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# Mapping Imagery

ArcGIS Desktop 10.1 Instructional Guide



**RICE**

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This guide was created by the staff of the GIS/Data Center at Rice University and is to be used for individual educational purposes only. The exercises outlined in this guide require access to particular software and datasets which are available at Fondren Library.

# Obtaining the Tutorial Data

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Before beginning the tutorial, you will copy all of the required tutorial data onto your Desktop. Follow the applicable set of instructions below depending on the particular computer you are using.

## Accessing tutorial data from Fondren Library using the *gistrain* profile

If you are completing this tutorial from a public computer in Fondren Library and are logged on using the *gistrain* profile, follow the instructions below:

1. On the Desktop, **double-click** the **Computer icon** → **gisdata (\\fon-gis04) (O:)** → **Short\_Courses** → **Bringing\_Data\_Into\_ArcGIS\_Series** → **Mapping\_Imagery**.
2. To create a personal copy of the tutorial data, **drag** the **ImageryTutorialData** folder onto the Desktop.
3. **Close all windows**.

## Accessing tutorial data online using a personal computer

If you are completing this tutorial from a personal computer, you will need to download the tutorial data online by following the instructions below:

1. Using a web browser, go to the Mapping Imagery short course webpage at: <http://library.rice.edu/gis-imagery>
2. At the bottom of the webpage, under the Resources section, **click** the **Mapping Imagery – Tutorial Data** link to download the tutorial data.
3. **Unzip** the **ImageryTutorialData** folder.
4. **Copy** the unzipped **ImageryTutorialData** folder to your Desktop or another location of your choice. Ensure that you note the file path of the location you have selected.

Any time throughout the tutorial that you see reference to the file path *C:\Users\gistrain\Desktop\ImageryTutorialData*, you will need to substitute it with the file path you have just selected.

The following step-by-step instructions and screenshots are based on the Windows 7 operating system with the Windows Classic desktop theme and ArcGIS for Desktop 10.1 software with an Advanced license. If your personal system configuration varies, you may experience minor differences from the instructions and screenshots.

# Setting Up a Map Document

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You will begin by opening ArcMap and creating a new map document.

1. On the desktop, double-click the **ArcMap 10.1** icon.
2. In the 'ArcMap – Getting Started' window, ensure that **My Templates** and the **Blank Map** template are selected.

At the bottom of the window, notice the default geodatabase for this map is currently set to C:\Users\gistrain\Documents\ArcGIS\Default.gdb. The default geodatabase should be set to the geodatabase that will contain most of the data for the particular map document you are working on. In this case, you will want to use the geodatabase in your *ImageryTutorialData* folder.

3. Next to the 'Default geodatabase for this map:' box, click the **Browse** button.



4. In the 'Default Geodatabase' window, click the **Connect To Folder** button.



5. In the 'Connect To Folder' window, select the *ImageryTutorialData* folder located on the Desktop.

Ensure that the *ImageryTutorialData* folder is highlighted in blue and not the *RiceCampusData.gdb* geodatabase that appears inside it. You never want to connect directly to a geodatabase, as doing so will prevent you from being able to access any of the data contained inside of it.

6. For 'Folder:', verify that either the *ImageryTutorialData* folder or the **C:\Users\gistrain\Desktop\ImageryTutorialData** filepath is listed and click **OK**.
7. In the 'Default Geodatabase' window, select the *RiceCampusData.gdb* geodatabase and click **Add**.
8. Ensure the 'Default geodatabase for this map:' box says "**C:\Users\gistrain\Desktop\ImageryTutorialData\RiceCampusData.gdb**" and click **OK**.

At this point, it is a good idea to save your map document and to continue saving regularly.

9. On the Standard toolbar, click the **Save** button.



10. In the 'Save As' window, use the 'Save in:' drop-down box to select the ***ImageryTutorialData*** folder.

You will save the map document here, directly inside the *ImageryTutorialData* folder, but NOT within the *RiceCampusData* geodatabase.

11. For 'File name:', type "RiceCampus" and click Save.

Remember that, in order for your GIS project to open properly on other computers, you must tell the map document to store relative pathnames to its data sources and take your **entire project folder** containing all of your data and your map document with you.

12. Click the File menu and select Map Document Properties....

13. Towards the bottom of the 'Map Document Properties' window, click the checkbox to 'Store relative pathnames to data sources' and click OK.

