Image Registration

Using Quantum GIS

Image Registration using QGIS

Objective: To georeference a satellite image using a georeferenced toposheet

Software: Quantum GIS 2.0.1

Level: Beginner

Time required: 3 Hour

Prerequisites and Geospatial Skills

1. Quantum GIS should be installed on the computer
2. Basic knowledge about the QGIS interface
3. Should have completed *Exercise ID: IGET_GIS_001 and IGET_GIS_003*

Reading

1. Sutton, T., Dassau, O., & Sutton, M. (2009). A gentle introduction to GIS. *Chief Directorate: Spatial Planning & Information, Eastern Cape.*

**Tutorial Data:** Tutorial data can be downloaded from IGET_GIS_004

Introduction

"Image registration is the process of overlaying two or more images of the same scene taken at different times, from different viewpoints or by different sensors (Zitova and Flusser, 2003)". In Geospatial perspective, we are establishing a relationship between the image coordinate system of the satellite imagery with the georeferenced base imagery or toposheet. In this practical, the georeferenced toposheet of south Pune (the output if *IGET_GIS_003: Georeferencing*) will be used as base image, and pixel based OrbView satellite imagery will be warped to the georeferenced toposheet of south Pune.

1. We start by opening the georeferenced toposheet in QGIS by clicking on the '***Add Raster layer***' button or via the Menu bar (*Layer → Add Raster*).
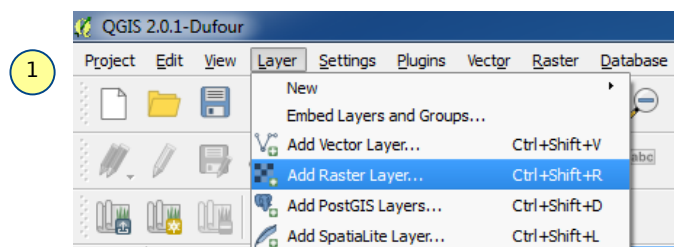

2. A window will pop up in which various files will be displayed. Click on the drop down menu below and select '***[GDAL] GeoTIFF***'. Navigate to the output folder of *IGET_GIS_003: Georeferencing* tutorial and select the georeferenced toposheet file ('*Toposheet_WGS84_georef.tif*') and click '***Open***'.

3. Before starting the registration, we must find out the CRS of the toposheet. The satellite image will need to have the same CRS as that of the georeferenced toposheet. Right-click on the toposheet layer located under '*Layers*' in the main window and then select '***Properties***'.
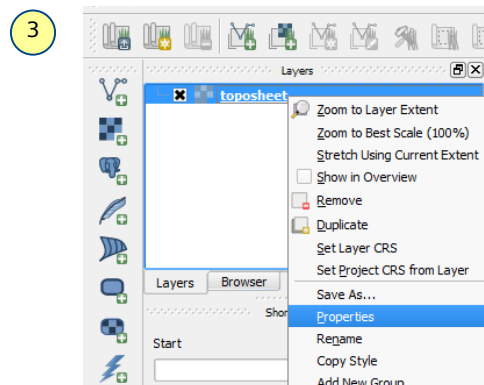
4. '**Layer properties**' window will pop up, select the '***Metadata***' tab and scroll down to the section '***Layer Spatial Reference System***'. It will have the following line written:

