file called <*imagename.imc> is appended to. In other words, each image in the project "remembers" its tie point names and pixel coordinates so we don't have to repeat all the previous steps.

To rectify the error, do the following:



- highlight the offending stereo pair on the left hand tree and press the delete key.

- click the Orientation button to display the raw image thumbnails along the bottom and repeat step 13 and 14 above, but this time with the correct order of images running from left to right.

- having done this, click the Orientation button and then select the re-assigned stereo pair of images. They should load complete with the tie points.

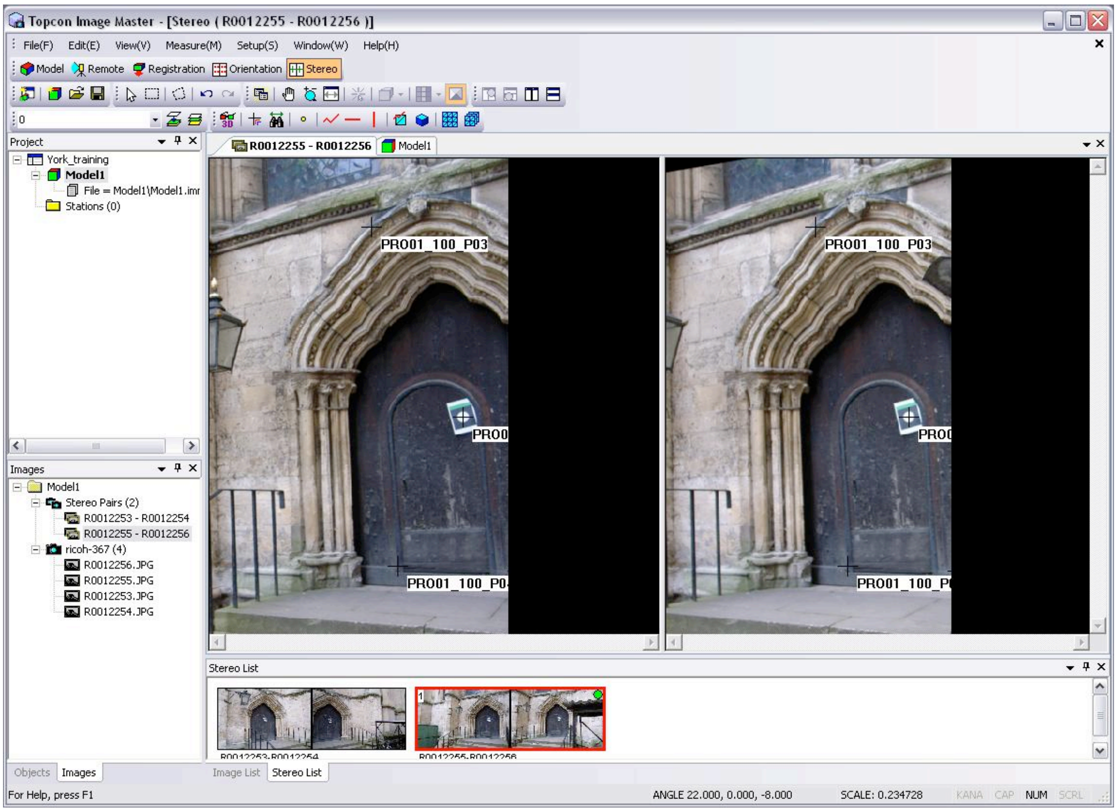
- because the structure of the project has changed, it is necessary to redo the bundle adjustment by clicking the calculator icon.

- now repeat step 34 and the stereo pair should be displayed the correct way up after transformation.

36. The stereo screen shows the pair of images with all elements of parallax and lens distortion removed. The image has been cropped to within the range of the tie points and each pixel now has a true 3D xyz coordinate. The three tie points with coordinates from the total station are displayed with a black cross and their corresponding name. A useful check of the survey accuracy thus far is to zoom in on the tie points and visually confirm that they are in the correct place.

Any deviation identified in the tie point position is either a function of poor accuracy during measurement in the field, or low accuracy or poor selection of tie points. This can often be remedied by inserting additional arbitrary tie points remembering to have a good spatial distribution.

The zoom and pan tools can be used to navigate around the stereo image.

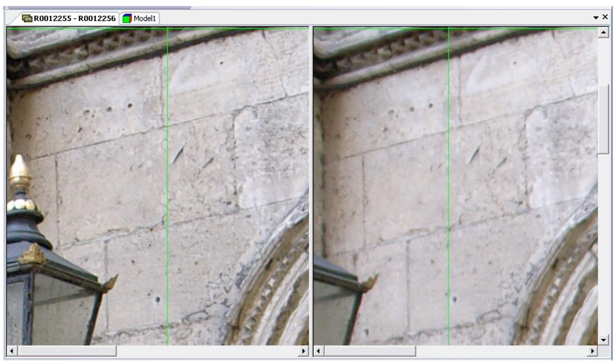


37. We are now at a stage that is analogous to measuring our target in the field where we choose to survey xyz points either discretely or as a dense surface mesh, define linework as vectors or simply add points.

The following stages will cover digitizing vector polylines and defining a polygonal area inside which a 3D DSM (surface mesh) will be automatically generated.

