

# Spatial Adjustment Tools in ArcGIS

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Accurate GIS analysis requires accurate spatial information. As part of your ongoing efforts to maintain a precise spatial data warehouse, you need to integrate new data with existing data or upgrade less accurate data to more accurate data. It may also be necessary to convert data that you've received in raw digitizer coordinates into existing georeferenced data coordinates.

These types of GIS operations are commonly called spatial adjustments. Experienced Workstation ArcInfo users will be familiar with the methods used in spatial adjustments, largely through the use of the ADJUST, EDGEMATCH, and TRANSFORM commands. The Spatial Adjustment toolbar, now in ArcGIS 8.2, contains tools and commands to help you improve the quality of your data. This article briefly introduces the features and functions contained in this toolbar and supplies basic descriptions of adjustment methods available.

The features in the Spatial Adjustment toolbar allow you to edge snap, rubbersheet, and transform spatial features as well as transfer attributes from one feature to another. The new toolbar

works within an ArcMap edit session so that the tools and commands used for spatial adjustments can take advantage of Editor toolbar functions such as setting the Snapping Environment or using the Magnifier window while editing. Add the Spatial Adjustment toolbar to an ArcMap session simply by clicking the View menu and choosing **Toolbar > Spatial Adjustment**.

## Adjustment Methods

There are three methods available in the Spatial Adjustment toolbar—Edge Snap, Rubbersheet, and Transform. Regardless of which method used, all Spatial Adjustments are based on displacement links, which are the graphic elements that represent the source and destination points for adjusting features. Links are represented as arrows where the arrowhead points toward the destination location. Displacement links can be added manually or from point coordinates contained within a Links file or Control Point file.

A Links file contains both the source and destination coordinates for a link. A Control Point file contains only the destination coordinates,

allowing you to manually add the source points. Adjustment methods are set from the Spatial Adjustment menu on the toolbar.

