

# UNIVERSITY OF SOUTH AUSTRALIA

DIVISION OF INFORMATION TECHNOLOGY, ENGINEERING AND THE  
ENVIRONMENT

School of Geoinformatics, Planning and Building

Semester 1, 2000

## **Imaging Technology N : 10221**

Time Allowed : 2 hours + 10 minutes reading time

### **General Instructions to Candidates**

Attempt any TWO questions from Section A and any TWO questions from Section B.

Answer questions from Section A in a **separate book** to Section B

All questions are of equal value.

This is an open book examination.

Programmable calculators are permissible.

Please ensure front of answer books are completed with your name, student I.D. number, course and section of the examination.

## SECTION A

### QUESTION 1

- a) Discuss the significance of spectral reflectance in terms of differentiating objects on the earth's surface from multi-spectral images.
- b) An urban council, which covers an area 15 kilometres by 12 kilometres, requires imagery that can be used to map facilities (bus stops, seats, gardens, road verges, pavements, buildings, etc.) The imagery needs to be acquired at 3 monthly intervals. Discuss the imaging sensors options that council has available.

### QUESTION 2

- a) Describe the role of Colour Look Up Tables (CLUT) in the computer display of digital images.
- b) Images taken of the edge of the Antarctic coast show areas of **very bright white snow and ice, brown rocks and dark seawater**. The detail visible over the areas of snow and ice is minimal. In order to effectively use the imagery in mapping programs it is essential that more detail is available over this area. However, when contrast stretching is applied to these areas on the imagery, little detail can be extracted.

Explain possible reasons for this situation and how it may be remedied when acquiring new imagery.

### QUESTION 3

- a) Sensors can generate images via a variety of acquisition methods. Using examples to assist discussion, explain the following examples of image acquisition:
  - Whiskbroom
  - Pushbroom
  - Star (frame)
- b) A poster is to be plotted via the use of a colour printer that plots at 600 dpi (dots per inch). The poster size is A3 and will be totally covered by colour imagery, graphics and text.
  - i) Calculate the approximate size of the plot file
  - ii) If an image file for the poster is to be delivered across the Internet, describe a method of reducing its size.
- c) Briefly explain the principles underlying wavelet image compression.

## **SECTION B**

### **QUESTION 4**

- a) Aerial photography is to be obtained of a city CBD (for instance Adelaide CBD). The area of interest is 1500 metres by 1500 metres and the tallest building has a height of 100 metres (above the average ground height). The ground heights in the area of interest are generally the same (on average 55 metres above datum) but there is a variation of  $\pm 5$  metres from the average.

The intended use of the photography is that it be rectified based on the assumption that the terrain is a plane at the average ground height AND that the rectified images be mosaiced together to form a continuous map of the CBD.

The camera available has a focal length of 303.75 millimetres and the photography will be from a flying height of 1725 metres above datum. The forward and side overlap are both to be 20% (note that it is not continuous stereo-photography).

- i) Determine the mean, maximum and minimum photographic scales.
  - ii) Calculate the ground coverage (area) of a single photograph for each of the scales in i) above.
  - iii) Determine the ground dimensions of each “neat” model for the mosaic.
  - iv) Determine the maximum relief displacement of any building that could be expected in preparing the photo-mosaic.
  - v) Calculate the number of “neat” models that would be required to form the final mosaic and provide an annotated sketch showing their optimum positioning.
  - vi) Consider that the flight plan specifications are to be changed from the description above to make the photographic coverage stereoscopic over the entire area of interest. State how this is best achieved and provide another annotated sketch showing the layout of the photography in this case.
- b) Briefly discuss ANY ONE of the following topics
- the use of stereo-viewing in image data extraction
  - the use of resampling and interpolation in image product generation
  - the use of film based cameras compared to digital cameras
  - the precision scanning of film based images to obtain digital images

## QUESTION 5

In order to produce a digital map of an area of interest you are required to rectify (using the 8-parameter model) a near vertical colour aerial photograph. The final map is to have a ground resolution of 0.1 metres.

The original hardcopy photograph is to be scanned into a digital form using a precise scanner with a pixel size of 12.5 microns (square) and a geometric precision of  $\pm 3$  microns in terms of pixel location. On the original film the area of interest is located centrally and can be considered to occupy 124 millimetres by 155 millimetres (in x and y directions respectively).

Other details of the photography are as follows :-

- the camera is a typical mapping camera with a focal length of 152.85 millimetres
  - the flying height is 1027 metres above datum
  - the average terrain height in the area of interest is 155 metres
  - the variation from average terrain height in the area of interest can be taken to be  $\pm 25$  metres
- i) Discuss this mapping task giving a step-by-step account of how you would proceed.
  - ii) Comment on the appropriateness of the 8-parameter analytical rectification.
  - iii) Estimate the likely “distortion” in the final product due to relief.
  - iv) Comment briefly on other sources of error that will effect the precision of the final product.

## QUESTION 6

- a) In an industrial measuring task two identical cameras are used to obtain a stereo-pair of photographs of a small target array measuring 1.5 metres wide by 1.0 metres high and 0.5 metres in depth (away from the camera base). The details of the set-up are as follows :-
  - both cameras have a focal length of 35.25 millimetres and a format of 60 millimetres by 45 millimetres (horizontal by vertical)
  - both camera axes are horizontal
  - both camera positions are at the same height of 0.25 metres above the bottom of the target array
  - the two camera positions are 0.5 metres apart, arranged symmetrically about a vertical plane normal to the face of the target array and emanating from the centre of the array
  - the camera positions are 1.25 metres distant from the face of the target array
  - both camera formats are “landscape”
  - i) Construct a coordinate system to describe the set-up and give values of the exterior orientation elements for each camera position.
  - ii) Compute the image coordinates of the four (4) corners of the front face of the target array in each of the photographs.
- b) Briefly discuss the use of the collinearity equations for the generation of “perspective scenes”.