38. To start with, the aim is to draw a simple polyline around some of the stone blocks in the wall. Zoom into the desired area and use the pan tool on the right image so that the same portion is visible in both the left and the right of the stereo pair.

Imagemaster Pro has a layer tool much like any GIS or CAD applications and it is good practice to assign different types of polyline or surface onto their own layers.



Click the layer icon and add a new layer by selecting NEW. Once you have given it a name and chosen some attributes for the layer, click OK. The new layer (here called blockwork) becomes the current layer.

To draw a polygon on this layer, select the polyline icon. The process of digitising polylines is as follows:

- align the cursor for the LEFT image at the position on the photograph where you wish to begin the polyline.

- using the mouse centre scroll wheel, control the position of the crosshair cursor on the RIGHT image until it is approximately in the same position as on the left image.

- Imagemaster pro has a useful tool to greatly increase the accuracy of this process. Pressing the SPACE bar on your keyboard enables a pixel-correlator that uses image matching to "snap" the right cursor to the same position as the left crosshair cursor. The correlator status is shown by a circle around the centre of the left crosshair. If it is red then NO MATCH is achieved, however when it is GREEN then Imagemaster estimates that it has a good match.

TIP: if the correlator cursor is red when it is first enabled, try moving the mouse slightly and it should quickly change to Green. As with the image orientation tie point auto-picking, take care to ensure that the software has correctly chosen the correct part of the image on the left and right. In areas of poor texture or low contrast (light or dark) it may fail, requiring manual control using the centre scroll wheel of the mouse.

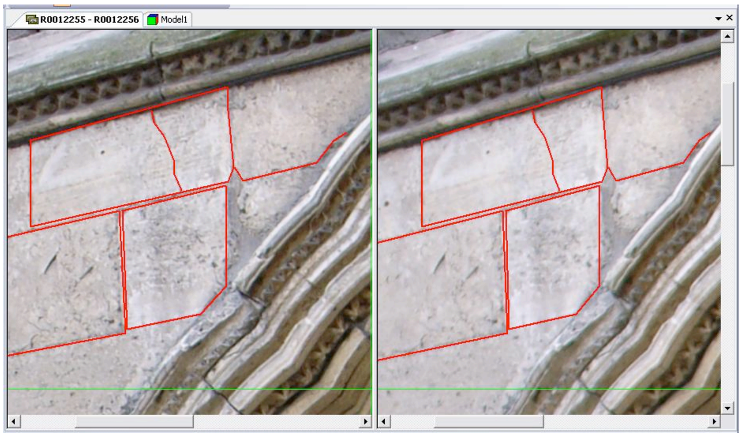
This video clip shows the process of polyline creation.

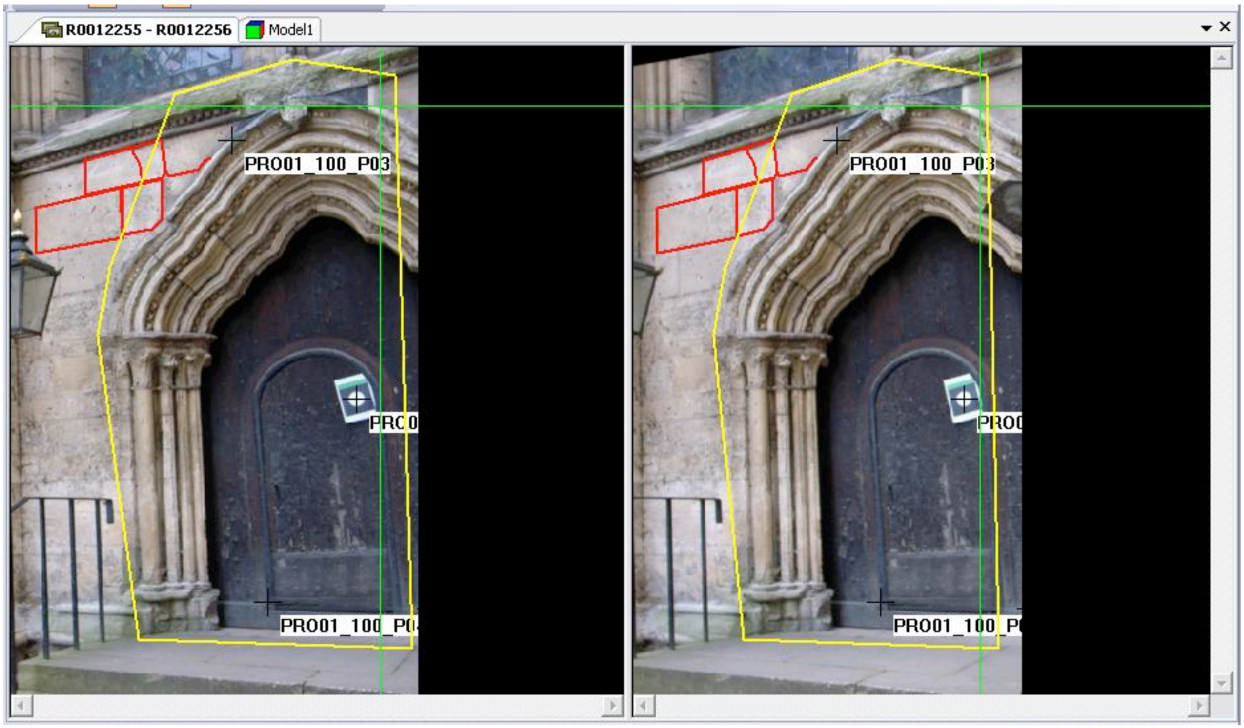
Repeat this process for some more blocks to get the feel of the tool. The "Polyline Measurement" dialogue box has a snap setting which can simplify digitising by snapping to the side or vertex of an adjacent polyline.

