

Transformation to Control Procedure for iWitness

This tip sheet was prepared for users with a basic knowledge of the iWitness™ close-range photogrammetry software system

The purpose of this tip sheet is to provide the basic understanding of the **Transformation to Control** dialog box within iWitness. For the sake of brevity, only the "3D transformation to control" feature is discussed in this tip sheet. For 1D (block shift) and 2D (transformation within an XY plane) see the iWitness User Manual.

Overview:

iWitness provides the user a method to "stitch" a series of multiple project images from different coordinate systems. This stitching capability is beneficial in order to 'break' sub-sets of images into manageable, smaller projects by keeping them all in the same coordinate reference system.

For example, if an accident reconstruction practitioner has acquired terrestrial-based images over a quarter mile in length, it is often easier to "break" the projects up into 500' to 600' length sub-projects and "stitch them together." This "stitching" is accomplished by using the *iWitness Transformation to Control* function along with measured *Control Points* (CP's). The CP's are simply four or more measured XYZ points that are observed in two or more iWitness networks. For our project example, we are simply using 4 traffic cones and DCS "cone-style Reference Point Markers" (RPMs) to illustrate the CP marking procedure. It should be noted the wider the CP's are separated in a 'real-world' project, the better. Further, the CP's do not have to necessarily be the cone-style RPMs as illustrated in the tip sheet, or spread coplanar, rather any natural feature in the images the user can accurately "cursor mark" in the images. An example might be a vehicle crash scene, perhaps marking the CP's on discrete features in the images, such as including the top of a streetlight standard or anything that is stationary during the picture taking process.

Procedure to use the iWitness Transformation to Control:

The assumption is the user has completed two networks (we will call them **Network1.iwp** and **Network2.iwp** for this tip sheet.)

Step 1: **Network1** has already been **scaled with the 3-2-1** (model rotation) within iWitness. **Network2** is also complete, but it does not require "scale" or "3-2-1" as the 3D transformation to control function will scale and rotate the Network2.iwp into the same coordinate reference system as Network1.iwp.

Step 2: The user **names the 4⁺ control points from Network1**. It is best to typically use six CP's, but for this tip sheet we only use four as the minimum amount for the least squares coordinate transformation. See Figure 1 for the named control points. The named points are **CP_9, CP_U, CP_V, CP_W**.