+proj=longlat +datum=WGS84 +no_defs

This indicates that, the image is in geographic coordinate system based on **WGS 84** datum. Note down the parameters for the image file and click '***OK***'.
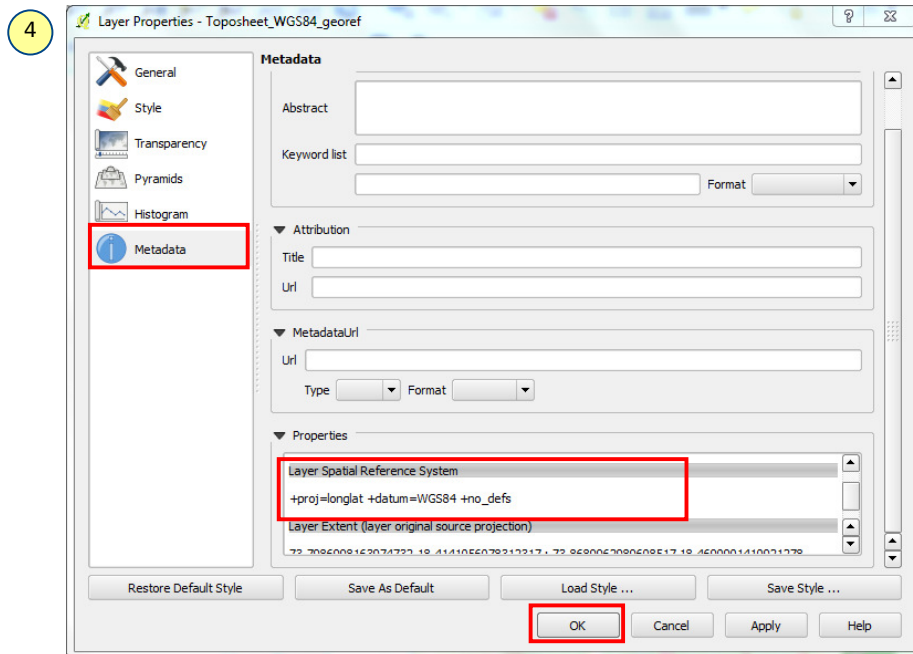

5. We then open the '**Georeferencer**' tool from the *Raster* tab in the Menu (*Raster → Georeferencer → Georeferencer*).
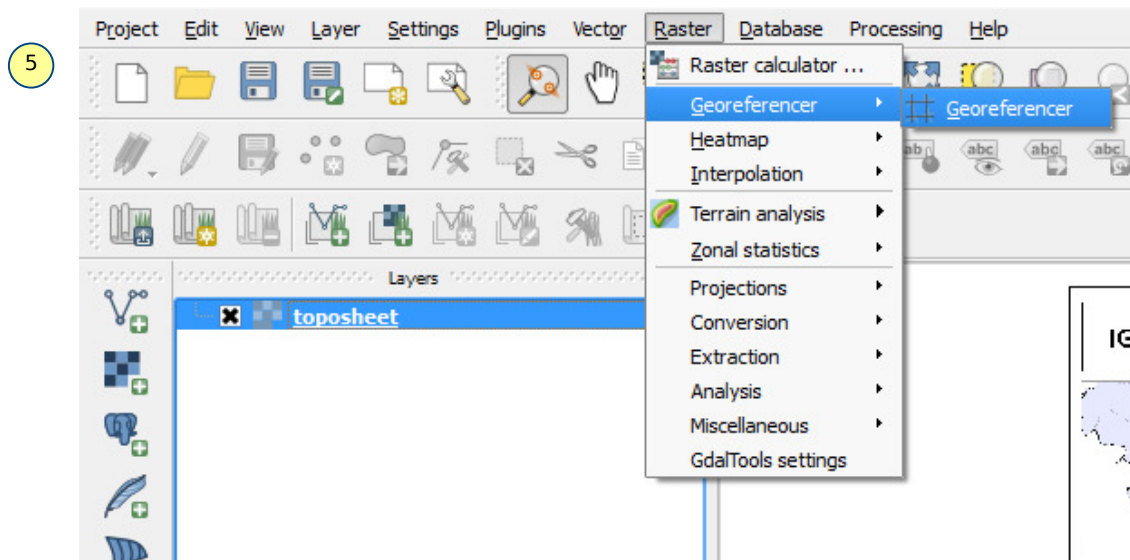
6. In the '*Georeferencer*' popup window, open the '*OrbView_SouthPune.tif*' which needs to be georeferenced by clicking on the '***Open Raster***' button or via the menu (File → Open Raster) (Refer *step2*).
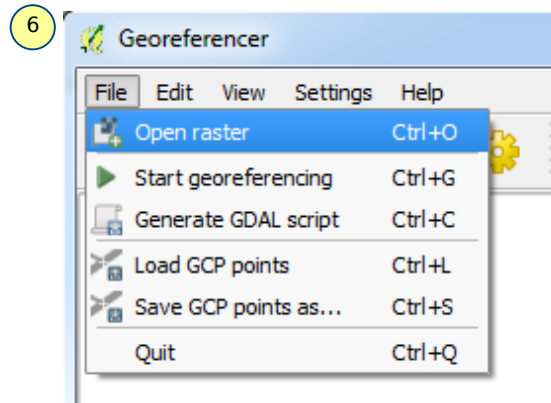