TIP: Snap to POINT is useful particularly if a coordinated tie point is on a significant part of the survey target such as along a roof apex, building or window corner etc.).

At the penultimate polyline node it is recommended to press C to (C)lose a polygon. If the vector being digitised does not end (such as a crack in a wall), digitising is completed by pressing the O key for (O)pen

39. Once some polyline vectors have been created, it is possible to view them in the model screen to check for accuracy.
Click the MODEL button to enter the 3D model screen. Manipulate the space using the right mouse button, centre scroll wheel and pan tool to view the vectorised blockwork on the wall.



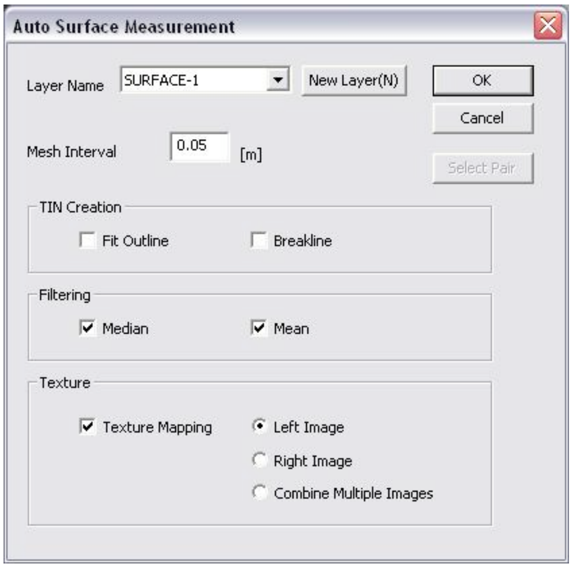


40. The next stage is to define a polygonal area inside which a 3D automated DSM will be created (yellow polyline above).

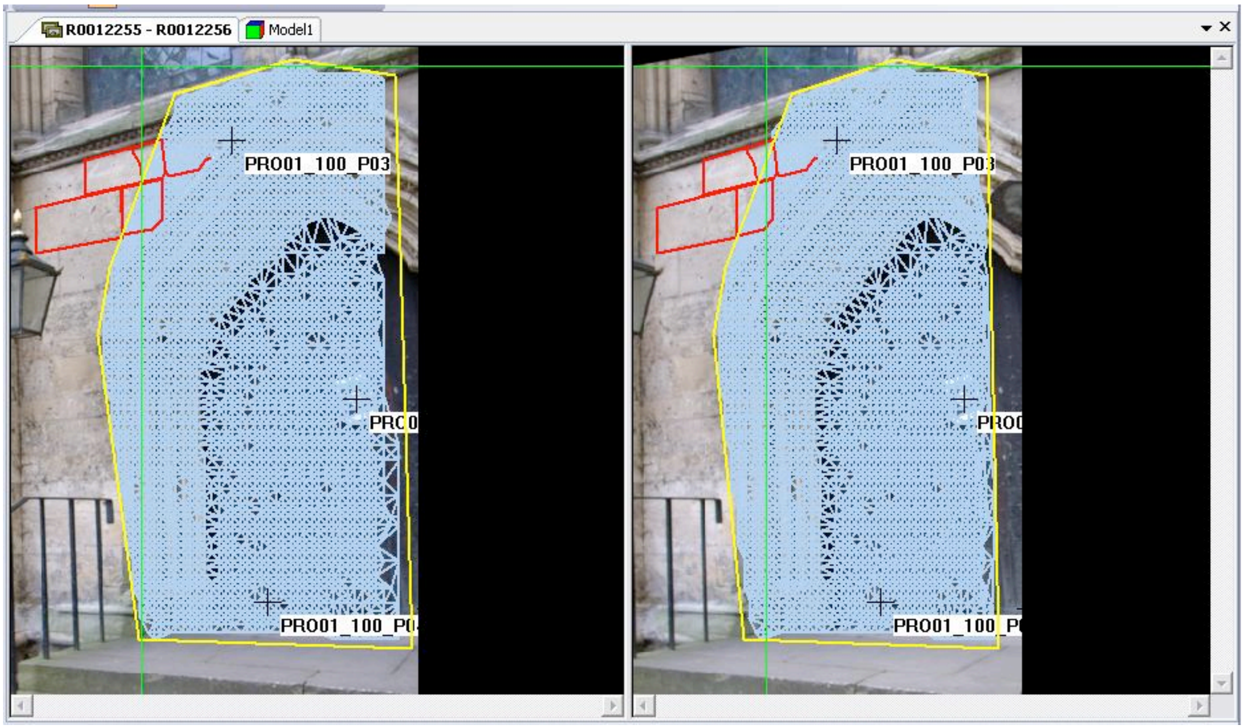
Zoom to the image extents using the <-> icon and define a polygon around a region of interest remembering to (C)lose it when finished. It is good practice to create a new layer for this polygon.

