

Lab 5: Georeferencing, Digitization, and Processing

Purpose: An introduction to georeferencing images, practice digitizing, and combine lesson up to this point.

To Do: Register a scanned image, digitize features from the image, and produce a map with these features and data from other sources.

To Turn In: Map with digitized features and other data and a Map from an area you have picked.

Data: S:\GEY_430_630_Spr04\traning

- *hen_sw_noref* is an unregistered, scanned image, scanner coordinates, 1 meter cell size.
- roads, a road data layer for the study area, in NAD27 Transverse Mercator coordinates.

Extensions Required for ArcGIS - ArcMap: none

Image data are a common source of information, and particularly useful when mapping vegetation, wetlands, or other natural resources. Digital orthophoto quadrangles (DOQs) are a uniform set of image data that are geometrically accurate and available for most of the United States. However, DOQs are black and white images, they are often based on photographs taken when vegetation is dormant, and they may not be recent.

Many natural resource applications require data that are best collected from color infrared (CIR) photographs. Wetland and vegetation identification are often easier, more detailed both spatially and categorically, and more accurate when using CIR photographs.


Unfortunately, CIR photographs are typically not in a form that may be easily used. With the widespread availability of reasonably precise image scanners, the CIR photograph may be converted into a digital grid that may be displayed on screen. We may then digitize directly on-screen. However, these coordinates will be in some arbitrary scanner or screen coordinate system. If we wish to convert the digitized vector features to a projected coordinate system, we must perform a georeferencing or image registration. An image registration, often called an image transformation, converts the image from a file or scanner coordinate system to a projected map coordinate system.

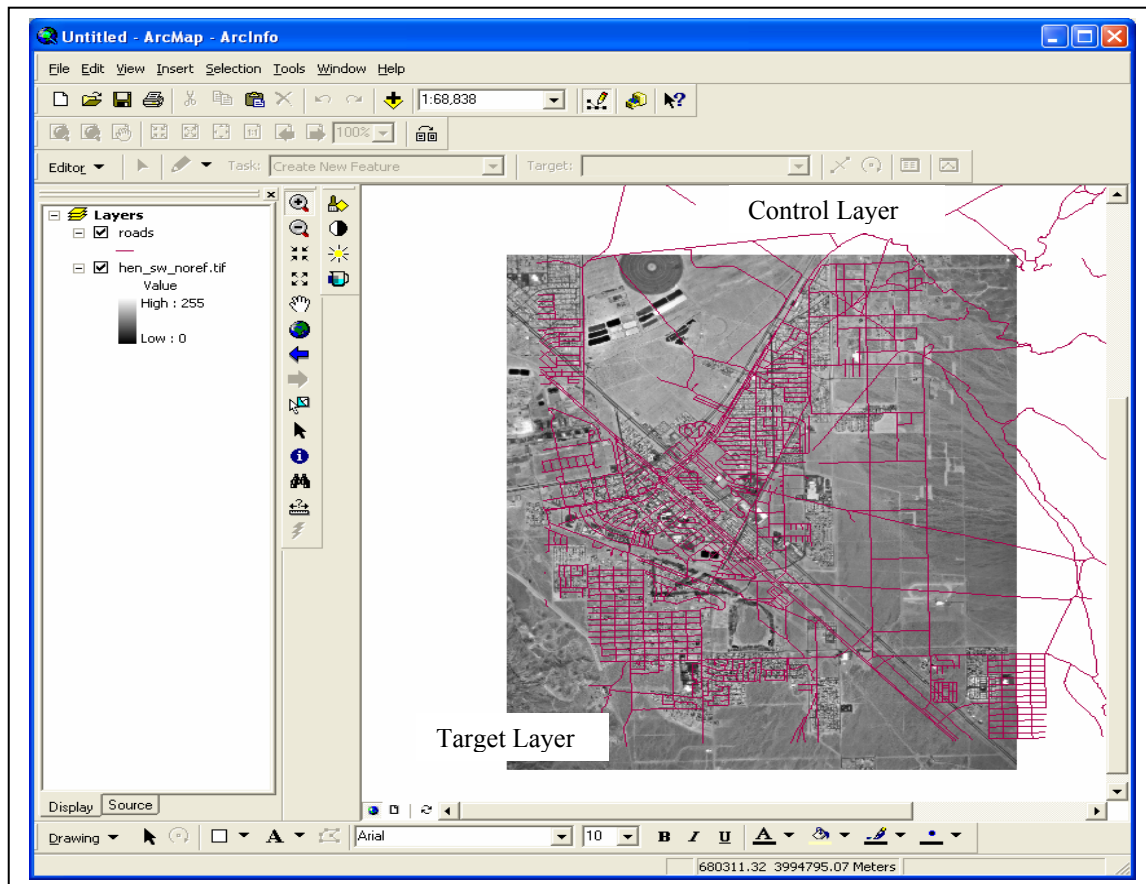
There are many forms of image registration, but the simplest is called a *first-order* or *affine* transformation. An affine transformation is appropriate when the terrain is flat and the photograph has been taken with a vertically oriented metric (mapping) camera. When a non-mapping camera is used, or when there is significant terrain, or when the camera is not pointed straight down (vertical), then a projective transformation should be used.

