

Georeferencing Raster Data using ArcMap 10.1

Introduction

Frequently digital geographic data are acquired by scanning aerial photographs or paper maps. Once the data are input they need to be assigned their proper map coordinates so that they will occupy a real world space.

Georeferencing defines the location of a dataset using known map coordinates and assigns it a coordinate system. This allows for the dataset to be viewed, queried, and analyzed with other geographic data. Typically in a GIS environment such as ArcMap, raster datasets (such as images) are georeferenced using a control layer. This layer contains known coordinates and is used as a point of reference for the georeferencing process.

This guide will make use of the Regional Municipality of Waterloo (RMOW) single line street network file as the control layer and a scanned map of the city of Waterloo, Ontario.

Preparing the data

1. Click on **File**→Add Data and select the control layer.
Note: The control layer is the layer with the known coordinates
2. Click on **File**→Add Data and select the dataset to be georeferenced
3. Turn on the **Georeferencing** toolbar by clicking on **View**→**T**oolbars→Georeferencing

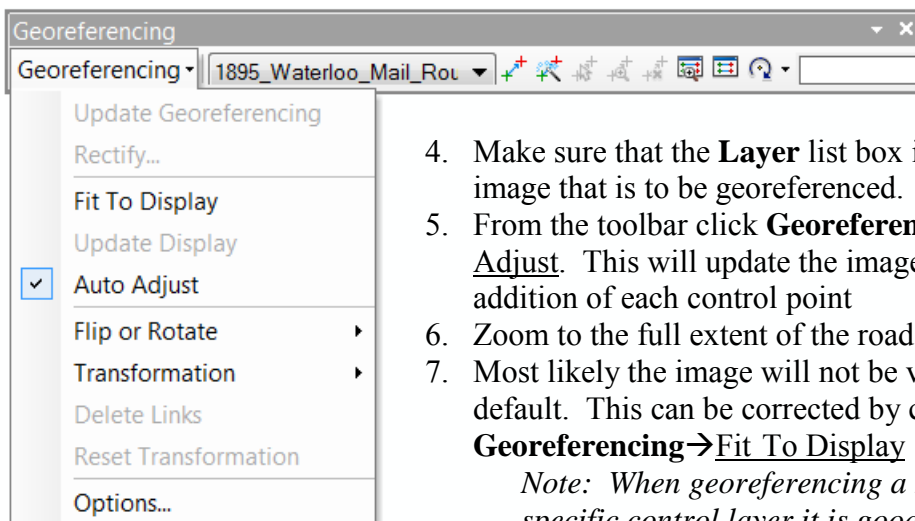



Figure 1: Georeferencing toolbar

4. Make sure that the **Layer** list box is set to the image that is to be georeferenced.
5. From the toolbar click **Georeferencing**→Auto Aadjust. This will update the image with the addition of each control point
6. Zoom to the full extent of the road network
7. Most likely the image will not be visible by default. This can be corrected by clicking **Georeferencing**→Fit To Display

Note: When georeferencing a map to a specific control layer it is good practice to project the control layer using the same projection as the paper map in order to minimize any distortion

Georeferencing the data

1. Begin by clicking the Add Control Points button 
2. Select a point on the image and match it to a point on the control layer. When georeferencing images, it is often helpful to use the corners of features such as fences, buildings, fields or the intersections of roads

*Tip: Use the magnification window to avoid having to zoom in and out at different extents. Click on **Window**→Magnifier*

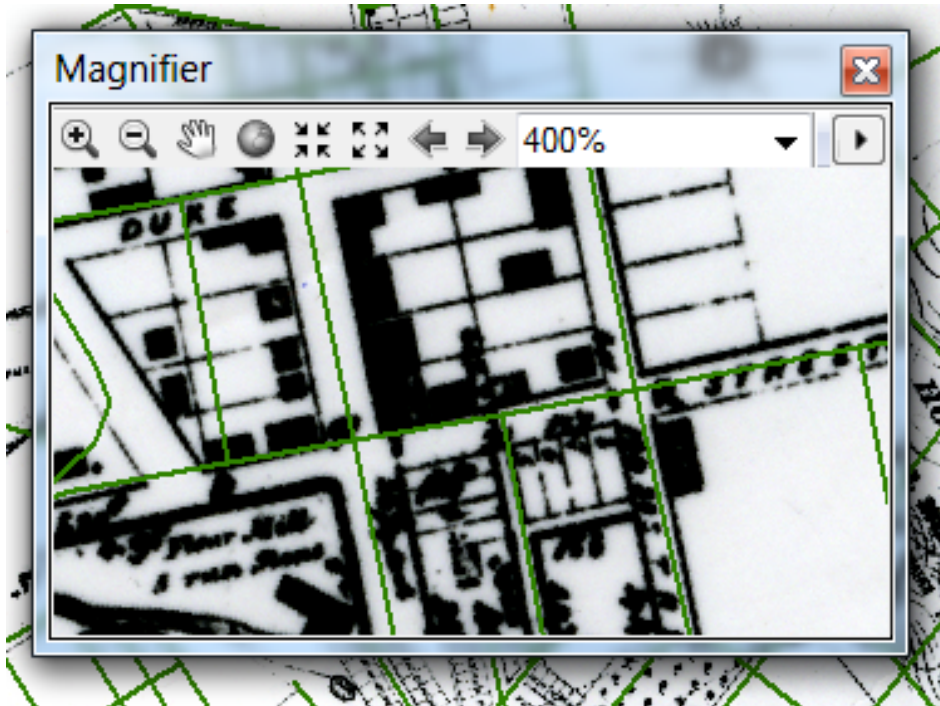



Figure 2: Magnification window

3. Continue adding the control points until the desired level of accuracy has been achieved. The image will update automatically if **Auto Adjust** is enabled
4. At any time the attributes of each control point can be viewed by clicking on the View Link Table button . This dialogue shows the map coordinates of the source (**X Source** and **Y Source**) and destination points (**X Map** and **Y Map**). By double clicking on the **X Map** and **Y Map**, the destination coordinates can be altered if they are incorrect. Also, any control point can be deleted via the **Link Table** dialogue
5. Once four control points have been added an RMS error can be calculated for each point. The RMS error measures the accuracy of the control points and can be used to find inaccurate entries. Frequently, major projects will require that the RMS error does not exceed half the pixel size, however, other projects will just try to minimize the amount of

error. Acceptable error levels depend on the accuracy required for the project and the data being georeferenced

6. Once all the control points have been added the image must be updated and, if needed, rectified. From the toolbar click **Georeferencing**→**Update Georeferencing** to store the control points. If this image is going to be used in ArcMap again there is no immediate need to rectify the image. Once the image is added to ArcMap it will be transformed on the fly using the coordinates obtained from the control points. A permanent transformation can be applied by **Rectifying** the image
7. To Rectify the image, click on **Georeferencing**→**Rectify** and specify the **Output** path and filename. Leave all other values as default
8. The image will be transformed and a new raster will be created in a TIFF file format



Figure 3: Georeferenced map with single line street network (RMOW)