Product**Review**

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Head to Head
Transform versus Triad versus Ez-Adjust versus just plain CAD

Several programs offer solutions to the problem of understanding your field work against a legal plat. Here I'll discuss Transform for Windows from PrimaCode Technologies, Triad for Windows from McGee Surveying Consulting, Ez-Adjust from SRH Surveying Software, and just plain CAD.

Except for Ez-Adjust, the developers have tried to simplify the process so that no understanding of the underlying process is necessary. The traditional way has been to bring the plat coordinates into a CAD program, bring up the field work in a separate drawing, insert the
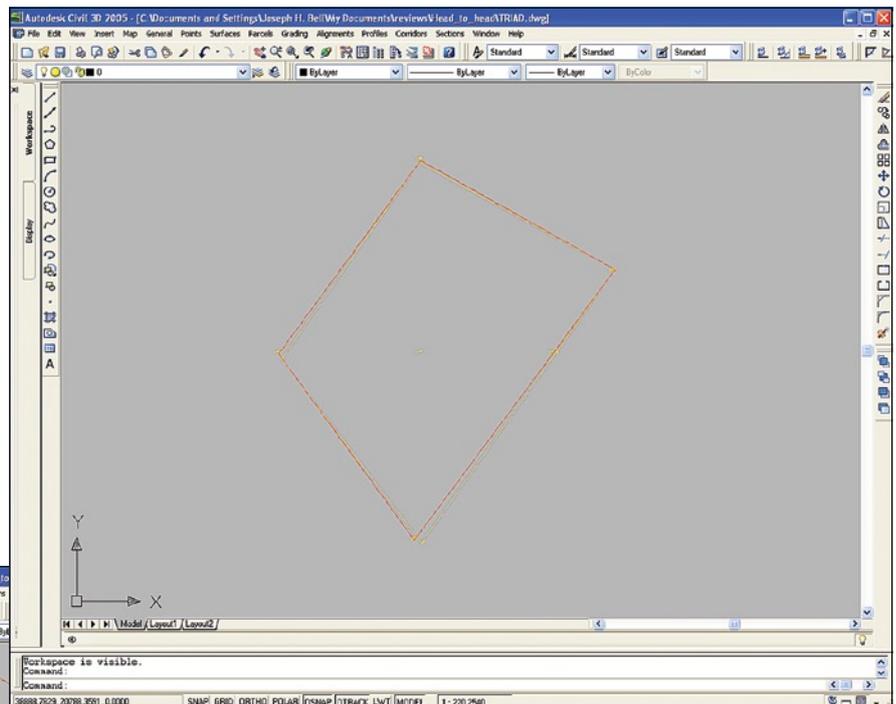

Figure 1

field work drawing into the plat drawing and then do a translation, rotation and (sometimes) scale. You could then visually inspect each found monument on the plat. **Figures 1, 2** and **3** show translation, rotation and scale in CAD. You can see that there is a good fit, but you can not really tell how good the fit is or with what certainty. You can translate, rotate and scale with some simple formulas but you can only use two points. More than two points and the formulas are no longer simple.