41. Before creating a DSM the bounding closed polygon needs to be selected. Click the select tool and click the polygon. Next click the DSM auto-surface tool icon (blue triangles).

This dialogue enables the various parameters for surface creation to be set. Create a New Layer by clicking the button and copy the settings shown below. Click OK to begin surface creation (this example will create a mesh of points every 5cm).

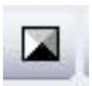


42. Once the DSM is calculated, the TIN is overlaid on the stereo image. A triangulated irregular network (TIN) is a digital data structure used in a geographic information system (GIS) for the representation of a surface. A TIN is a vector based representation of the physical land surface or sea bottom, made up of irregularly distributed nodes and lines with three dimensional coordinates (x,y, and z) that are arranged in a network of nonoverlapping triangles.



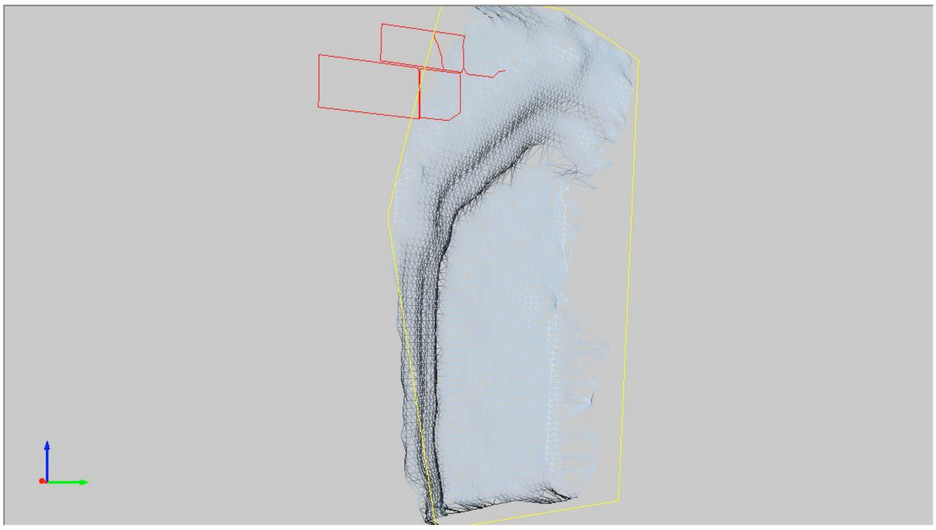
43. To view the photo-rendered surface model in 3D, click the MODEL button

TIP: The viewing area can be maximised by clicking the "map pins" on the vertical and horizontal screen areas. The view can be simplified by turning off various features such as the grid and point names by clicking VIEW > DISPLAYED ITEMS.

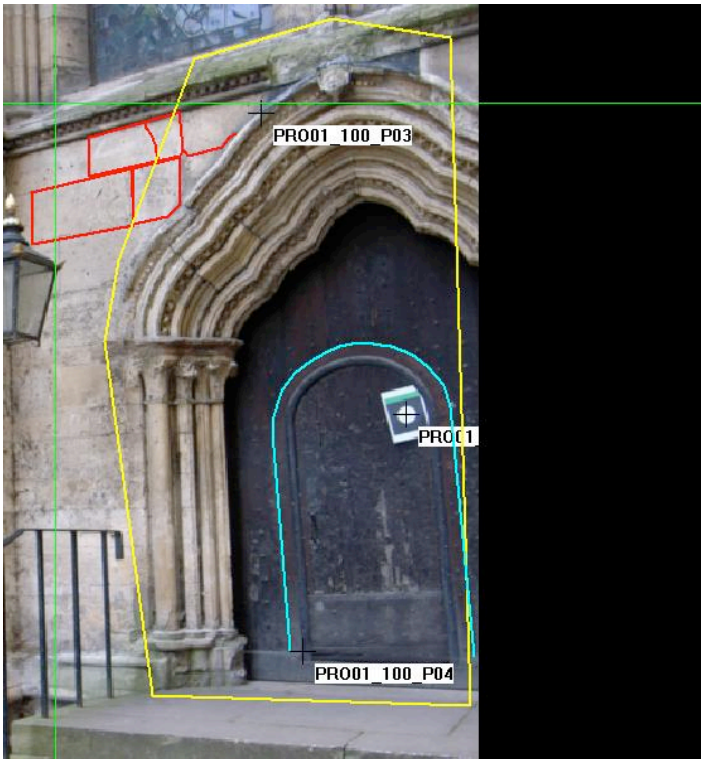


44. Clicking the texture icon turns off the photo rendering and displays the underlying TIN surface. This is useful for diagnosing errors (usually caused by mis-matched polyline nodes when digitising on the stereo screen).

At this stage spurious "blunders" in the TIN creation can be easily seen. In this instance the TIN appears to step out from the door of the building causing distortion of the arch feature inside the door. This can be avoided at the stage of digitising the polyline by observing the rule of placing a polygon node or vertex at a change in 3D relief (such as going from the stone arch to the door, and at the foot of the door onto the stone step).



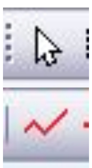
45. Another way of fine tuning the 3D surface is through the insertion of BREAKLINES. Breaklines are any vector inside the 3D surface polygon and is used during the DSM creation to terminate triangles.