7. On opening the OrbView satellite image, you will be presented with the pop-up window to select the *Coordinate Reference System*. Look for the '***WGS 84***' CRS under the *Geographic Coordinate Systems*. To narrow the search type in '***WGS 84***' in the filter. Select '***WGS 84***' and click '***OK***'. Now you can see the orbview image on the *Georeferncer*'s workspace.
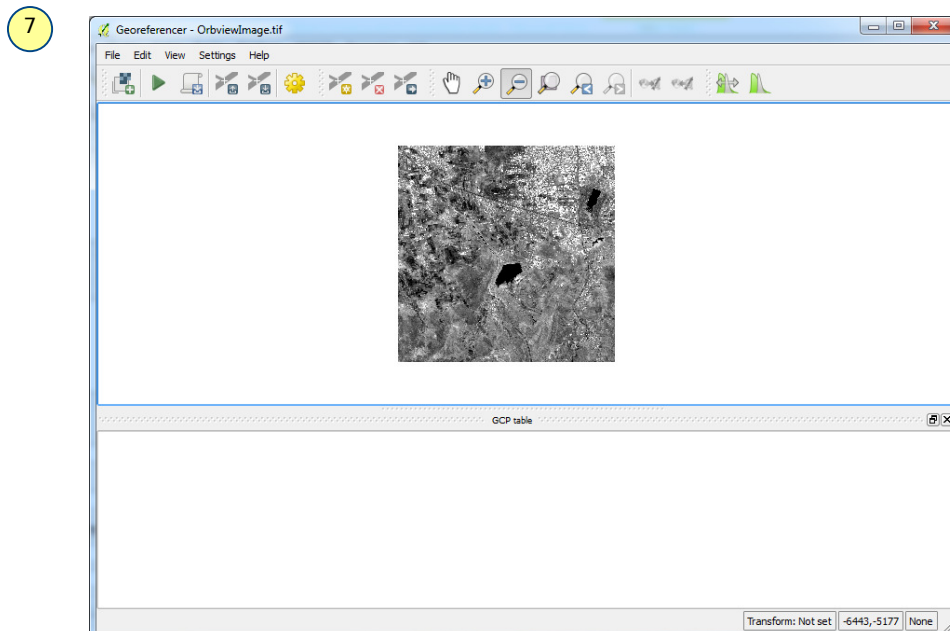

8. Next, identify and zoom into a feature that is easily identifiable on the image. Generally, features like road intersections or building corners are used. To zoom in to a feature

use the Pan , Zoom In , and Zoom Out buttons located on the toolbar or you can use scroll button in mouse.

9. To add a GCP click on the '**Add Point**' button. On clicking the mouse pointer will turn into a '+' sign. Use this pointer to click on the feature that is easily identifiable on both, the image and the toposheet.

