Spatial Adjustment Tools: The Tutorial

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In this exercise, you will perform some spatial adjustment and data management operations data to be used in analysis and to make the database cohesive and efficient.

Step 1: Convert the street centerlines for a new subdivision from an AutoCAD drawing exchange file (dxf) drawing to a new feature class in the Redlands Streets layer.

Step 2: Add displacement links to the new subdivision streets using a Control Points file.

Step 3: Transform the data to real world coordinates by using the Spatial Adjustment tools in ArcMap to transform the new subdivision streets from digitizer units to Universal Transverse Mercator (UTM) Zone 11 so that they will match the existing streets.

Step 4: Use the Spatial Adjustment tools on stream data layers to perform an edge snap operation that will align features in two adjacent layers.

Step 5: Transfer attributes between these newly aligned adjacent stream layers.

What You Will Need

- ArcGIS 8.2 (ArcInfo or ArcEditor licenses)
- Sample dataset download from the *ArcUser Online* Web site
- An unzipping utility such as WinZIP

Step 1: Convert CAD file to geodatabase feature class

Each CAD drawing has two entries in the ArcCatalog tree, a CAD dataset that represents all the layers in the drawing—point, line, polygon, and annotation—and a CAD drawing This exercise will use the CAD dataset.

1. Download the sample data from the *ArcUser Online* Web site. Create a folder called tutorial and unzip the archive using WinZip.
2. Start ArcCatalog. Navigate to the tutorial folder. Right-click on sub_digunits.dxf and choose Properties. Click on the Spatial Reference tab. Notice there is no projection information associated with this file and the values for the CAD dataset extents are very small because represent the digitizer units—in this case inches. Click OK to dismiss the CAD Feature Dataset Properties dialog box.
3. Right-click on sub_digunits.dxf and choose Export > CAD to Geodatabase from the context menu.

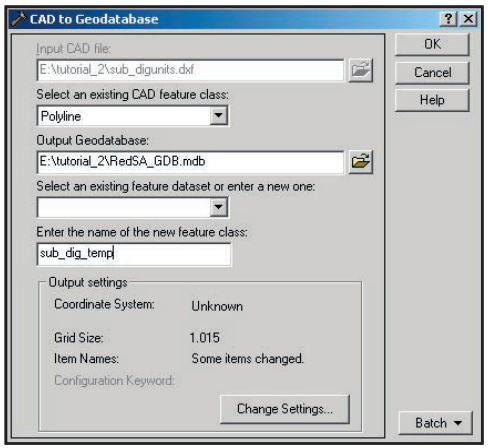

Figure 1: Export the sub_dignunits.dxf to the RedSA_GDB geodatabase using the CAD to Geodatabase utility in ArcCatalog.

4. In the CAD to Geodatabase dialog box, confirm that Polyline is selected. Under Output Geodatabase, click on the browse button and navigate to the RedSA_GDB geodatabase and click Open. For Enter the name of the new feature class:, type sub_dig_temp. Do not close the dialog box. The CAD to Geodatabase dialog box should look like Figure 1, shown on the previous page.

You will import the spatial reference information from the Streets feature class in the RedSA_GDB geodatabase. However, you will need to adjust the spatial extents (i.e., X/Y Domain) for this new feature class to contain the area for both the street centerlines in digitizer units and the UTM streets.

1. Click the Change Settings button. On the Spatial reference tab, click the Change button.
2. Click the Import button to import a coordinate system for the new feature class.
3. Browse to the Streets feature class in the RedSA_GDB geodatabase. Click Add. Notice that the coordinate system is updated in the Spatial Reference Properties window. Do not close the dialog box.

The extents for the Streets feature class have been copied for the minimum and maximum X and Y values. The sub_dig_temp features fall outside this range. For the transformation process to be successful, the X/Y domain or extents must cover the coordinate values where the features currently fall and the coordinate values where they will be moved. The minimum X and Y values need to be altered to account for the subdivision features' currentl location.

1. Still in the Spatial Reference Properties dialog box, click on the X/Y Domain tab. Type 0 for both the Min X and Min Y. The X/Y Domain values should match those shown in Figure 2.
2. Click OK to dismiss the Spatial Reference Properties dialog. Click OK to dismiss the Output settings dialog. Click OK on the CAD to Geodatabase dialog.
3. The new subdivision's streets have now been added to the RedSA_GDB geodatabase. In ArcCatalog, preview the sub_dig_temp feature class.