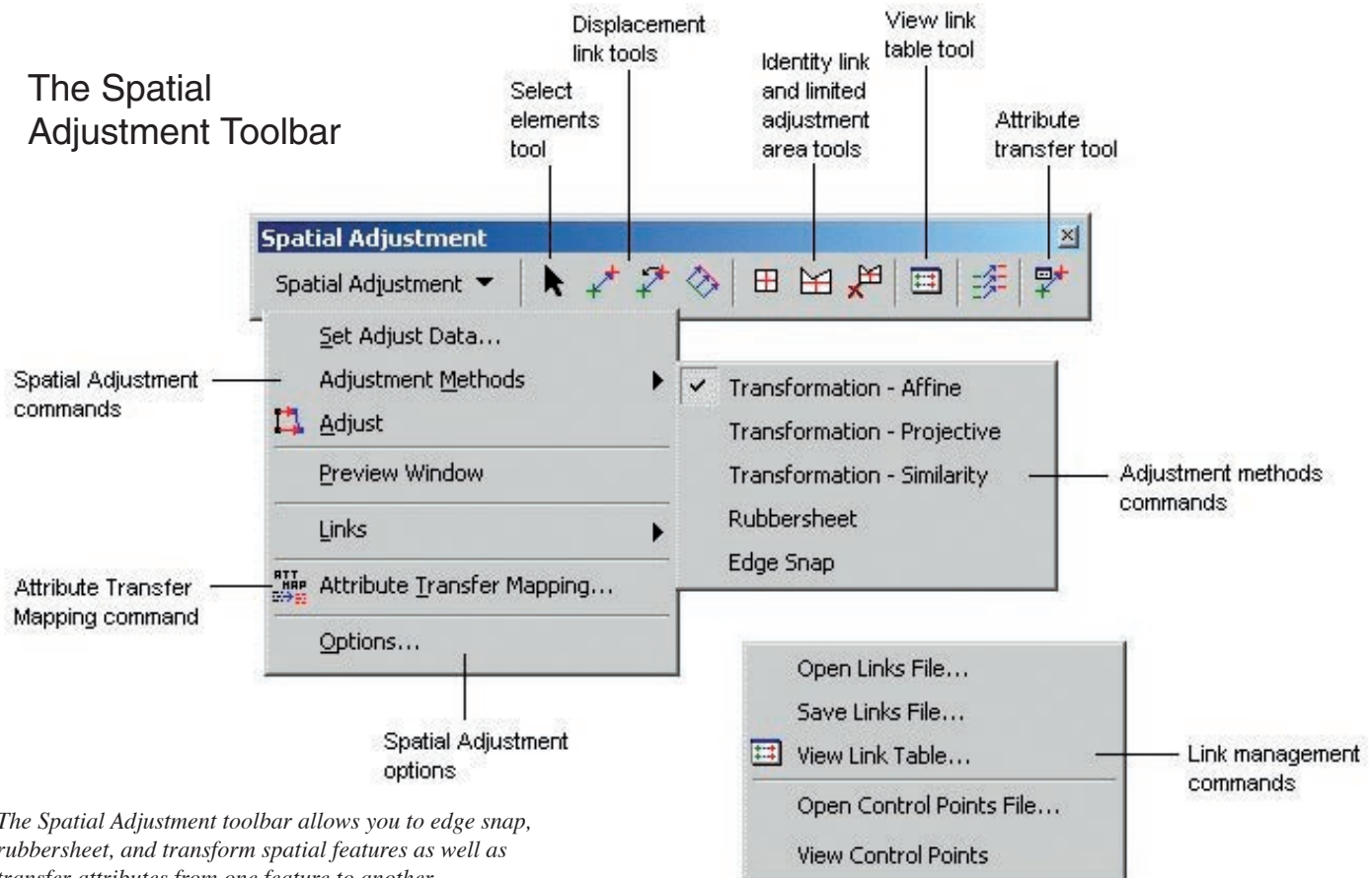
## Edge Snap

The Edge Snap, the simplest of the three adjustment methods, aligns features along the edge of one layer to features along an adjoining layer. This ensures that all features along shared borders of layers have the same edge locations. In ArcMap, the Edge Snap method supports two snap options: Smooth and Line. The Line Edge Snap option moves only the vertices connected to the source point, while the Smooth Edge Snap option moves the vertices connected to the source point as well as the remaining vertices on the feature to give an overall smoothing effect. This adjustment method is most commonly used to align mapsheet-bounded data layers into a larger seamless layer.

## Rubbersheet

The Rubbersheet adjustment method is most commonly used to align one layer to another.

## The Spatial Adjustment Toolbar



The Spatial Adjustment toolbar allows you to edge snap, rubbersheet, and transform spatial features as well as transfer attributes from one feature to another.

During this process, the surface is literally stretched by moving the features in a piecewise transformation that preserves straight lines. Use the Limited Adjustment Area tool to define or limit the spatial extent of features that the rubber-sheet operation will change. Matching a coastline or lakeshore between layers or adjusting a street centerline to match an orthophoto image are situations in which you would use the rubbersheet adjustment.

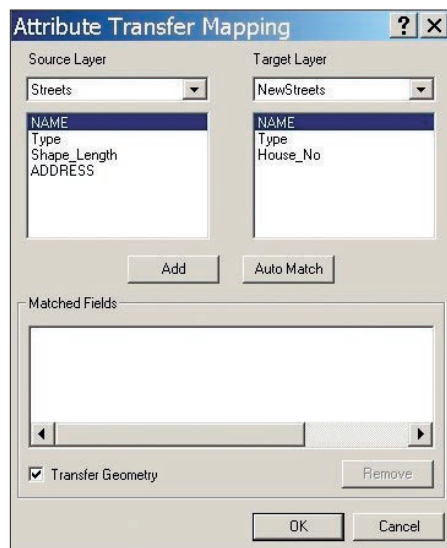
### Transform

The Transform adjustment method moves data from one coordinate system to another. Although this method is most commonly used to transform data from digitizer or scanner units to real-world coordinates, it can also be used to shift data within a coordinate system (e.g., converting feet to meters).