Part I

Loading Image Data

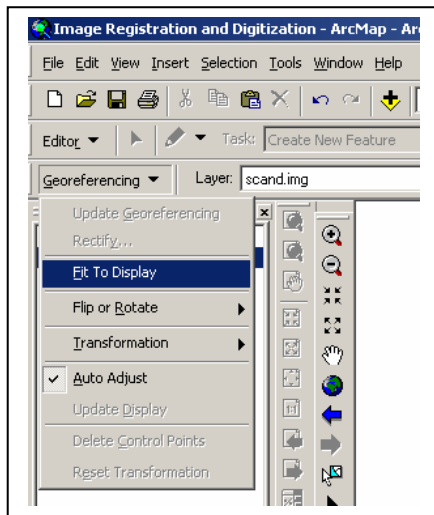
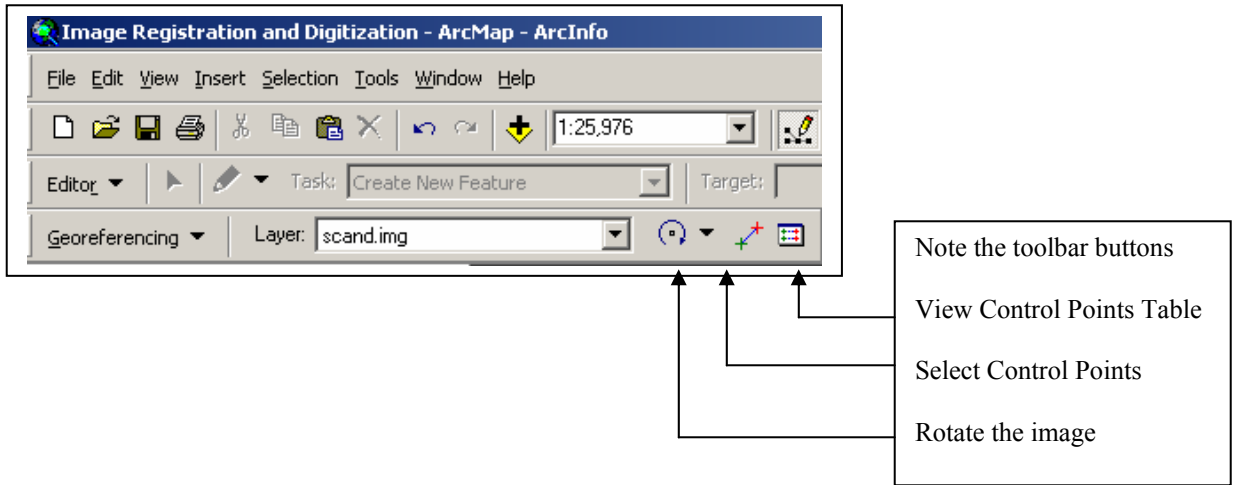
The first thing you need to do is load a control layer and a target layer. In our case the target layer is an image, but there are times when we wish to register point, line, or polygon feature layers. Here, our target image (*aerial photo*) is in scanner or some other untransformed coordinate system. This is the image you wish to register. The control layer (*roads.shp, roads in Henderson, NV*) is the source for your control information. This control layer must be in the desired map coordinate system. You will identify points in the control image, and match them to corresponding points in the target image. When you have enough points and are satisfied with them, you create the transformed image.