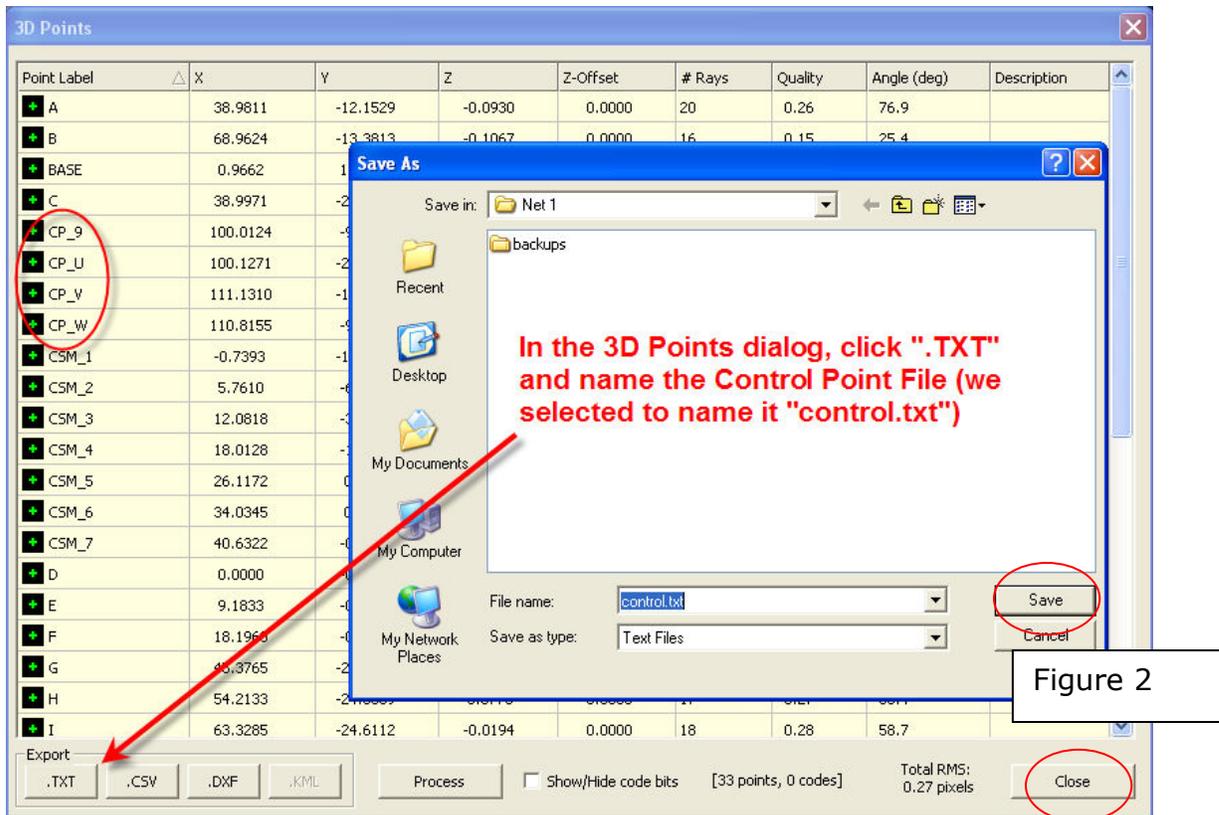


It should be noted the 4 CP's are located into the "depth" of the image, whereas Network1 camera positions are generally observed closest, or in common to the forward side of CP_9 & CP_U, (reference the markers "O, B, and N") whereas Network2 is located into the depth or backside of Figure 1, (behind CP_W and CP_V where the police vehicle is parked in the image.)

Step 3: The user is ready to export the CP's (you do this by clicking on the 3D Points dialog.)



See Figure 2, on the next page with the 3D Points dialog open.



Save the "control.txt" in the same folder as the project (in our case the project folder is named "Net 1". Click "Save" in Figure 2.

Step 4: In Figure 2, the 3D Points dialog is still open. Click on the ".DXF" button in the lower left of the dialog and name the DXF (in this case, name the DXF as "Net1.dxf") and save it to the Net 1 folder. Then click "close" in the 3D Points dialog. You are now complete with Net1.iwp. Close out of Net1.iwp, as we are ready to work with Net2.iwp.

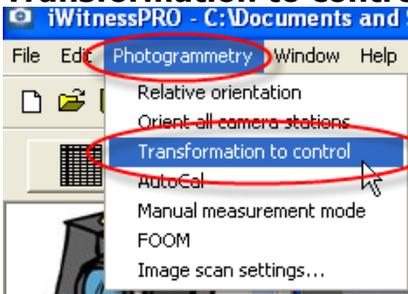
Reiterated, Network2.iwp is into the "depth" of Figure 1. NOTE how there aren't any of the markers in the Network2 area of Figure 1. That is because one can "recycle the markers" from Network1, to Network2, after Network1 has been imaged. It is critical that the CP's remain in the same location throughout all of imaging Network1 and also Network2!

Step 5: Open the second network (we named it Net2.iwp). If all CP's are present in one image, open the image in the workspace for control point marking. The point IDs for the CP's in Network2 are not the same Point IDs (unless you previously renamed them.) Figure 3 on the next page illustrates the 4 CP's ready for Control Point marking. Note: white lines were created (snapped) between the 4 CP's when this project was originally completed. These lines are not required, but give a good visual reference.



Figure 3

Step 6: Use the file pull down and **select Photogrammetry + Transformation to control**



The Transformation to control dialog is now presented in Figure 4.

