

# Introduction to GIS

## Lab 3: Geometric Transformation

Lecturer: Dr. Yan Yingwei

### Exercises:

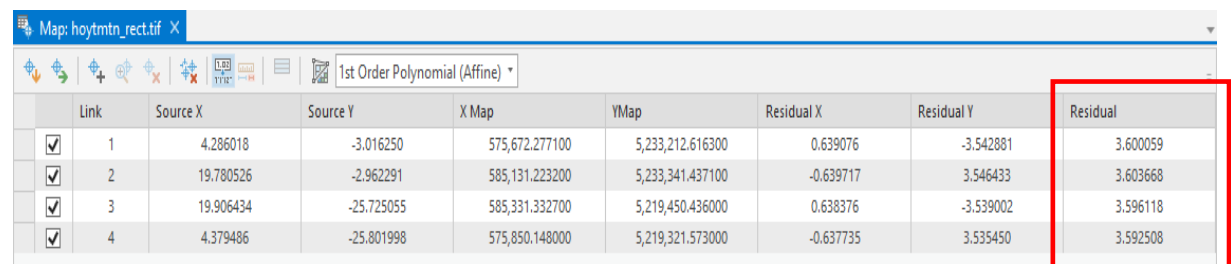
#### Part I: Map-to-map Geometric Transformation

Q-1. What is NAD 1927 UTM Zone 11N? Please describe it in detail. Why do we need to set the SRS as NAD 1927 UTM Zone 11N? (4 marks)

See: <https://epsg.io/26711>

- NAD 1927: Datum - North American Datum 1927
- UTM Zone 11N: The Universal Transverse Mercator (UTM) grid system is a Projected Coordinate System (PCS), the location represented by UTM Zone 11N is at the northern hemisphere
- The image to be georeferenced is with an area located at this UTM zone (this answers why)

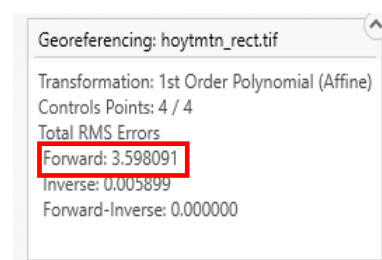
Q-2. Submit a screenshot of your Control Point Table and the on-screen image georeferencing details. What is the total RMS error in meters? Please explain how it is calculated using equation(s) and the values in your Control Point Table. (3 marks)



The screenshot shows the QGIS Control Point Table for a map named 'hoytmtn\_rect.tif'. The table has 9 columns: Link, Source X, Source Y, X Map, YMap, Residual X, Residual Y, and Residual. There are 4 control points listed, each with a checked 'Link' checkbox. The 'Residual' column values are 3.600059, 3.603668, 3.596118, and 3.592508. A red box highlights the 'Residual' column.

	Link	Source X	Source Y	X Map	YMap	Residual X	Residual Y	Residual
<input checked="" type="checkbox"/>	1	4.286018	-3.016250	575,672.277100	5,233,212.616300	0.639076	-3.542881	3.600059
<input checked="" type="checkbox"/>	2	19.780526	-2.962291	585,131.223200	5,233,341.437100	-0.639717	3.546433	3.603668
<input checked="" type="checkbox"/>	3	19.906434	-25.725055	585,331.332700	5,219,450.436000	0.638376	-3.539002	3.596118
<input checked="" type="checkbox"/>	4	4.379486	-25.801998	575,850.148000	5,219,321.573000	-0.637735	3.535450	3.592508

(GCP table screenshot)



(Screenshot for on-screen image georeferencing details)

- The total RMS error in meters should be greater than 4 m and the unit is needed.
- The calculation is as follows (with an equation filled with the values from the GCP table).

$$\text{The total RMS error} = \sqrt{\frac{(\text{Residual } 1)^2 + (\text{Residual } 2)^2 + (\text{Residual } 3)^2 + (\text{Residual } 4)^2}{4}} = 3.598091$$

Example solution 1: The total RMS error = 
$$\sqrt{\frac{\sum_{i=1}^n (Residual_i)^2}{4}}$$