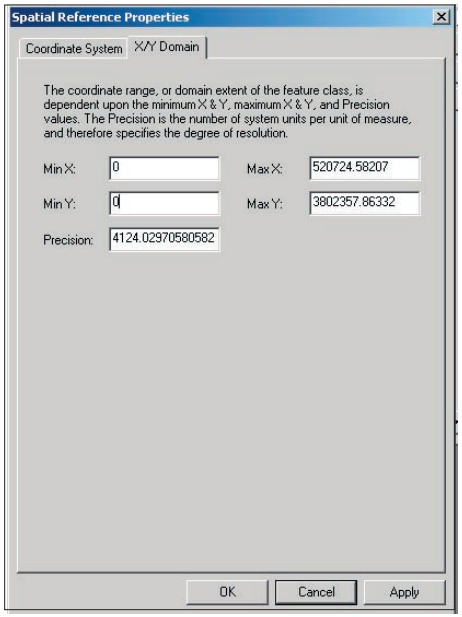

Figure 2: Adjust the values in the X/Y Domain dialog box to match the illustration.

Step 2: Add displacement links

The streets in sub_dig_temp are still in digitizer units and need to be shifted in coordinate space to match the Streets feature class.

1. Start ArcMap and open a new empty map. In ArcCatalog, drag the Streets feature class from the RedSA_GDB into the ArcMap document. Add the sub_dig_temp feature class. If you get a warning that the data is missing spatial reference information, click OK.
2. Because the sub_dig_temp features are in digitizer units, they are not visible at the current ArcMap extent. Double-click on the symbol for sub_dig_temp in the Table of Contents to bring up the Symbol Selector dialog box.

3. Change the symbol to Highway Ramp which has a default color of red and a width of 1.70. This will make it easy to identify the new subdivision's streets once they are transformed to match the Streets data.
4. Right-click on sub_dig_temp and click Zoom To Layer.

To use the Spatial Adjustment tools, you must begin an editing session. If necessary, open the Editor toolbar by choosing View Toolbars > Editor. Also open the Spatial Adjustment toolbar by clicking on View > Toolbars > Spatial Adjustment.

1. On the Editor toolbar, choose Editor > Start Editing. On the Spatial Adjustment toolbar, choose Spatial Adjustment > Set Adjust Data.
2. Click the radio button next to All features in these layers: and uncheck the Streets layer. The dialog should match Figure 3. Click OK.
3. Choose Spatial Adjustment > Adjustment Methods > Transformation–Affine.

The algorithm used in the Affine transformation requires at least four displacement links. Displacement links define the source and destination coordinates for the transformation. Displacement links can be added manually or loaded through a links file. A links file, which is a tab-delimited text file, contains both the source and destination coordinates for each displacement link. Alternatively, a Control Points file that contains the coordinates for the destination points can be used to manually add the source points.

The destination coordinates for street intersections and ends in sub_dig_temp are already known and have been stored in a Control Point file. You will use this text file to manually create displacement links. However, first you will set up the snapping environment for snapping the control points to the street centerlines.

1. Click Editor > Snapping , and turn on End Snapping for the sub_dig_temp layer. Close the Snapping Environment window.
2. Click Spatial Adjustment > Links > Open Control Points File.
3. Browse to the tutorial folder and select SubGCP.txt. Click Open.

This text file contains the destination coordinates that will be added to the ArcMap display. There are six coordinate pairs listed in the file. The ID number for each destination point matches an ID for one of the source end points of a street feature in the street feature class as illustrated in Figure 4.

1. Right-click on the X or Y Destination value for the control point for ID number 1 and click Add Link.
2. Move the mouse into the ArcMap display area. You will be able to see the displacement link reaching from outside the display area.
3. Snap to the end of the street for source point 1 as shown in Figure 5.

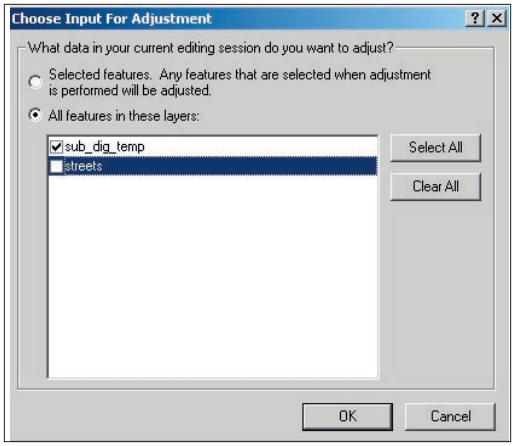

FIgure 3: After starting an Editing session, choose the data that will be adjusted.

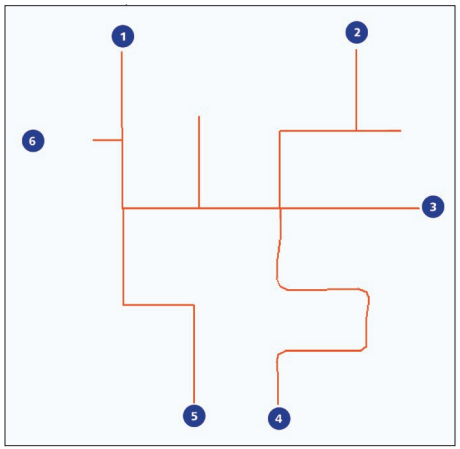

FIgure 4: The IDs for the control points correspond to the end points of the street features.