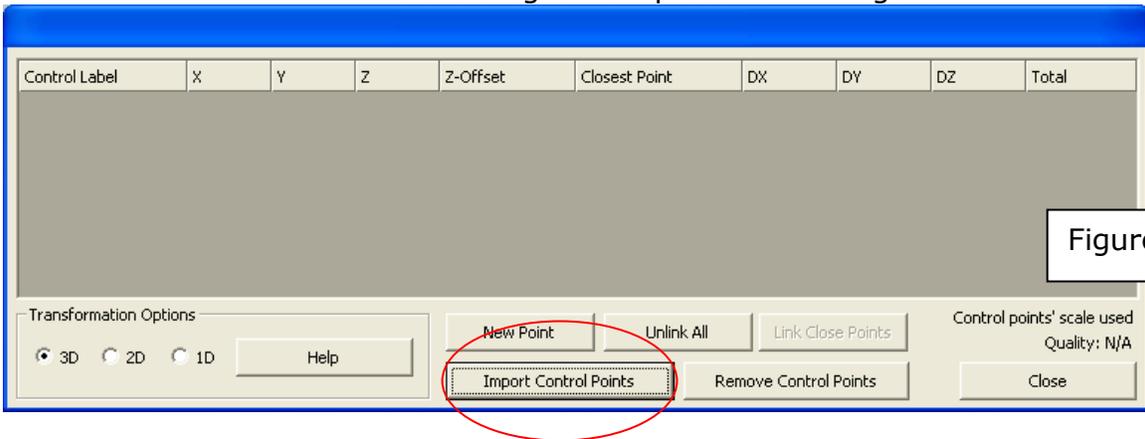
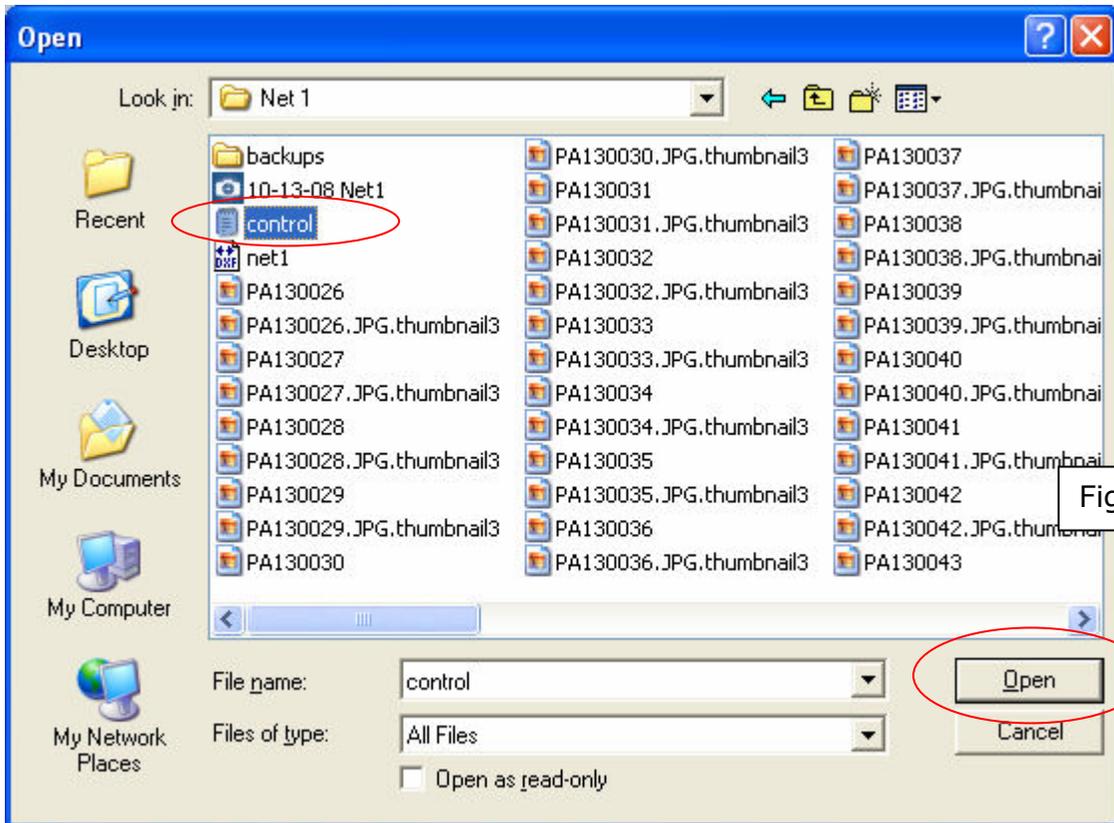


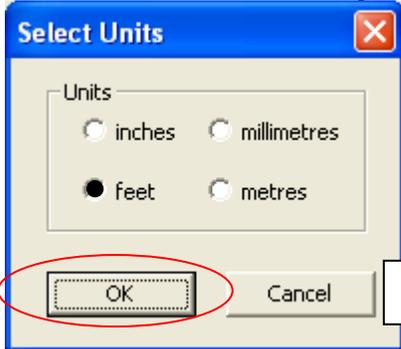
Figure 4

Step 7: Click on the **"Import Control Points"** as noted in Figure 4.

Note: The MS Windows "Open" dialog is presented now. You will **"path"** to **the Net1** folder to **select the "control.txt"** file you previously made in Step 3, then click **Open**. See Figure 5 on the next page illustrates these actions.