Transform, Triad, and Ez-Adjust do a translation, rotation and scale and, if given more than two common points, generate a certain amount of information
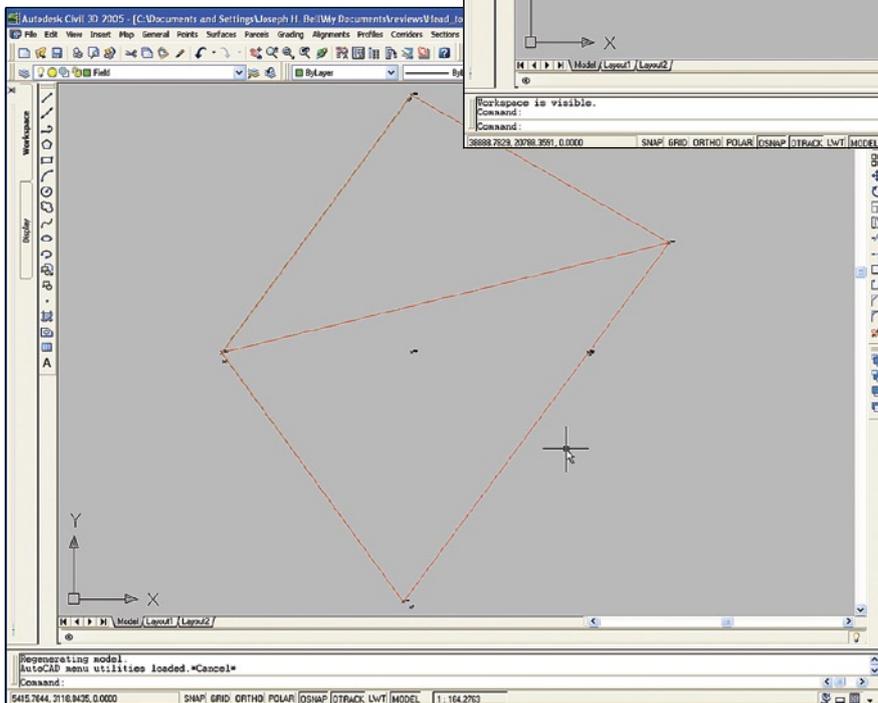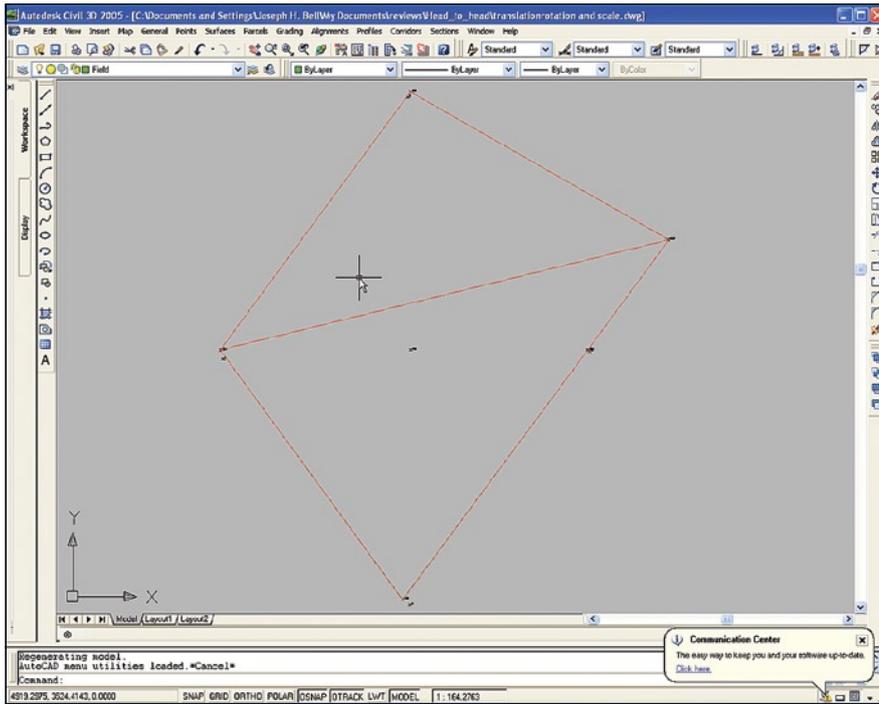

Figure 2

Figure 3

about the fit. With more than two common points we have redundancy and when we have redundancy we can do a least-squares fit and get some mathematical proof of the correctness of fit.

Figure 4 shows the results of the same set of coordinates using those more complicated formulas in Transform. There are no graphics, just the result of the least-squares adjustment of field measurements to map coordinates. Transform will also hunt for pairs and use all that it finds. If the file is very large this can be very time consuming. At the bottom of the screen you can see that these are at the 99% confidence level. You can use 95% confidence level or standard confidence levels. The variations in the northing and easting coordinates are shown. You can also show the bearings and lengths of the vectors from one set of coordinates to the other set. You can hold the field measurements fixed and see the variations in the map coordinates.