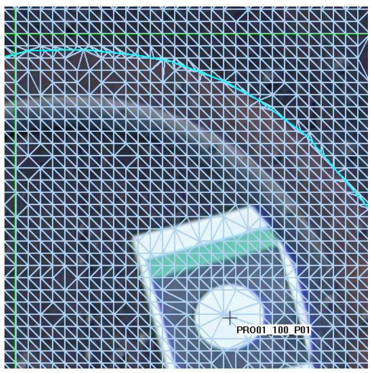
Go back to the stereo screen and go to the layer control to disable the layer containing the TIN. Alternatively the TIN can be disabled by going to VIEW > DISPLAYED ITEMS and un-checking TIN.

Zoom in on the inner arched door and draw an open polyline around the edge of this feature.

TIPS WHILE DIGITISING: the M and Z keyboard keys greatly speed up digitising for rapid switching of the pan and zoom tools. If a polygon node is clicked in the wrong place, or the auto-correlator makes an error, right clicking steps back to the previous polygon node.



Re-editing a polygon is possible by clicking the select icon, clicking the polyline to be re-edited and then clicking the polyline tool. Imagemaster will ask if you wish to continue editing the selected polyline.



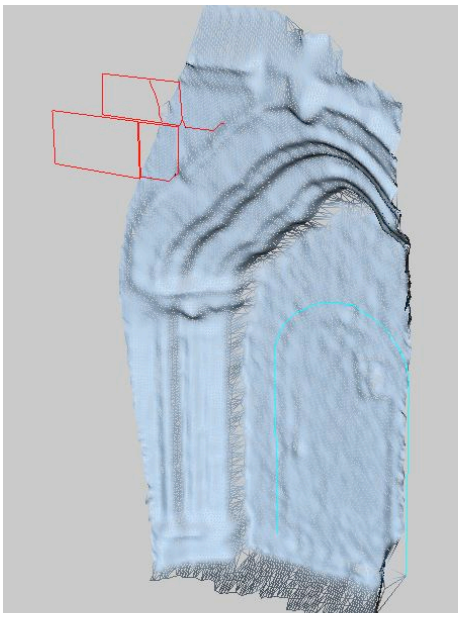
46. At this stage we will remake the TIN inside the yellow polyline around the door and use the blue polyline as a breakline. <note that breaklines can be exported as .DXF vectors, therefore can represent an important part of the construction of a survey.>

Repeat step 41 above, but this time tick the Breakline box and also increase the density of the DSM mesh to 2cm.

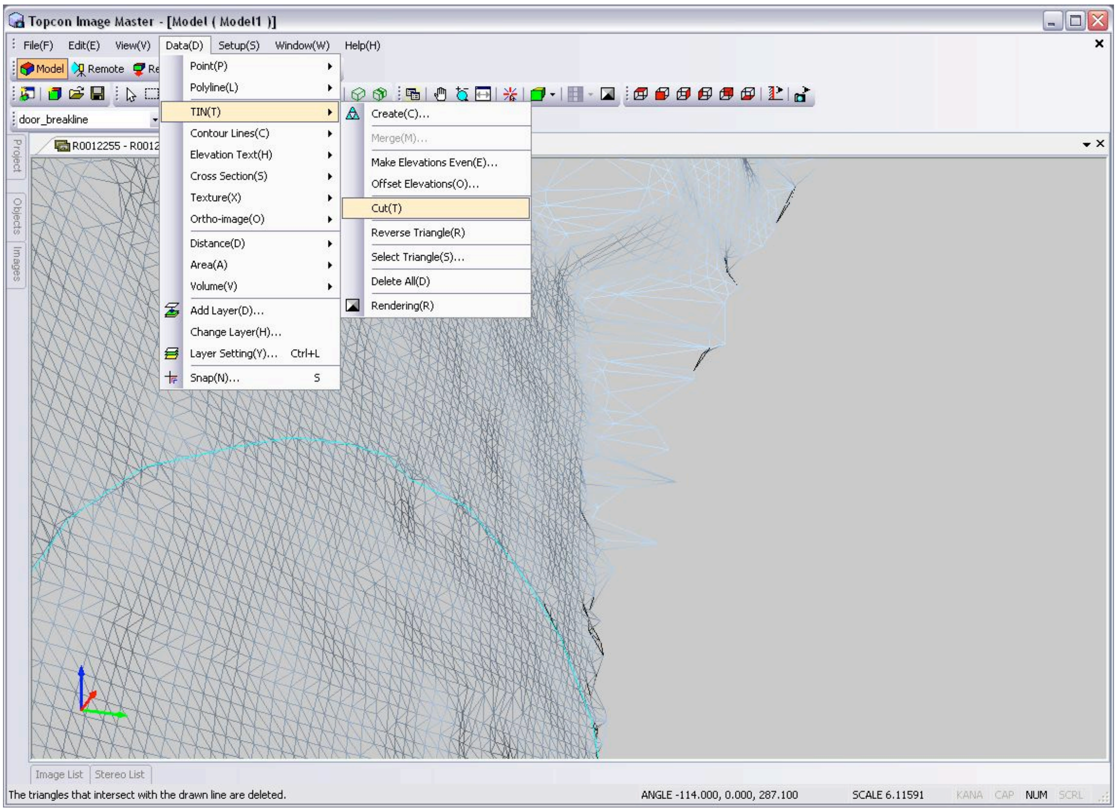
Note that the same layer as the original TIN has been selected - in this instance layer SURFACE-1 will be updated.