Step 8: You will be prompted to enter the **UNITS** (see Figure 6). Note: the units should be the same for all project networks. In our case the Units were **feet**. **Select the proper radio button** and then click **OK**.



The Transformation to control dialog box **is now populated with the control.txt file information**. Figure 7 illustrates this on the next page. In our example, there are only 4 "**Control Labels**" that we're concerned with using - (highlighted for illustration with a red box in Figure 7.)

Control Label	X	Y	Z	Z-Offset	Closest Point	DX	DY	DZ	Total
CP_9	100.0124	-9.6547	1.3416	0.0000	N/A	N/A	N/A	N/A	N/A
CP_U	100.1271	-20.5445	1.5422	0.0000	N/A	N/A	N/A	N/A	N/A
CP_V	111.1310	-19.9771	1.4784	0.0000	N/A	N/A	N/A	N/A	N/A
CP_W	110.8155	-9.0537	1.1846	0.0000	N/A	N/A	N/A	N/A	N/A
CSM_1	-0.7393	-10.7810	-0.1645	0.0000	N/A	N/A	N/A	N/A	N/A
CSM_2	5.7610	-6.5985	-0.1874	0.0000	N/A	N/A	N/A	N/A	N/A
CSM_3	12.0818	-3.1034	-0.2551	0.0000	N/A	N/A	N/A	N/A	N/A

Transformation Options: 3D 2D 1D

Control points' scale used: Quality: N/A

Buttons: New Point, Unlink All, Link Close Points, Import Control Points, Remove Control Points, Close

Figure 7

Step 9:

To begin the control point labeling, the cursor is now presented in the shape of a blue triangle. **Hold the Ctrl key on the keyboard** and the cursor temporarily becomes the white 'select' arrow. **Marquee drag the cursor around the control point** (it will become yellow as shown in "Action 1" below). See Figure 8.



Figure 8

Step 10:

Now **click the cursor in the Control Label box** for the **specific control point**, see "Action 2" noted above.

Once the control point has been successfully accomplished, you'll see a green tick mark as illustrated in Figure 9.

Control Label	X	Y	Z	Z-Offset	Closest Point	DX	DY	DZ	Total
A	38.9811	-12.1529	-0.0930	0.0000	N/A	N/A	N/A	N/A	N/A
B	68.9624	-13.3813	-0.1067	0.0000	N/A	N/A	N/A	N/A	N/A
BASE	0.9662	16.9898	1.1907	0.0000	N/A	N/A	N/A	N/A	N/A
C	38.9971	-22.1315	0.1040	0.0000	N/A	N/A	N/A	N/A	N/A
CP_9	100.0124	-9.6547	1.3416	0.0000	✓ CP_9	0.000	-0.000	-0.000	0.000
CP_U	100.1271	-20.5445	1.5422	0.0000	N/A	N/A	N/A	N/A	N/A
CP_V	111.1310	-19.9771	1.4784	0.0000	N/A	N/A	N/A	N/A	N/A

Transformation Options: 3D 2D 1D

Control points' scale used: Quality: N/A

Buttons: New Point, Unlink All, Link Close Points, Import Control Points, Remove Control Points, Close

Figure 9

Figure 10 illustrates the CP_9 control point after accomplishing Step 10.

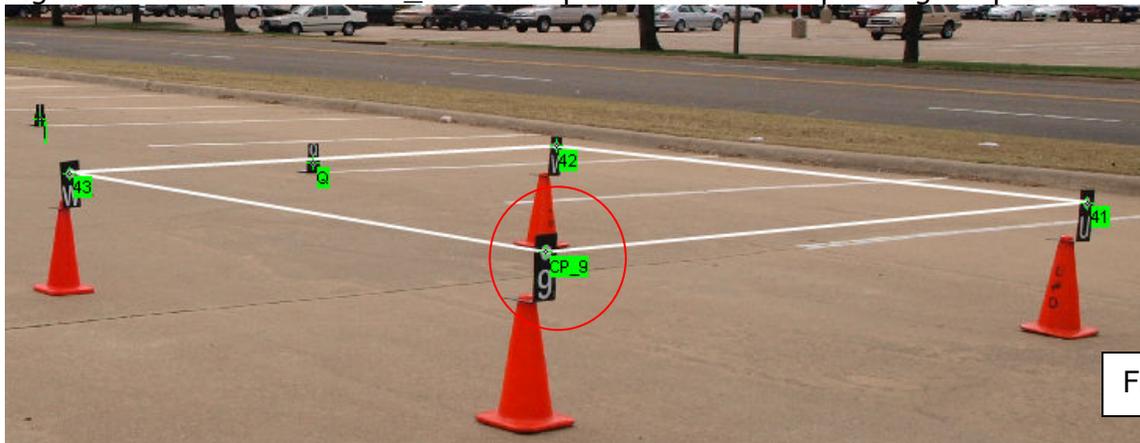


Figure 10

Step 11:

