GEOM 3002: Lab 4
A. Interpretation and mapping of land use/land cover in the Ottawa region using digital aerial imagery
B. Image geometry and flight planning

Due October 17, 18 at the beginning of your lab period. Submit in cuLearn.
10% of final course grade.

Relative marks noted at end of each question in brackets.

PART A: THEMATIC MAPPING USING VISUAL INTERPRETATION

The goal of this part of the lab is to introduce you to land use/land cover (LULC) classification, visual interpretation of LULC, image interpretation in urban environments, and the Ottawa municipality online aerial image database.

The Municipality of Ottawa has awarded your company, *Eyewitness Geomatics Inc.,* a contract to map land use and land cover. The municipality has acquired a large database of aerial photographs that is available for use and interpretation. Your initial task as a pilot test is to develop a methodology that will be potentially applied to all photos for the municipality.

Using Mozilla Firefox web browser, go to http://maps.ottawa.ca/geoottawa/
- Select "I want to" and then "View the historical air photos" and then "2017".
- Zoom into an area of interest to you until the scale bar in the bottom left indicates 0.5km / 0.5 mi, or something close to this (it may vary with different screens).

- The area you select must have a mix of **<u>at least 5 LULC types comprised of some urban and some natural LULCs</u>** (i.e. 5 minimum; there can be more than 5) that you can interpret and map. Common urban LULC types are high density residential, low density residential, industrial, commercial, institutional, transportation, park, etc. Natural land cover types may be forest, short vegetation, water bodies (lakes, ponds, streams), etc. See the lecture notes and textbooks for examples of classes commonly used.
    - When doing this, note the difference between land cover (e.g. treed vegetation) and land use (e.g., park). For this assignment you may have a mix of land cover and land use types or have all land cover or all land use classes.
    - Also note: When you select your area, make sure you will be able to map the whole area – i.e. you **<u>must cover the entire image with polygons</u>** (e.g. no image area can be left unclassified).
    - To export a copy of the area on your screen, from the "*I want to…"* dropdown menu, select '*Print the Map*'. You may add a title and author to the output. Select jpeg as the output format and click *print*. Once the map comes up on your screen, right click and select 'Save As…" and save to your directory. Then insert it (copy it or insert the file) into some software system such as a GIS, graphics software, Word, Powerpoint or Paint that allows you to draw polygons, fill the polygons using different colours, add a legend etc.
- Outline the selected LULC classes throughout the image to produce a LULC map. Fill each polygon with a colour representative of that class. Create a legend showing the classes using their associated colours. Make sure you have a title and a north arrow on your map.
- Once you have completed the above, as an introduction to temporal change analysis, think of an area that has changed a lot over time (if you don't know Ottawa, pan around in the suburbs). Kanata, Stittsville,

Richmond, Orleans, Barrhaven, etc., are examples. You can also use the area of your LULC map if it has changed over time. Select a previous year that is at least 30 years ago. Clicking on and off between your selected photos and the 2017 photos will alternate between them. Or, select "I want to", "View the historical air photos" and move the slider slowly over the photo years to visualized changes. When you do this, you can visually assess the land cover changes that took place between your earlier year and 2017.

Submit the following for Part A of this lab:

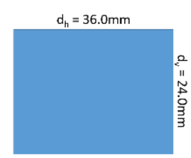
1. Your air photo image and LULC map (with legend) in colour. Your mark for the map will be based on: a. the consistency and correctness of the LULC classes that you selected; b. accuracy of interpretation; c. neatness and clarity of map production; and d. how well you followed the guidelines above.
2. 1.5 pages (maximum) that:
    a. Lists and provides a brief description of the elements of interpretation (see lecture notes and Lab 2) that you used to identify each LULC type; this can be in the format of an interpretation key as discussed in the lecture.
    b. Describes in point form issues that arose in this process (e.g., in defining classes, identifying the classes in the photo, drawing polygons around land cover objects, etc.).
    c. Briefly describes what types of temporal land cover change you noted and issues that arose when trying to assess the temporal change.

Part A marks: 7% of final course grade.