The image above right shows the effect of breaklines on the TIN

47. Return to the MODEL screen to view the new model in higher resolution with a more accurate TIN surface.



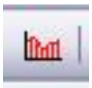
48. It is possible using the DATA > TIN > CUT tool to remove spurious triangles from the TIN. This is also possible using the select tool to choose a triangle and DELETE.



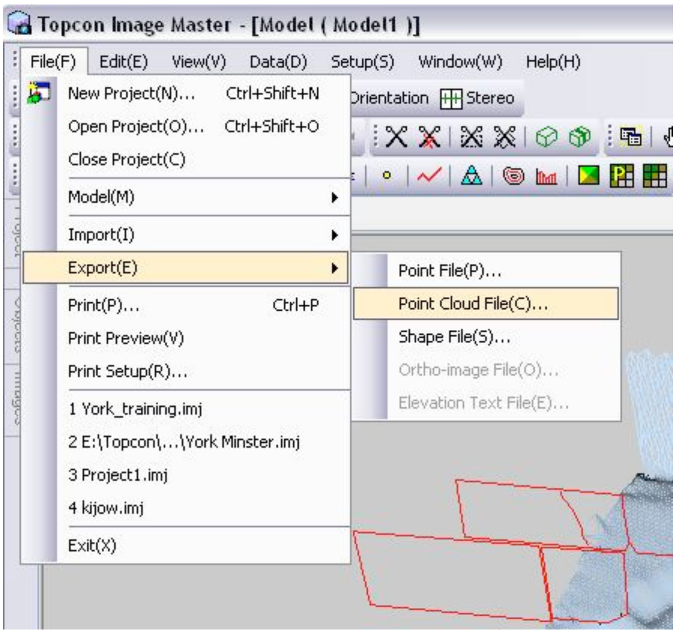
49. The 3D model can be interrogated in several ways:

- click the Data(D) menu item and choose to measure DISTANCES, VOLUME or AREA of a surface

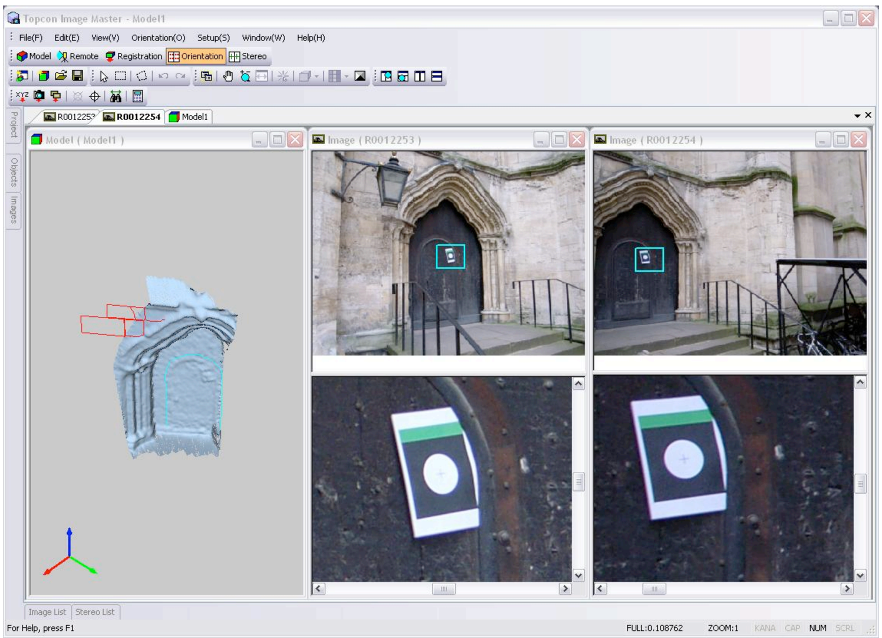
-  click the Contour icon to contour the 3D surface

 click the cross section icon to draw a cross section of through part of the DSM

50. We have completed the process from orientation of the raw images through to creation of a 3D surface. It is possible to export data at this stage in several formats found under the FILE > EXPORT options.



51. The next stage is to learn how to tie together more than one pair of images. In this instance another pair of photographs was acquired to fill in the missing data on the door that could not be seen from the location of the first pair.