- Start ArcGIS - ArcMap, and open a blank map.
- Set up the saving with Save-As; give the map a descriptive name and location on in your Lab 5 data directory.
- From S:\GEY_430_630_Spr04\training add hen_sw_noref, this is our **target layer**.
- Now from S:\GEY_430_630_Spr04\training add roads.shp. This is our control layer, the one from which we will get control locations.
- Notice how the two data layers are in different locations on view. If you can't see both layers, click the zoom to full extent button,  and you should now see both the image layer and roads layer (see figure)



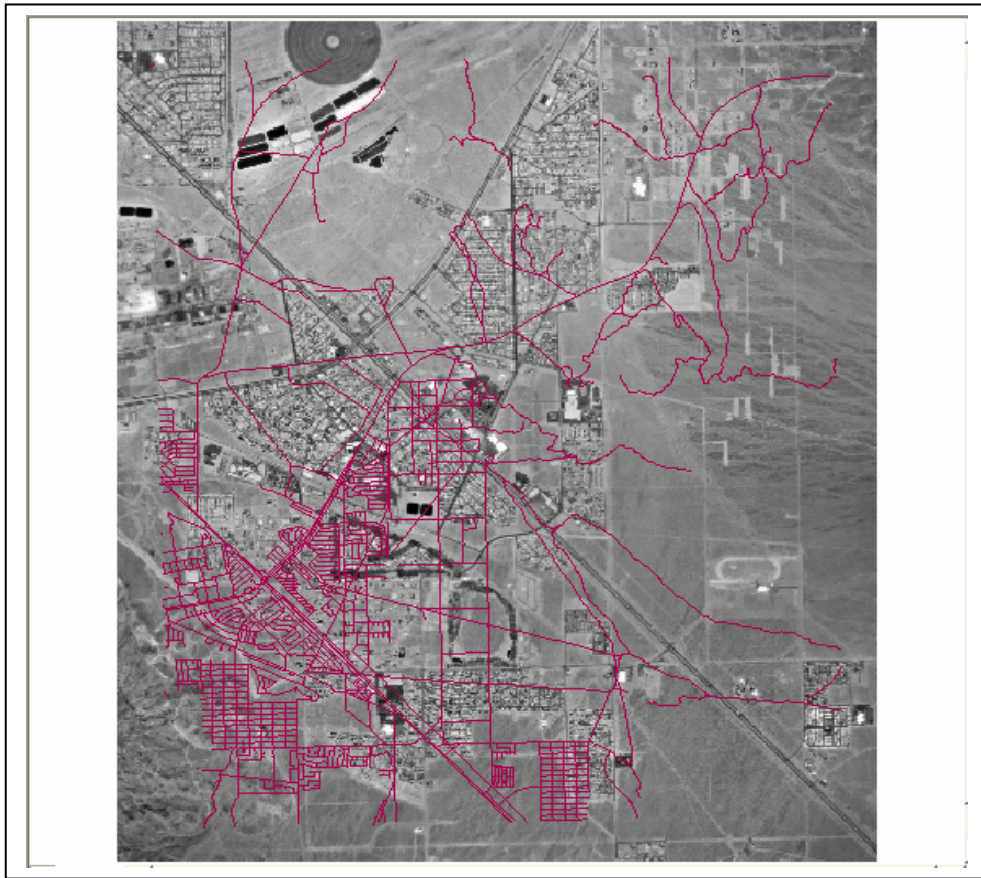
- Make the roads.shp layer active (click on it) then right click and select Zoom to, Layer. This will put the roads into the center of the display. We need to see all the roads to begin Georeferencing. To get the georeferencing tool bar, Click view, toolbars, georeferencing.