14. On the Standard toolbar, click Save again to store this setting in your map document.

15. On the Standard toolbar, click the Add Data button to open the 'Add Data' window.



16. Double-click the ***RiceCampusData*** geodatabase.

17. Click the ***buildings*** feature class.

18. Hold down Shift and click the ***streets*** feature class to select all four feature classes.

19. With all four feature classes selected, click Add.

The layers of the Rice campus should look familiar. If desired, update the symbology of each of the layers to a color of your choice. For example, you might choose to make the *parking* and *streets* layers gray, the *sidewalks* layer tan, and the *building* layer red.

Now you will add in a JPEG file depicting an aerial view of campus. This image is just like any other image file you are familiar with and does not contain any sort of spatial reference.

20. Again, on the Standard toolbar, click the Add Data button.

21. In the 'Add Data' window, click the Up One Level button to return to your ***ImageryTutorialData*** folder.



22. Select the ***aerial.jpg*** raster image and click **Add**. (Do *not* double-click the aerial file to add.)
23. When asked if you'd like to build pyramids, click **Yes**.
24. When a window appears alerting you that the aerial image does not have a spatial reference, click **OK**.
25. In the Table of Contents, right-click the ***streets*** layer and select **Zoom to Layer**.
26. In the Table of Contents, right-click the ***aerial*** layer and select **Zoom to Layer**.

Both layers appear in the data frame, but, as expected, the image cannot be lined up with the other data layers, because it has not been georeferenced and no projection has been defined.

Occasionally, you will come across an undefined data layer for which you cannot locate complete metadata telling you the coordinate system and projection for the data. In other cases, you may wish to make use of raster data that never had a coordinate system in the first place, such as this aerial photograph or a scanned historical planning map. Whenever the spatial reference for a layer is unknown or non-existent, you must georeference the layer by lining it up visually with other layers that have a known projection.

## Georeferencing

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Since the aerial photograph never had a coordinate system associated with it, you will need to georeference it based on the other campus layers using control points. Control points are recognizable points in both layers that occur in the same geographic location.

1. Click the **Customize** menu and select **Toolbars > Georeferencing**.

Before you can begin to align the aerial image with the other layers, you will need to be able to see them all in the same view.

2. Right-click the ***streets*** layer and select **Zoom to Layer**.
3. In the Georeferencing toolbar, click the **Georeferencing** drop-down menu and select **Fit to Display**.

The full extent of the image now appears behind the current layers. It is always good to zoom in to the approximate extent of the image before using the Fit to Display command. Notice that while both layers are now visible, they are not yet aligned.

You now need to identify a common point in both the aerial image and the vector layers.

4. In the Table of Contents, uncheck the ***parking*** and ***sidewalks*** layers to make the aerial image easier to view.



9. Click on the southwest corner of the upper deck of the stadium in the *aerial* layer.



10. With a line linking to the first point you clicked on, click on the southwest corner of the upper deck of the stadium on the *buildings* layer.

The two points will snap together, lining up the image at that particular control point.

11. In the Table of Contents, right-click the *streets* layer and select **Zoom to Layer** to return to the full extent of the image.

At this point, the image is aligned at the one control point, but the scale of the image does not match the scale of the vector layers, so nothing else is yet aligned. You will need to select another control point to begin to establish the proper scale. Remember, it is best to select a point that is **not** horizontally or vertically in line with the existing control point.

12. Visually, identify **Fondren Library** in both the *aerial* layer and the *buildings* layer.
13. On the Tools toolbar, click the **Zoom In** button.

14. In the center of campus, click and drag a box around Fondren Library in **both layers** to zoom into the area in which you will add your second control point.



15. In the Georeferencing toolbar, click the **Add Control Points** button.
16. Hold down the **Spacebar** to temporarily override snapping, so that you can accurately click on the **southwest corner of Fondren Library** in the *aerial* layer, without being forced to snap to the vector layers.



17. Release the **Spacebar** to reactivate snapping and, with a line linking to the first point you clicked on, click on the **southwest corner Fondren Library** on the *buildings* layer.

The two points will snap together, lining up the image at that particular control point.

18. In the Table of Contents, right-click the **streets** layer and select **Zoom to Layer** to return to the full extent of the image.