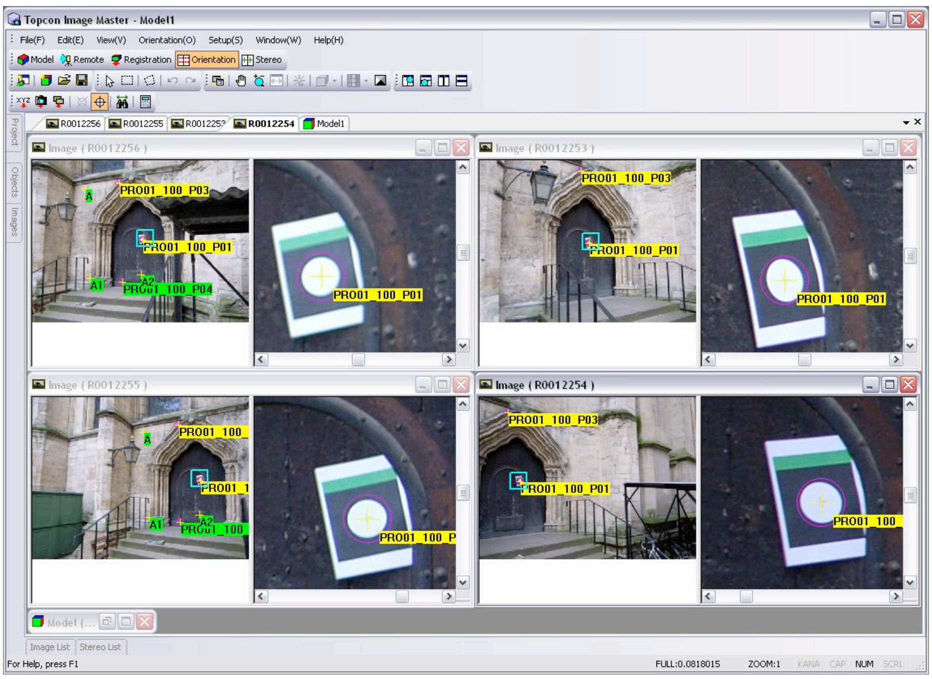
Click the ORIENTATION button and click the mouse over the Images tab on the far left hand side of the Imagemaster Pro window. Double click the second pair of images (R0012253_R0012254) which will then be displayed with their wide and zoomed views.w

52. Right click and choose Measure Tie Point. It is now possible to identify some of the tie points that were used in the first pair of photographs. Imagemaster Pro needs a minimum of three COMMON tie points between adjecent pairs of images in order to tie them together.

It is possible to use control points PRO01_100_PO3 and PRO01_100_PO1, however the third point at the foot of the door is masked by the railings. In this instance it is required to choose a NEW tie point that is common in ALL four images (of the first two pairs).

53. The recommended and fastest way of doing this is to open FOUR images at once and use the tie point pixel matching tool. Opening four images is achieved by closing the open images by clicking the red X (and saying "YES" to save the image coordinates).

Click the Image List tab on the lower left and whilst holding down the CTRL button highlight all four images that require linking. One all four images are selected (the order is not important), right click and choose OPEN IMAGES.



54. With four images open, the common tie points between all four is colour coded in yellow (green signifies common points between one pair).

55. Identify a common feature on all four images using the zoom and pan tools. Click the feature on any one of the images and then use the centre mouse button (or binocular icon) to initiate automatic pixel matching of the point in the remaining three images. Click MEASURE if this process is successful.

56. Now there are the minimum of three tie points linking the first and second pairs of images, close down the first two and resume measurement of the remaining three (to give the minimum of 6 per pair) tie points using arbitrary features.

57. Click the CALCULATE button or the calculator icon to initialise bundle calculation. A satisfactory result similar to below should be displayed. Any Y-parallax or Image Coordinate errors >1 should be remedied by clicking the Image Coordinates tab and resolving any bad tie points.

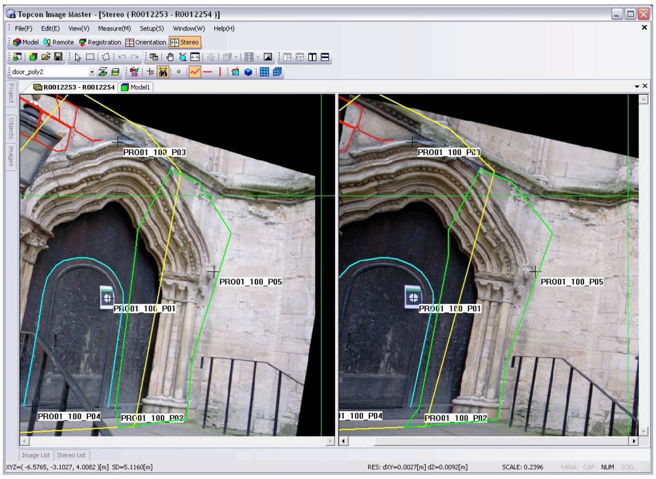
58. Because additional tie points have been added to the original stereo pair from the first two images, it is necessary to re-make the stereo images. Clicking the STEREO button and the Stereo List tab at the lower left of the Imagemaster window and then choosing a stereo pair will initiate transformation / creation of the stereo pair.

TIP: Imagemaster Pro has a facility to create ALL stereo images once orientation has been carried out. To do this, click FILE > CREATE ALL STEREO IMAGES with the STEREO mode button enabled.

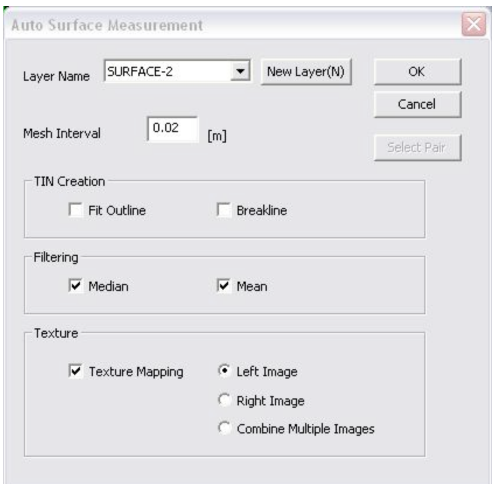
NOTE: BECAUSE THE COORDINATES OF PAIRS OF IMAGES MAY CHANGE SLIGHTLY WHEN ADDITIONAL TIE POINTS ARE ADDED (SUCH AS IN STEP 53 ABOVE), THE RECOMMENDED WORKFLOW IS TO CARRY OUT ORIENTATION OF ALL IMAGE PAIRS, CREATE STEREO PAIRS AND THEN DIGITISATION OF POLYLINES / CREATION OF SURFACES.