Notice the Georeferencing toolbar. Make sure the Layer: is hen_sw_noref. This is the layer we on to which we will add geographical coordinates (*georeferencing*).

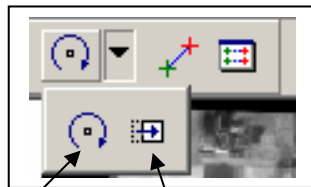


In the Georeferencing drop down box select the Fit to Display

- This will bring the target and control layers close together.



- We will use selected control points to line up the aerial photo, but 1st let try and line up the photo by hand.



- Use the Rotate cursor or the Pan cursor to try and move the picture to match the roads. You will notice you can't do it. Sometimes you get close with one road but the next one is off. That is because the roads layer and the unregistered image are not only out of alignment but also differ in SCALE. This gives you a better idea how the affine georeferencing algorithm works. The affine transformation will shift, scale and rotate the image.

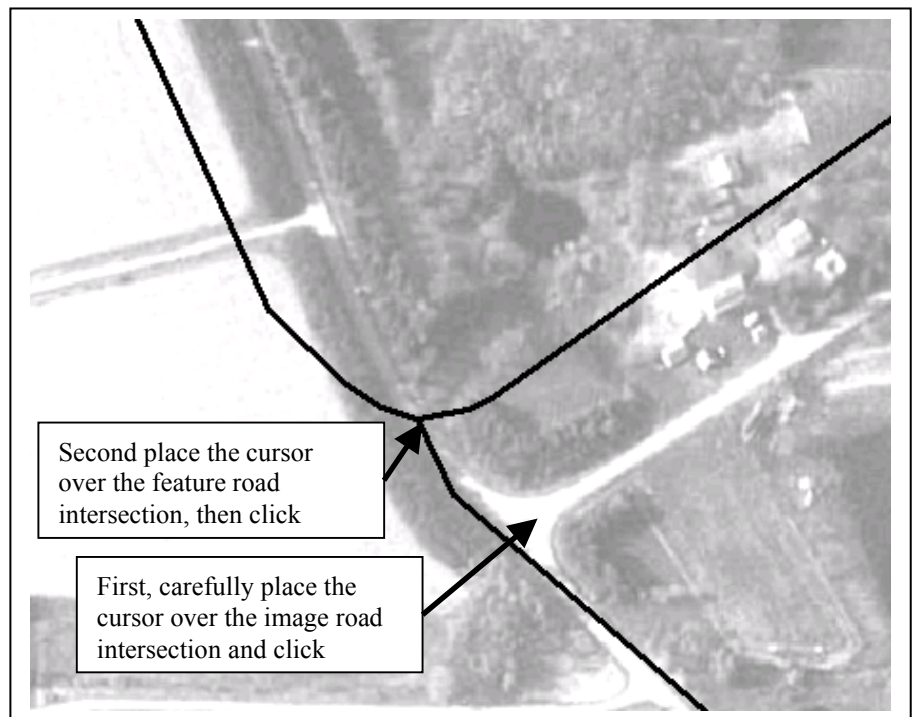
To georeference the image select the control point cursor.



Now select a succession of control links, or points, between the target layer and the control layer.