Figure 5 shows the results from Triad. There are no graphics. The coordinate files used actually came as a sample with Triad. Triad identifies the pairs by the point numbers using the addition of 400 to the point number to identify the pairs.

To use Ez-Adjust, the pairs have to be identified by having the same point number. **Figure 6** shows the results in Ez-Adjust. Note that in all three pro-grams I have held the map coordinates so you could compare the results. Note also that not only can you hold the field work as in the other two programs; you can hold neither as fixed which would be the most useful. Also note that if the coordinates are not held fixed you can use standard deviations and even covariance. In Ez-Adjust you get results in three forms. In Figure 6 you see the actual transformation values calculated and used. You get the adjustment statistics and you get the listing of the files used. In **Figure 7** you can see the adjusted coordinate values, the residuals in northing and easting and the normalized residuals. These are only the pairs. In **Figure 8** you can see the coordinates of all the points with the standard deviations at the 99% level.

Now we can go back to Transform from Primacode and understand what has been calculated. Transform gives us the residuals but does not give us the normalized residuals. What you are really looking for are "outliers". That is hard to do since a large change or residual might be the result of a very large observation. If you could use a normalized residual, the problem would be much easier. A normalized residual or change is the result obtained by dividing the change or the residual by the size of the observation. A graph of the normalized residuals is a bell shaped curve. Small normalized residuals are more frequent than large normalized residuals. When the bell shaped curve is distorted by "outliers" you can zero-in on possible errors. Transform only gives the residuals to two decimal places in Figure 4 but they can be set to three decimal places by setting the distances to three decimal places. When you do this,
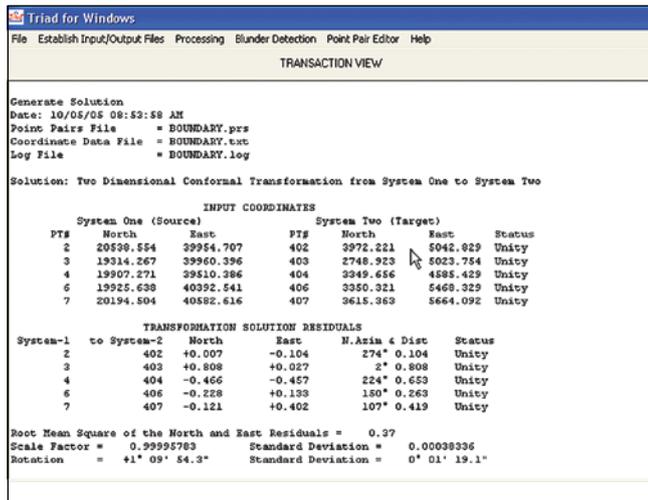

Figure 4

Figure 5

Figure 6

the results are exactly the same as with Triad and Ez-Adjust.

Triad does not show normalized residuals either but it does show the residuals to three places. Triad does give the transformation parameters. Triad also has a blunder detection program. It allows you to rerun the adjustment leaving out one or more points. It gave a warning at rejecting three pairs (there are only five pairs and that would leave a simple transformation, rotation and scale with no redundancy, and, therefore, no least-squares adjustment). This is a lot like running a traverse starting at each point and seeing which gives the best closure.

These are tools. Some are different than others—Transform has programs that inverse between points and, if you have State Plane Coordinates on two points, it will convert all the points to State Plane Coordinates—but they add only a very small bit of information upon which to accept or reject a monument or to reset missing monuments. Much stronger evidence are things like obvious disturbance, a different physical monument than called for with no record evidence of how it was replaced, calls to adjacent features or to other records, etc. These are still the most important items in deciding whether to accept or reject a monument or place a monument. This is the curse of the monument controlled system. In Egypt, monuments help to identify a corner but the true corner is a set of coordinates.