10. You will be presented with a dialogue box where you have to input the map coordinates. Click on '**From Map Canvas**' and then Zoom/locate the corresponding feature in the toposheet (loaded in the main window) using scroll wheel in your mouse. Click on it and then click on '**OK**' in the dialogue box. If you are using 'Zoom in'/ 'Pan' (Navigation) tools, you have to right-click the mouse button for '+' sign.
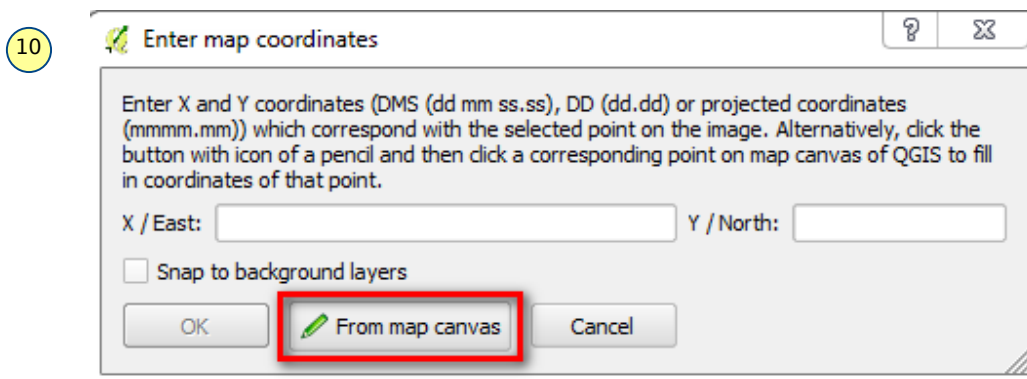
11. This ties the image pixel to its corresponding location in the toposheet.
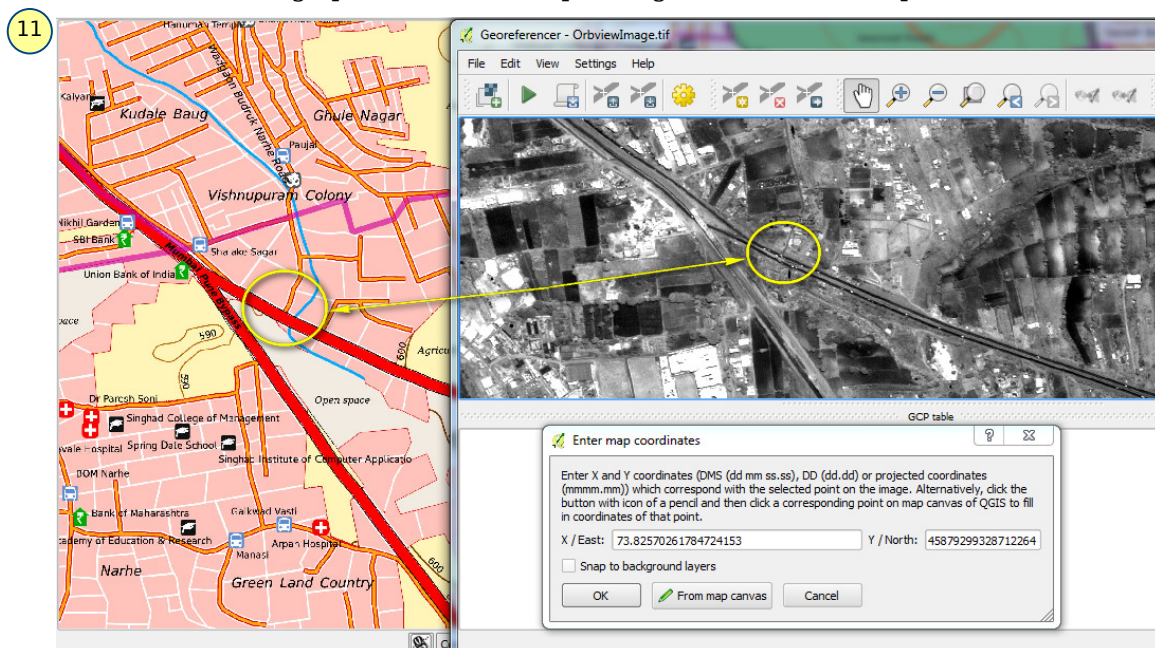
12. Similarly, we then identify at least 6 more well distributed tie points in the image which we can tie to their corresponding locations in the toposheet. While selecting the tie points be sure to match the points as accurate as possible. The features selected for the GCPs should preferably be towards the edge of the map, away from each other and not co-linear. Therefore repeat steps 8-11 for another 6 tie points.