59. Once all the stereo images are created, it is possible to switch between pairs using the PAGE UP / PAGE DOWN keyboard buttons. Note that because the stereo images now have true coordinates and they are linked together, polylines and TINS may appear on overlapping parts of adjacent pairs (see video clip).

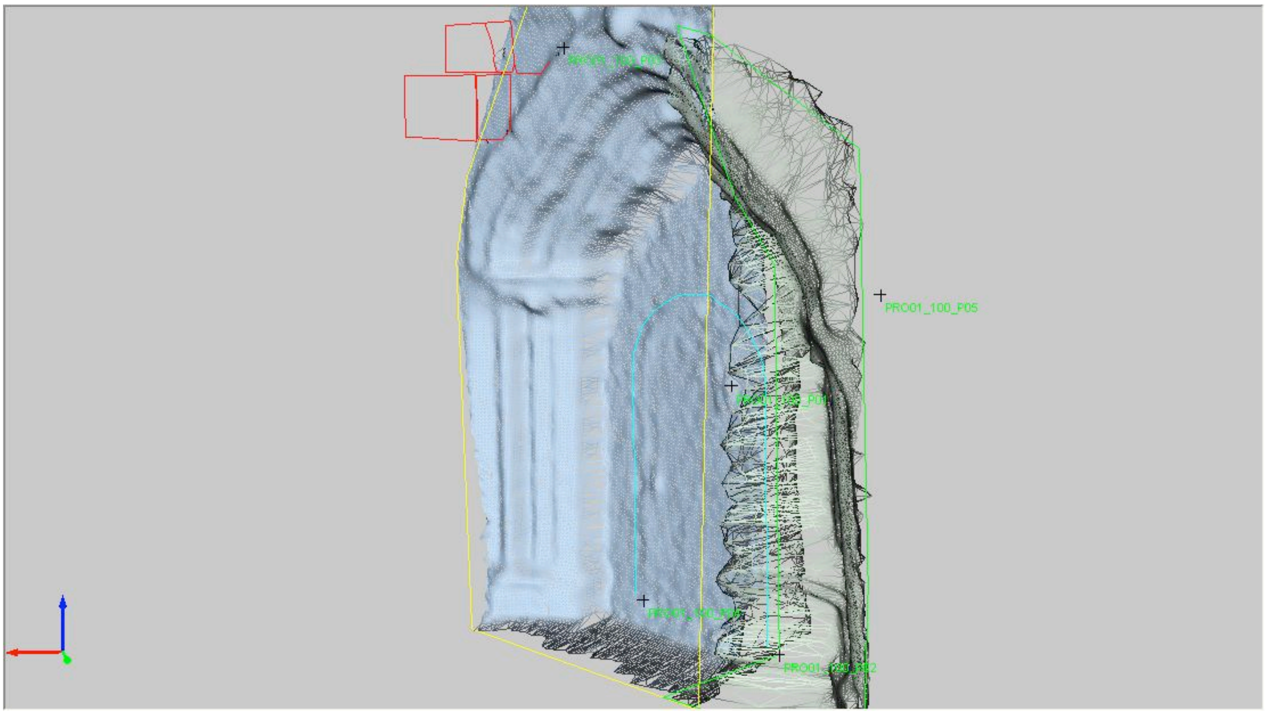
60. Ensuring that the second pair of stereo images is displayed, repeat step 40 and draw a polyline around the remaining part of the arched doorway that has not been surface mapped in 3D. It is advisable to overlap the polyline / TIN between adjacent pairs. The new polyline is shown below in green.



61. Create another 3D surface using the auto-surface measurement tool, copying the settings on the dialogue below.



62. Once the TIN is created, switch to the model screen. It is evident that there is a problem in that the polyline from the first pair has influenced TIN creation. It appears to be influenced by the position in space of the other polyline from the first pair. This of course could be avoided if the yellow polyline was flat with the door surface (as recommended above), however the TIN can be created without this problem by turning OFF the layer holding the yellow polyline.(Hence the recommendation to exercise good layer management).



NOTE: The above case of TINS being influenced by nearby polygons that are not breaklines also applies to polylines in a different plane BEHIND the surface being 3D modeled. The way around this is again to switch off the layer containing a polyline that may be having an influence.

63. Experiment with the various tools for displaying different 3D views. Go to VIEW> ROTATE > PLAN VIEW etc.

Once an elevation view for example has been set, it is possible to genereate orthophotos for export as geo-referenced bitmaps (DATA > ORTHOIMAGE> CREATE).

Data clipping tools enable the area of interest to be fine tuned and the focus tool enables model rotation about a given 3D point.

SAVE YOUR PROJECT AND EXIT