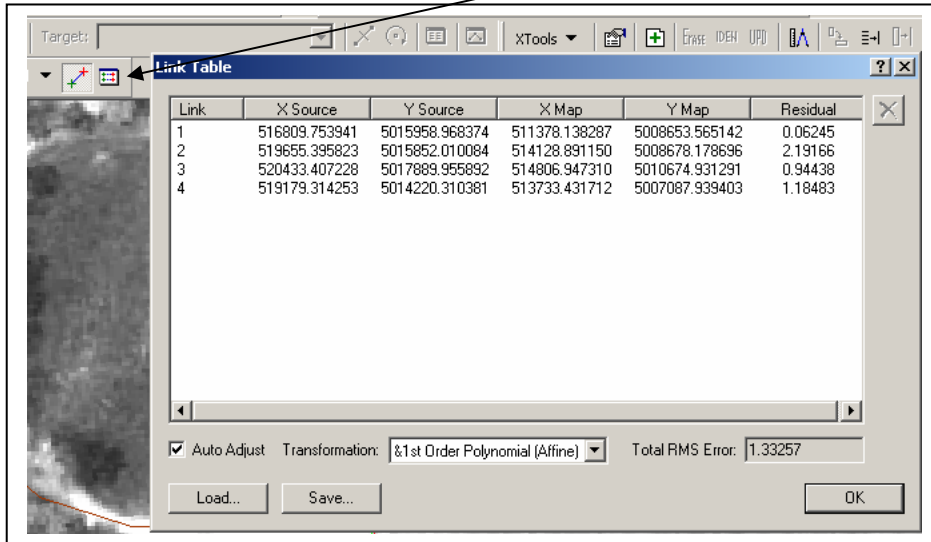
Note that the selections should always proceed as:

- ***First select a point in the target layer (the image),***
 - ***then select the corresponding point in the control layer (the roads in this case)***
- Zoom in on the view to a portion with a road intersection. Zoom in enough so that you may clearly see the width of the road, and easily position the cursor in the middle of the road on the image (please see the figure).
 - Carefully place the cursor in the center of a road intersection in the image, and click.
 - Now, carefully place the cursor over the corresponding road intersection in the feature layer, and click. If all went well, you should see the image shift slightly match the feature a bit.



- It is best to pick well distributed points, so for you second point select a intersection on the right side of the picture.
- Repeat this procedure, that is, pan to a different road intersection, click on the image version first, then on the feature layer version.
- Use the scroll arrows to pan on the image or use the zoom buttons.
- If you lose you link line after you zoom or pan, click once on the Control Point button. This will bring you line-in-process back on to the display.

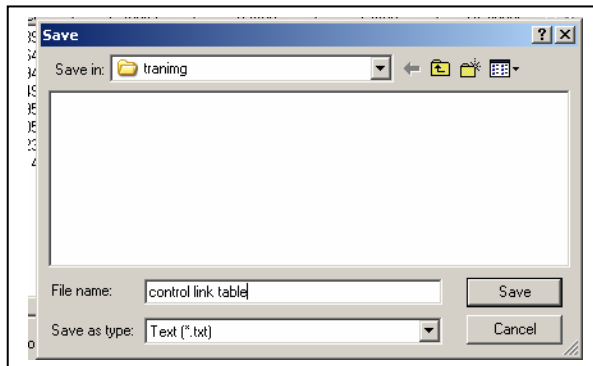
- With each successive control link, the image should line up a bit better.
- After your 4th link examine the Control Link Table. (Use the button)



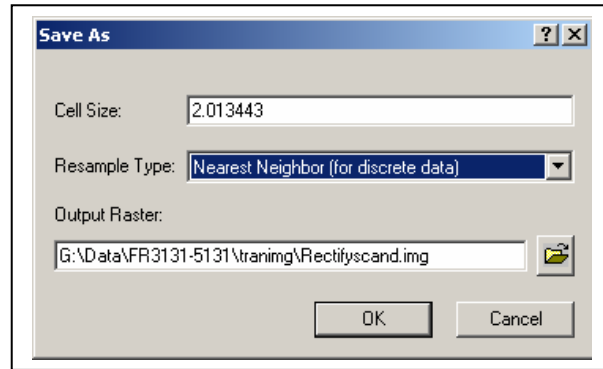
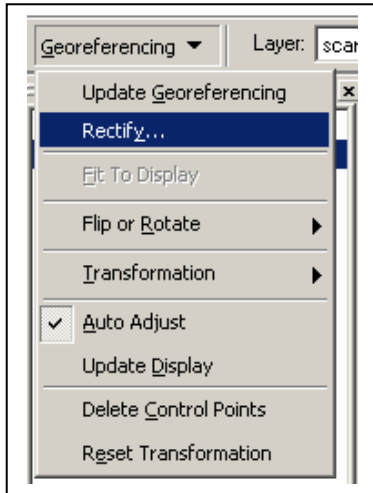
- Notice that after the 4th link you get a report of the current point error, and the RMS error in the lower right Link Table. This reports an index of the accuracy of your transformation. Strive to keep your mean number below 13, and if you can, below 10.
- Continue until you have at least eight control links. If you make a mistake, open the Link Table, select the line and push the Delete key.