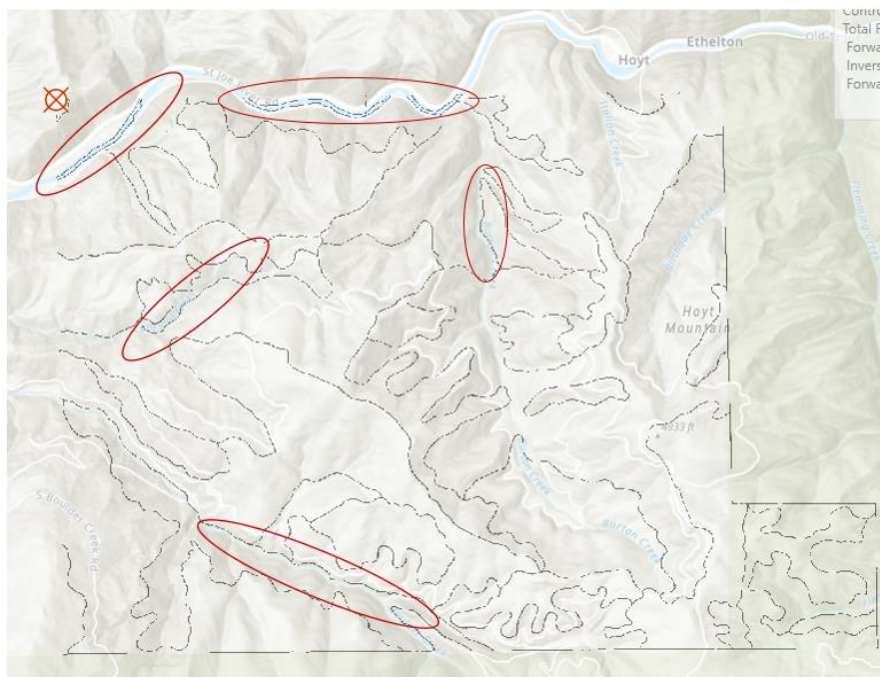
$$= \sqrt{\frac{(3.60059)^2 + (3.603668)^2 + (3.596118)^2 + (3.592508)^2}{4}} = 3.598091 \text{ m}$$

The total RMS error = 
$$\sqrt{\left[ \sum_{i=1}^n (x_{acu,i} - x_{est,i})^2 + \sum_{i=1}^n (y_{acu,i} - y_{est,i})^2 \right] / n} = 3.598091$$

Example solution 2: The total RMS error = 
$$\sqrt{\left[ \sum_{i=1}^n (x_{acu,i} - x_{est,i})^2 + \sum_{i=1}^n (y_{acu,i} - y_{est,i})^2 \right] / n} =$$

$$\sqrt{[(0.639076)^2 + (-0.639717)^2 + (0.638376)^2 + (-0.637735)^2 + (-3.542881)^2 + (3.546433)^2 + (-3.539002)^2 + (3.535450)^2] / 4} = 3.598091 \text{ m}$$

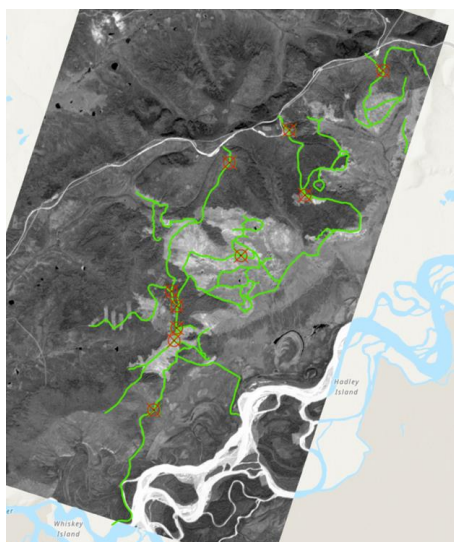
Q-3. Insert the screenshot of the overlaying of the georeferenced map and the base map in a Word document. (0.5 marks).



(Evaluated the georeferencing quality by observing the overlay of rivers)

## Part II: Image-to-map Geometric Transformation

Q-4. Please submit the screenshot of your selected GCP points superimposed on the image together with your on-screen georeferencing details (4 marks).



- For the image, please check whether your GCPs follow the following principle of GCP selection:
  - Relatively evenly distributed on the image and spread out across the map.
- No less than 10 links are required
- Total RMS < 15 m

Please send your inquiries on the marking to your respective TA who assist with the marking as shown in the table below within 7 days from today. Please Cc me.

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SAW YUN YA	Xu Dong
SEE AIK KAI, BRYAN	Xu Dong
SEE QI-EN	Xu Dong
SHAWN LIM LE YANG	Xu Dong
SOH TZE NING	Xu Dong
SOH WOON HAO KENNETH	Xu Dong
SOH ZHU EN JOANNE	Xu Dong
SONG RUIHAO	Xu Dong
SUMAIYA AZAD	Baoyan
TAN JAY LEN	Baoyan
TAN KANGDE ANDREW	Baoyan
TAN KIA SHUANG	Baoyan
TAN KIAT WEE, GARETH	Baoyan
TAN LU JIE LUCAS	Baoyan
TAN YI JUN KEITH	Baoyan
TAN YU JIA	Baoyan
TAN YU KAI LIONEL	Baoyan
TANG HAO MING WHELAN	Baoyan
TANG KAI EVAN	Baoyan
TARA LINGARAJ	Baoyan

TARNOVSKAYA ALISA	Baoyan
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TEO YUN YEW JARRETT	Baoyan
TEOH WEN XUAN	Baoyan
TUNG ZHI YONG, IAN	Baoyan
WAYNE WONG HOI YIN	Baoyan
WEE JING WEN	Baoyan
WEE YI XUAN	Baoyan
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WONG SAM TOU	Baoyan
WONG WEI	Baoyan
YANG LITING	Baoyan
YANNI GAN	Baoyan
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