PART B: IMAGE GEOMETRY and FLIGHT PLANNING

Your company, *Eyewitness Geomatics Inc.* has been contracted to acquire high-resolution UAV-based vertical photos of the planned light rail corridor extension from to Moodie Drive and Hwy 417 to Palladium Drive in Kanata. The area to cover is 11.0 km (the length of the extension) x 800 m. The required ground pixel size is 5 cm.

You will use a Canon EOS 5DS R colour camera on your hexacopter drone. It has an imaging sensor that is 36.0 mm (d_L) x 24.0 mm (d_S) and a 24 mm fixed focal length lens.



This camera produces images of 8677 x 5785 pixels. For stereo images to produce a high resolution DEM, and to ensure complete coverage of the area, you have decided that you need a forward overlap of 60% and a sidelap of 25%.

Note: Round <u>final</u> answers in metres to the nearest metre. Use those rounded numbers in any subsequent question where they are required. If you are unable to do the preceding question, use an assumed value for the required number.

Please do not copy answers from another student. Try to learn this on your own. Ask Emily or Doug if you are having problems. There will be an optional question on flight planning on the exam.

1. What will be the ground coverage of each image (D_L x D_S) in metres x metres? (1 mark)

D_L : 0.05m pixels x 8677 pixels = 433.85m = <u>434 m</u>
D_S : 0.05m pixels x 5785 pixels = <u>289.25m</u> = <u>289 m</u>

2. Determine the flight altitude (H) for the camera above ground level rounded to the nearest metre. (1 mark)

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$\frac{f}{H} = \frac{d}{D}$

$\frac{24}{H} = \frac{36.0}{434}$

$H = 24 \times \frac{434}{36.0} = 289.3\ m = \underline{289\ m}$

<u>OR</u>: $\frac{24}{H} = \frac{24.0}{289}$

$H = 24 \times \frac{289}{24} = \underline{289\ m}$

3. Calculate the number of images required to cover the area using the methods given in class (or in Lillesand *et al*.). Orient the camera with the long axis, d_L, perpendicular to the flight direction. (4 marks)

<u>Images/line:</u>
D_S = 289 m; Advance = 0.4 x 289 m = <u>115.6m</u>

<u>Flying the lines along the long dimension of the area minimizes turn arounds:</u>
$\frac{11000\ m}{115.6\ m}$ = 95.16 + 2 (for each line end) = 97.16 = 98 images per line (rounded up)

<u>#lines:</u>
D_L =434 m; Side advance = 0.75 x 434 m = 325.5 m

$\frac{800\ m}{325.5m}$ = 2.46 + 1 = 3.46 = <u>4 lines</u>

<u>Total images = 98 x 4 = 392.</u>

4. For an aircraft speed of 10 knots, calculate the time interval between photos in seconds to one decimal place. Note: First find out how to convert knots into m/s. Then, from the distance between images (the forward advance in m), calculate the time to travel that distance at the determined speed in m/s. (2 marks)

1 knot = 0.51444m/s
10 knots x 0.51444 = 5.14 m/s

Advance/image = 115.6m.
$\frac{115.6\ m}{5.14\ m/s} = \underline{22.5s}$

5. Estimate how long it will take to do this job in minutes rounded to the nearest minute. Assume you can launch the UAV at the start of the first flight line. Include the time to arrive at altitude and to descend after the flight is over, assuming an average ascending and descending rate of 5m/s and 1 minute for each turnaround. (4 marks)

Time to ascend to 289m altitude = 289/5 = 57.8s. Descent also = 57.8s. Ascent + descent = <u>115.6s</u>

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Time between images: 22.5s between images x 392 images = <u>8,820 s</u> (Note if they say 388 spaces x 22.5s = 8730 s, that is actually more correct, because there is one less space/line than photos/line and there are 4 lines)

 # lines = 4, so # turnarounds = 3 x 60s each = <u>180s</u>

Total = 115.6 + 8820 + 180 = 9115.6s = 151.9 = <u>152 minutes</u>.

<u>Total marks B = 12 ÷ 4 = 3%.</u>
<u>Total marks Part A = 7%.</u>
<u>Total A+B= 10%</u>