(One tip: You can often select more than eight points and delete the ones that contribute the least to the fitting equation. The Residual numbers on the right side of the Link Table tell which ones are most helpful. Remember to keep your points well distributed, don't delete all the high residuals so that your retained points are all on one side of the image)

- Write down your final RME value. You will later add this to you printed Map.
- When you are done, from the Control Link Table, save you link point table. Use a name you can remember.



- From the Georeferencing Toolbar select Rectify to save the image to a file.

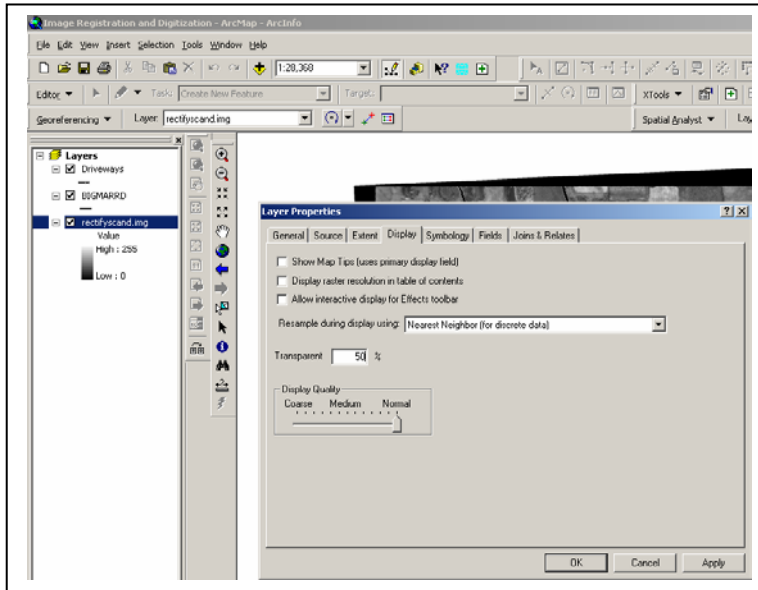


Remove you unregistered photo (hen_sw_noref) from the Map and add your new registered image. If you used the default name it will be Rectifyhen_sw.img.

Now you need to do one last thing. Digitize the new roads/driveways that appear on the image (see the example in the figure below for a minimum set to digitize, your work will be looked upon favorably if you are more thorough).

To digitize, remember:

- In the view, Create a new Layer, Poly-line, Import the Projection from the other layers in the Map.
- Start editing; setup Snapping to the roads and to the new driveway layers. Select the draw line button, and digitize the lines. Remember to double click to end a line, and pan and zoom to get a detailed view so that you may digitize them accurately.
- When you are done, remember to select Save Edits, and then Stop Editing.



Now select the Registered Image layer and right click to Properties – Display.

Change the Transparency to 50%. This will help you see the roads and driveways on the printed Layout.

Create and print a layout containing the transformed image, the roads and driveways, new roads, a scalebar, north arrow, title, legend.

Part II:

Now that you are experts in map making, it is time for you to spread your wings a bit and see how well you know your stuff. Go out online and find a DOQ or DRG of your choice. Please complete the following steps on your processing.

1. Download data source – provide the link and filename in your write-up.
2. Reproject the data with at least two different projections and hand in a map similar to Lab 4 with the 3 different projections.
3. Using the original data, digitize point, polylines, and polygons. Hand in a map similar to Lab 3.
4. Write-up the step you took for all processes.

Name:

Suggestions for Improvement: Lab 5

Please help me improve this lab. As incentive, any improvements incorporated (or major errors removed) will gain you a point on your final grade total.

What didn't work in this lab, and how would you fix it?

What was the best part of this lab exercise?