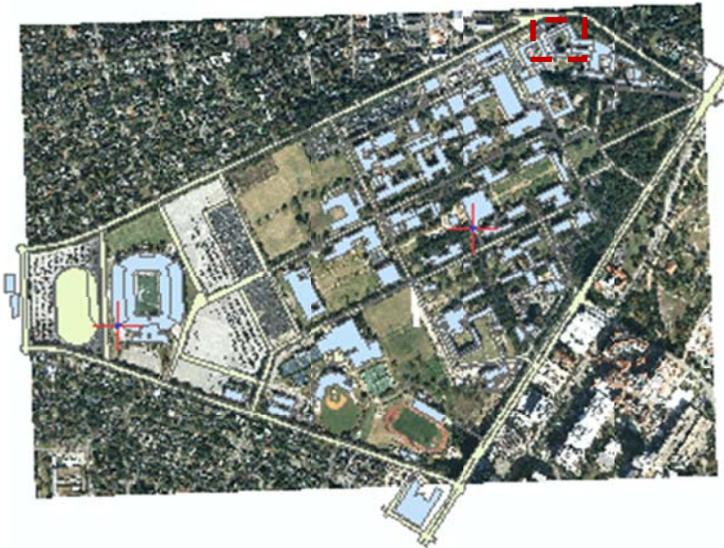
At this point the majority of the image appears to be aligned. If you decide to add another control point, you should do so wherever there is currently the most discrepancy between the image and the vector layers.

Notice that, in the northern-most section of campus, the buildings are not quite aligned. You will add a third control point in that area.

19. Visually, identify **Martel College** in both the *aerial* layer and the *buildings* layer.

20. On the Tools toolbar, click the **Zoom In** button.

21. In the northern-most portion of campus, click and drag a box around **Martel College** in **both layers** to zoom into the area in which you will add your third control point.



22. In the Georeferencing toolbar, click the **Add Control Points** button.

23. Hold down the **Spacebar** and click on the **northwest corner of Martel College** in the *aerial* layer.



24. Release the **Spacebar** and, with a line linking to the first point you clicked on, click on the **northwest corner Martel College** on the *buildings* layer.
25. In the Table of Contents, right-click the **streets** layer and select **Zoom to Layer** to return to the full extent of the image.

At this point, the image looks well aligned with the other vector layers.

26. On the Georeferencing Toolbar, click the **View Link Table** button.

Link	X Source	Y Source	X Map	Y Map	Residual_x	Residual_y	Residual
<input checked="" type="checkbox"/> 1	442.044412	-1570.457610	3107796.628091	13825201.333691	0	-5.58794e-009	5.58794e-009
<input checked="" type="checkbox"/> 2	2308.650435	-1118.846703	3110919.401373	13826064.079013	1.86265e-009	9.31323e-009	9.49766e-009
<input checked="" type="checkbox"/> 3	2680.736282	-129.604243	3111533.044503	13827755.753779	-1.39698e-009	-9.31323e-009	9.41742e-009

Auto Adjust      Transformation: 1st Order Polynomial (Affine)

Degrees Minutes Seconds

This table lists all the control points you have added. The residual, in the final column of the table, is a measure of how distorted the image has become. A lower residual indicates that the georeferenced image has less distortion from the original image. It not necessary to obtain a residual of zero, as this is difficult unless both layers are from the same source or were already in the same coordinate system.

If you added a poor or incorrect control point, you could select it in the table and click the Delete Link button to remove it. You could also simply uncheck it, so that it is no longer factored in to georeferencing calculations. You would then want to continue adjusting your control points until you achieved the desired result.

**27. Close the Link Table.**

Notice that none of the final three control points are in line with each other vertically or horizontally, the image appears to be well aligned, and the residual is at or close to 0. These are all indications that the georeferencing was successful.

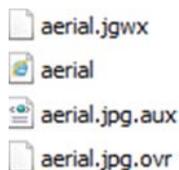
**28. When you are satisfied with your control points, on the Georeferencing toolbar, click the Georeferencing drop-down menu and select Update Georeferencing.**

Notice that the control points have disappeared.

**29. On the Standard toolbar, click the Save button.**

**30. Close ArcMap.**

**31. On the desktop, double-click the *ImageryTutorialData* folder.**



Before beginning this tutorial, there was only one aerial file: *aerial.jpg*. During the tutorial, you generated the three additional files. The JGWX file contains the spatial referencing information that you just created. Because this new file has been created, the image will now line up spatially whenever you add it into a new data frame. In other words, you only need to georeference a layer once.

The OVR file contains an index of the image that was created when you selected to build pyramids upon first loading the image. The pyramids provide a quicker rendering of the image when you zoom in and out in the Map Display window. The XML file contains the metadata used by ArcCatalog to describe the newly georeferenced aerial image.

If you were to delete these three accessory files, the image would no longer be georeferenced and would be returned to its original state.