4. Click the Refresh View button located on the lower left side of the map canvas. The created displacement link is displayed and the ID 1 is removed from the Control Point file displayed in ArcMap.
5. Add the rest of the displacement links in the same manner based on the end points shown in Figure 4.
6. Click the Refresh View button to show all six displacement links.

You can view both the source and destination coordinates for the links and the root mean square (RMS) error for each link in the adjustment by viewing the Link Table. If any link does not have an acceptable RMS value, it can be modified or deleted.

1. On the Spatial Adjustment toolbar, choose Link > View Link Table. All the displacement links have values less than 0.5, which is acceptable for this data.
2. Link number 4 has a little higher RMS error than the other links. Right-click on it in the Link Table and choose Delete Link.
3. Notice how the overall value for RMS error drops slightly. Close the Link Table.

Step 3: Transform the data to real world coordinates

1. From the Spatial Adjustment toolbar, click Spatial Adjustment > Adjust. The sub_dig_temp features should disappear from the display area because they have been transformed to match the other streets.
2. Right-click on the Streets layer in the TOC and click Zoom To Layer. You will be able to see the bright red streets of the new subdivision added to a city block in the center-east of the streets layer.
3. Zoom in on the new streets. Set the Selectable Layer so that only sub_dig_temp is selectable by choosing Selection > Set Selectable Layers and turning off the Streets layer.
4. To locate all streets on the same layer, select all the features in sub_dig_temp. Choose Edit > Copy or Ctrl+C to copy the selected features to the clipboard.
5. In the Editor toolbar, set the Target layer to Streets. Click Paste or Ctrl+V to paste the features into the Streets layer.
6. Choose Editor > Stop editing from the Editor toolbar. Remove both Streets and su_dig_temp layers from the Table of Contents.

Step 4: Edge Snap Two Layers

You may often find it necessary to align two layers whose borders are slightly out of alignment. The edge snap, the most basic of the spatial adjustment methods, takes care of this problem. The next exercise uses data about streams. Click on the Add

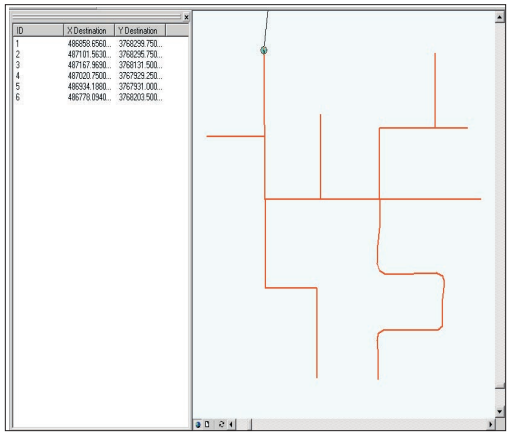

Figure 5: Right-click on the control point for ID number 1 and choose Add Link. Move the mouse into the ArcMap display area and the displacement link reaches from outside.

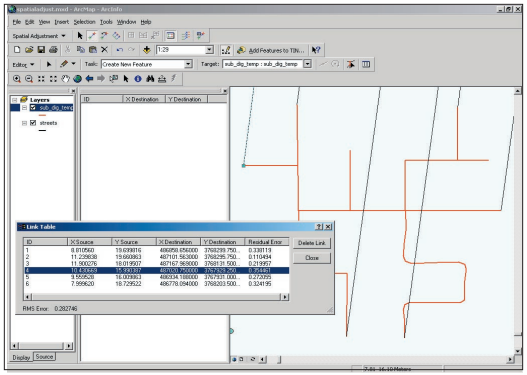

Figure 6: Choose Link > View Link Table from the Spatial Adjustment toolbar to view the RMS values.

Data button and navigate to the tutorial folder. Add the stream_west and stream_east shapefiles to the map. Change the layer symbology as shown in Figure 7. Locations for colors in the palette are given in parenthesis.

Layer	Attribute	Value
stream_west	color	Malachite Green (5th row, 8th column)
stream_west	line width	2.00
stream_east	color	Electron Gold (3rd row, 4th column)
stream_east	line width	2.00

Figure7: Layer symbology

Notice that the stream features on the two layers don't align, and one has a slight overlap. The difference is approximately 50 meters and could be the result of digitizing error or other source data distortion. You will set up the initial spatial adjustment environment and then add Displacement Links. To work more efficiently, you will use the Magnifier window which will eliminate most of the panning and zooming associated with making these edits.

