UNIVERSITY OF SOUTH AUSTRALIA

DIVISION OF INFORMATION TECHNOLOGY, ENGINEERING AND THE ENVIRONMENT

School of Geoinformatics, Planning and Building

Semester 2, 2001

Imaging Technology N : 10221

Time Allowed **:** 2 hours + 10 minutes reading time

General Instructions to Candidates

Attempt ALL questions.

Marks for each question are shown thus **[marks]**.

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

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 [25 marks]

Near vertical aerial photography is to be obtained of a city CBD. The area of interest is 1200 metres by 1800 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 75 metres above datum) but there is a variation of ±10 metres from the average.

The intended use of the photography is that it be rectified (using the 8-parameter model) based on the assumption that the terrain is a plane at the average ground height AND then the rectified images are to 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 1745 metres above datum. The forward and side overlap are both to be 20% (note that it is not continuous stereo-photography).

a) For the circumstances described above
   i) Determine the mean, maximum and minimum photographic scales.
   ii) Calculate the ground coverage (area) of a single photograph for each of those scales.
   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.

b) 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.

c) Briefly describe the operational steps involved in the rectification process and be sure to comment on the ways in which we can check the quality of the mathematical fit(s) between the images and the ground.

QUESTION 2 [15 marks]

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 target array centroid (i.e. the point at the centre of the target array) in each of the photographs.

QUESTION 3 [10 marks]

Discuss in detail any ONE of the following topics

- the use of stereo-viewing in image data extraction
- the use of resampling 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

SECTION B

QUESTION 4 [15 marks]

Image data formats vary from simple to complex. Outline the different formats in terms of complexity. Discuss the different ways each of the different file formats deal with georectification, variable ground pixel size, number of bands, image display and data quantization.

QUESTION 5 [10 marks]

Discuss the reasons for digital image compression and the problems involved. Outline, in your own words, the concepts behind run-length encoded compression, JPEG compression and wavelet compression.

QUESTION 6 [15 marks]

Explain in detail different methods of using histograms, look-up tables and image arithmetic to enhance digital imagery. Explain the principal component transform. Why enhance an image, and when is it inappropriate to enhance an image?

QUESTION 7 [10 marks]

What is a convolution filter? Give several detailed examples of convolution filters.