I hope we have gotten past the time when least-squares was the Holy Grail. All three of these programs perform a least-squares adjustment of a four parameter translation, rotation and scale of two sets of coordinates. All produce residuals although only Ez-Adjust provides normalized residuals. Both Triad and Ez-Adjust provide the values actually used for translation, rotation and scale. Only Transform provides a routine for hunting for pairs but it is as slow if the file is large, and you must manually pick the first two points. It occurs to me that if you coordinate a map and take it into the field, you will know which coordinate pairs in you data collector are the same corners as the ones on the map. Should you mistake something on the ground for something on the map, any of the three programs will tell you which one it is. If it is a small difference, Ez-Adjust with normalized residuals is the only one which will correctly identify the mistaken corner. Remember, these programs are one small piece of the puzzle. Whether you have picked the wrong corner or whether the original surveyor set the corner out of position will always be a matter of evidence to be evaluated by a professional surveyor.

Which is easiest to use? Transform and Triad are aimed at the average surveyor. Ez-Adjust is a professional package for someone who works a lot with control networks, so I find it the easiest. The name Ez-Adjust makes it sound like some cut down version of a least-squares adjustment by the variation of coordinates. I believe it is easy to use, but definitely not a cut down package. This is a full blown adjustment package for the most rigorous applications. In Part Two I will discuss the different between 2D and 3D adjustments and some tools that will blow you away. ⅃ₛ
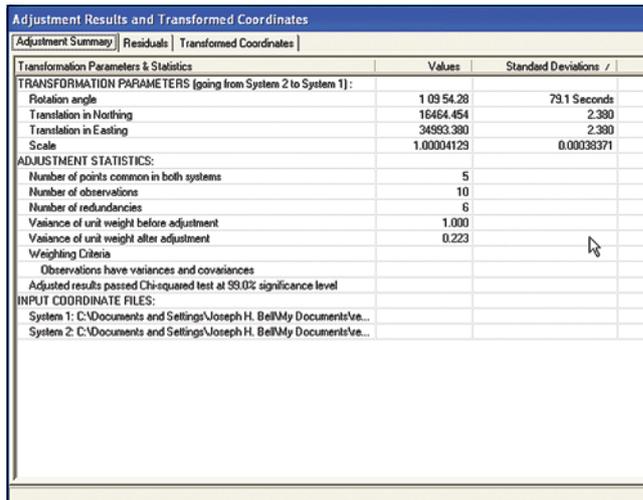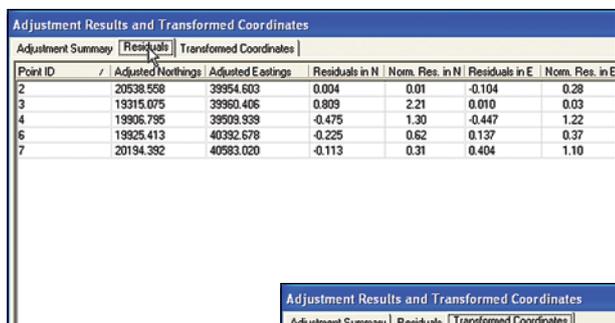

Figure 7
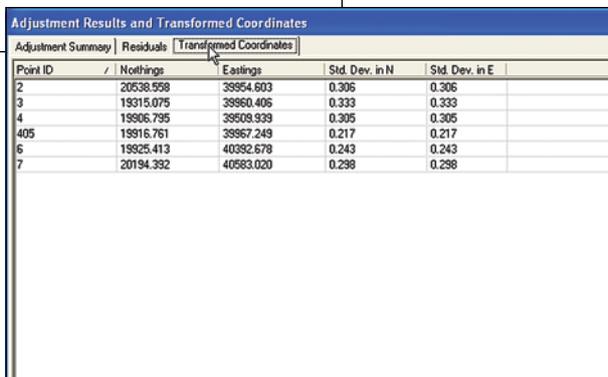

Figure 8