1. Start an Editing session. In the Editor toolbar, set the Snapping Environment to Ends for both layers.
2. Choose Spatial Adjustment > Set Adjust Data. In the Choose Input For Adjustment dialog, choose All features in these layers. Uncheck the stream_east layer and click OK.
3. Choose Spatial Adjustment > Adjustment Methods > Edge Snap.
4. Choose Window > Magnifier to open a magnifier window and drag the window to the top (northernmost) stream edge gap. Right-click on the Magnification window title bar, select Properties , and change the zoom factor to 600 percent.
5. On the Spatial Adjustment toolbar, select the New Displacement Link tool. Use this tool to link the eastern ends of the stream_west line features (shown in green)to the western ends of the appropriate stream_east line features (shown in gold) as shown in Figure 8. Add displacement links for the other two gaps, leaving the magnifier window over the southernmost stream.
6. Choose Spatial Adjustment > Adjust. Notice that the default Edge Snap method simply moved the overlapping line from the last vertex of stream_west to the dis-

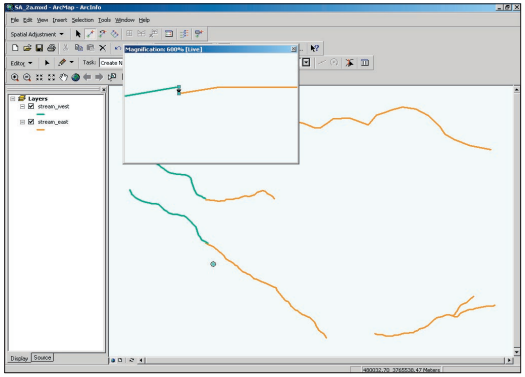

Figure 8: Use the New Displacement Link tool to link the eastern end of a stream_west feature to the wesern end of the corresponding stream_east feature.

placement link on stream_east. It is unlikely that the stream makes such a distinct linear change. Choose Edit > Undo Adjust. The stream_west line features will return to their original positions and the displacement links will reappear.

7. Click Spatial Adjustment > Options. Under the General tab, confirm that Edge Snap is the selected Adjustment method. Click on the Options button and select Edge Snap if necessary and make sure Smooth is selected for Method. Click OK to close both dialog boxes.
8. Perform the Adjust function a second time. Notice the difference in the Edge Snap result. Choosing the Smooth option for the Edge Snap method changed the number of vertices altered by the adjustment. The Line option moves the line feature from just the last vertex, while the Smooth option spreads the change throughout all the vertices of the feature. Because you earlier used Set Adjust Data to select the stream_west layer only, those are the only features altered. Save your edits

Step 5: Transfer Attributes

Now that you have aligned the features from stream_west to those in stream_east, you need to update the more accurate attribute values from stream_east to stream_west. The stream_west layer does not contain attribute values for either the Name or CFCC fields. By using the Attribute transfer tool, you will accurately and quickly update the values for stream_west.

1. Change the Snapping Environment. Check Edge snap for both stream layers and uncheck End snap. Close the Snapping Environment window.
2. Choose Spatial Adjustment > Attribute Transfer Mapping.
3. Under Source Layer, select stream_east. Under Target Layer, select stream_west. Notice that the fields for each individual layer appear in the window below. The two layers have three of the four fields in common.
4. Click the Auto Match button. The three fields names present in both layers appear in the Matched Fields panel. Select the remaining Name and StreamName fields by clicking on each once. Notice that the Add button becomes active. Click the Add button. The Name and StreamName field values will be matched during your attribute transfer process.
5. Make sure that the Transfer Geometry box at the bottom left corner is **NOT** checked. Click OK.
6. Click on the Attribute Transfer tool, located at the end of the Spatial Adjustment toolbar. Select the uppermost river in the stream_east layer by clicking once. You will see it flash, and the cursor will have a link anchored to your selected seg-

ment.

7. Move the cursor left to the edge-snapped stream_west feature and click once. You will see the river flash once. In the Table of Contents, right-click on the stream_west layer and select Open Attribute Table. You will see that the Name and CFCC columns now contain updated information.
8. Repeat the Attribute Transfer for the remaining two edge-snapped streams. The column values will be updated automatically. Close the Attribute Table. Choose Editor > Stop Editing and save your edits.

Conclusion

These data management operations are vital for maintaining the spatial accuracy of data. In this exercise, you learned how to convert a CAD drawing file into a geodatabase feature class and how to transform the digitizer units of the converted CAD file into real world coordinates using the Spatial Adjustment tools in ArcMap. You also updated and corrected less accurate spatial data and attribute information by using two spatial adjustment tools—Edge Snap and Attribute Transfer.