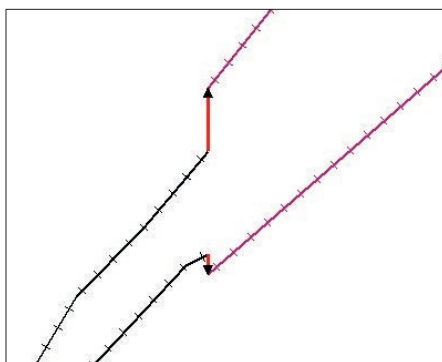
ArcMap supports three types of transformations: Affine, Similarity, and Projective. An Affine transformation, which requires a minimum of three displacement links, can scale, skew, rotate, and translate the data. The Similarity transformation scales, rotates, and translates the data but will not introduce skew or rescale the axes; it requires a minimum of two displacement links. A Projective transformation, the most mathematically complex adjustment method, requires a minimum of four displacement links. For more information on the algorithms used in transformations, see the ArcGIS Desktop online Help or the Spatial Adjustment chapter in *Editing in ArcMap*, one of the manuals that comes with ArcGIS.

### Additional Features

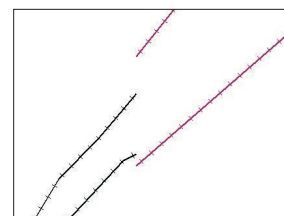
You can examine the displacement link attribute information in the Link Table by clicking on the Spatial Adjustment menu in the Spatial Adjustment toolbar and choosing Links > View Link Table. This window supplies information about the displacement link source and destination



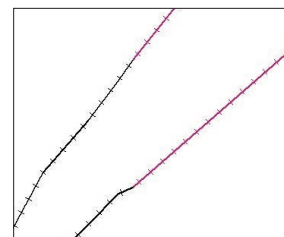
The Attribute Transfer Mapping window allows you to select the source and target feature layers and then specify which attribute fields will be used for the attribute transfer.



Displacement Links (indicated in red) show the direction of feature adjustment.



Before Edge Snap



After Edge Snap

ID	X Source	Y Source	X Destination	Y Destination	Residual Error
6	0.213440	4.139636	481694.826605	3766834.985850	0.001167
7	1.439353	2.059641	481737.238237	3766763.514049	0.005963
8	5.699393	0.079696	481885.238793	3766695.332405	0.009581
9	7.649498	1.350512	481952.947412	3766738.844471	0.004352
10	9.599603	2.670475	482020.655154	3766784.073227	0.001916

The Link Table contains useful information about source and destination link points as well as the average Root Mean Square (RMS).

point x,y coordinates and ID numbers and, in the case of the transformation functions, it supplies the Root Mean Square (RMS) errors. During the transform process, a least squares equation is used to determine the average discrepancy between the source points and the destination points and is expressed as the RMS error.

Once the Control Point information is loaded, you can right-click on a control point and manually click on the source point to add a link. Right-clicking on a record in the table allows you to select or delete a poor link if you need to reduce RMS error. Once the links have been added, choose Adjust Data from the Spatial Adjustment menu to transform, rubbersheet, or edge snap the data to the new location.

The preview window, another feature of the Spatial Adjustment toolbar, allows you to view the results of adjustments in a window separate from the map data view before committing any changes to the data.

### Attribute Transfer

Rather than transforming the whole dataset, you may want to update only a small number of features from one layer to another. The Attribute Transfer function copies attributes from one selected feature to another in a different layer. The Attribute Transfer Mapping window allows you to select the source and target feature layers and then specify which attribute fields will be used for the attribute transfer. You can manually specify which fields are common or click the Auto Match button to match multiple fields that have the same names. You may also opt to transfer the geometry of the feature.

### Summary

The adjustment and attribute transfer functions available through the Spatial Adjustment tools allow you to improve the quality of your data by

- Increasing the flexibility and speed with which you can control adjustment parameters
- More accurately tying data to high-quality ground control points
- Reducing the number of separate map files through accurate aggregation
- Automating the attribute transfer process, thereby reducing data entry errors
- Allowing more precise control of the number of features and area extent over which spatial adjustments will operate

Additional information about these tools, and spatial adjustments in general, can be located through ArcGIS Desktop Help. Visit *ArcUser Online* to download the companion tutorial. This tutorial covers the process of importing a CAD file created with digitizer coordinates, using an Affine Transform to integrate the CAD data into an existing feature class, using the Edge Snap method to align two separate files, and then using the Attribute Transfer command to update attributes on the resulting snapped data.

### About the Author

Peter Kasianchuk has a bachelor of arts in geography/archaeology from Simon Fraser University in Vancouver, British Columbia. In addition to many years as a tree planter and musician, he has GIS and field experience in ecosystem surveys, mapping for BC First Nations Treaties, and natural resources.