Continue the same actions of Step 9 for the 4 control points. NOTE: once 3 (noncollinear) control points are marked, a coordinate transformation is automatically invoked within iWitness. We strongly recommend that you use a minimum of four control points.

In Figure 11, when all 4 control points have been successfully marked, there will be 4 green tick marks in the column named "Closest Point". Additionally, in the lower right corner of the dialog, it states "**Quality: RMS = (number).**" The lower the number the better. In this tip sheet example, the control points were semi-automatically "centroid-marked" with iWitness' X-key, so the Quality: RMS number is going to be very small. The RMS number is a function of how well the (2) XYZ data sets "matched" each other for image marking and as a rigid-body fit to each other. In real-world applications, where natural features are used for this process, you might see these numbers as high as Quality: RMS = 0.100 or even as much as 0.200. The user can also see which of the 4 CP's in our example fit the best (or worst) by analyzing the results in the DX, DY and DZ field as noted in Figure 11.

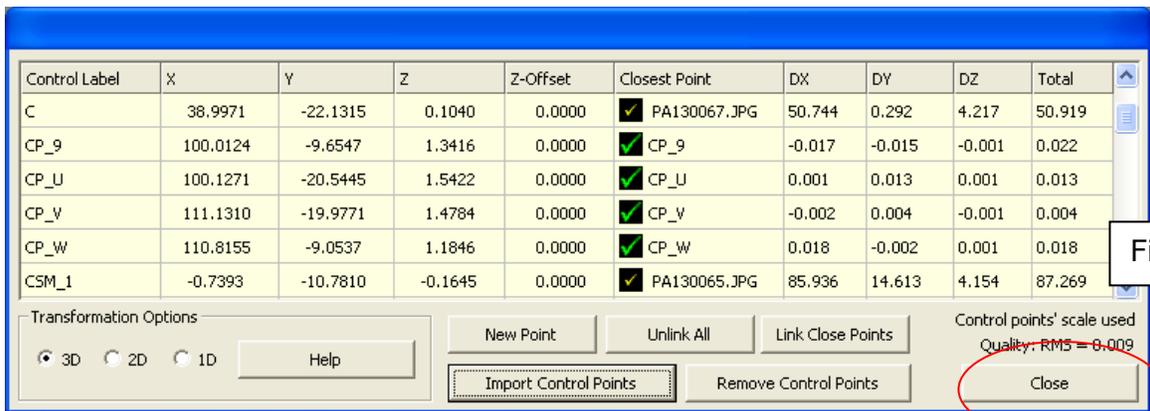


Figure 11

Step 12:
Click the **Close** button in Figure 11.

Step 13:
DXF export the same as identified in Step 4, but this time save the DXF in the Network2 folder, and call it Net 2.dxf.

Step 14: At this point, you can drag both Net1.dxf and Net2.dxf into your favorite CAD program as both networks are in the same coordinate system. The process can be "leapfrogged" if there at least 4 common points from network2, to network3, etc., etc.

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Final thoughts:
Don't use it if it isn't necessary

Using an average consumer grade 8 (or more) mega pixel digital camera, our customers are routinely doing "accident reconstruction mapping projects" as long as 600' (183m) **with just a single network (i.e., no need for transformation to control.)** The key is having enough common features in the images; this is why spreading the RPMS in the scene works well. For a good illustration of a 3D mapping project with a single network over 500' long, see the presentation at:
http://www.iwitnessphoto.com/solutions/auto_ped_fatality.html

Use it when it's necessary

The iWitness 3D transformation to control is a very powerful tool that allows one to Stitch projects together. A good example would be working a crash scene, where one side of the street might be completely occluded by a jack-knifed 18-wheeler semi truck. In this example, to "stitch" both sides of the streets crash scene together, all it takes is 4 common points for use in iWitness' Transformation to control dialog to get the multiple networks in the same coordinate reference system.