13. We now set the transformation settings for the image by clicking on the '***Transformation Settings***' button . The *Transformation Settings* window pops up in which we will enter the transformation information of our map.

14. Click on the '***Transformation Type***' drop down menu and select '***Polynomial 2***'. This is the second order polynomial transformation. This requires at least 6+1 tie points for the transformation.

15. Click on the button next to '***Output Raster***'. A dialogue box will appear in which we enter the name of our output file. It is recommended to include the name of the original file in this file for example '*OrbView_SouthPune_WGS84_georef.tif* ', This helps us to keep track of our work.

16. '***Check***' the check box '*Load in QGIS when done*', leave the reset of the values as default and click '***OK***'.
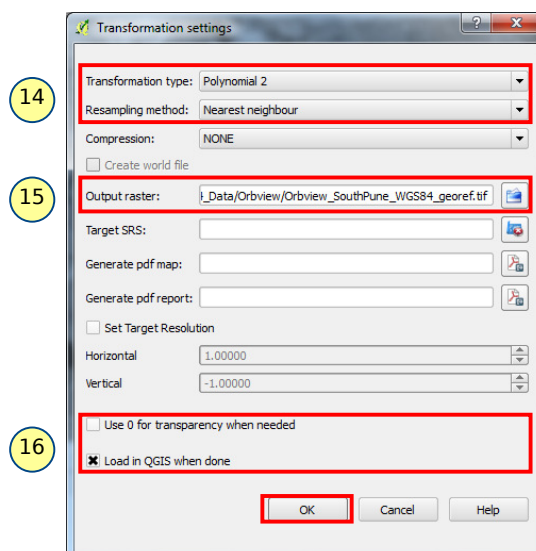
17. After Click '***OK***', the last column '*residual [pixels]*' displays some values. These are the

error values associated with the GCPs. Generally an error value of 1 or less would be recommended in most cases. In this case consider it as 3 pixels.

Note: The accuracy of the georeferencing can be gauged from its *Root Mean Square* (RMS) error which is seen in the last column in **'GCP table'** of the Georeferencer. In this case, try and get the error to be less than 3 pixels. If the error is higher than 3 pixels, adjust the GCPs so that total error can less than 3 pixels and ensure the GCP locations are matched properly on both imagery and toposheet. Here we used 3 pixels because the *OrbView* image has a resolution of one metre and the *plottable error*[1] of our toposheet is 2.5 m because it is on scale of 1:10000. Due to this reason, theoretically it is not possible to achieve the accuracy less than 2.5 m i.e., nearly 3 m because we don't have a concept of half a pixel in an image.

18. Double check and adjust the GCP locations if the value is greater than 3. To adjust a point click on the *'**Move** GCP Point'* button, and then click and drag the point to the desired location. Use '***Delete Point***' button to delete an erroneous GCP. We can also enable and disable the GCPs by using check boxes under **'on/off'** column in **'GCP Table'**.

19. Once we bring the error around or below 3 pixels, click the '***Start Georeferencing***' Button . The processing will take about 2 minutes. The georeferenced image will be found at the location specified for the 'Output File' in *step 15* and will be loaded over the toposheet in map canvas.

Tasks
1. What is image registration and explain its importance in GIS & Remote sensing projects?
2. If two data sets have same CRS, is there any need to perform Image registration?
3. What type of transformation you will use in case of undulating terrain and discuss why?

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[1] Plottable error is the shortest distance that can be depicted on a toposheet at a given scale. It is generally measured as the corresponding ground distance of 0.25 mm on map.