

**UNIVERSITY OF SOUTH AUSTRALIA**

DIVISION OF INFORMATION TECHNOLOGY, ENGINEERING AND THE  
ENVIRONMENT

School of Natural and Built Environments

Semester 1, 2004

**Earth Observation Science 1  
(GEOE 2012)**

Time Allowed: 2 hours + 10 minutes reading time

**General Instructions to Candidates**

Attempt **ALL** questions.

Marks (percentages) for each question are as indicated.

This is an open book examination.

Programmable calculators are permissible.

Please ensure the front of each answer book is completed with your name, student I.D. number, program and course.

**QUESTION 1**

(25 marks)

Consider that you are required to investigate the changes to a specific area of coastline comprising of sand dunes and beach using current (i.e. 2004) photography and comparing it to photography from 1975. The area of interest is contained within a single image in both cases. The new and old photography are both hard copy (i.e. film) which is to be digitised (i.e. scanned) and then rectified. The comparison would take place between the two rectified images. *Further details of the imagery are given in the table below.*

A sufficiently accurate digital elevation model (DEM) exists for the 2004 imagery but this will not be the same for the past era (i.e. 1975) because the sand dunes and beach are constantly changing. Hence the suggestion is to employ **ortho-rectification for the 2004 imagery** and **8-parameter rectification for the 1975 imagery**. The terrain heights in the area of interest can be taken to vary from 0 meters ASL (above sea level) to 12 meters ASL (with the average being 6 meters ASL).

- (i) Discuss each method of rectification being sure to comment on the control requirements and give a brief account of the required operational procedures.
- (ii) Estimate (i.e. calculate) and discuss the likely error in the rectified image caused by using the 8-parameter method for the old photography instead of ortho-rectification.

<b>Year of photography</b>	<b>Scale of Photography</b>	<b>Focal length of camera</b>	<b>Maximum radial distance from principal point to extremity of area of interest on the photograph</b>
<b>1975</b>	1:40,000	88.65 mm	91.2 mm
<b>2004</b>	1:20,000	153.15 mm	75.4 mm

**QUESTION 2**

(25 marks)

In the formation of a stereo-model in analytical photogrammetry the sequential procedures of interior orientation (IO) and exterior orientation (EO) (either in separate steps of relative orientation (RO) and absolute orientation (AO) or simultaneously in a single step method) are generally performed.

For **each procedure** give a brief description of

- the aim of the procedure;
- the observational procedure and “pointings” required including the number, position and nature of the observed points; and
- the method(s) by which we evaluate the success of the procedure.

**QUESTION 3**

(20 marks)

An area of the Adelaide Hills is to be mapped with photography of an average scale of 1:20,000. The area of interest is 12.6 kilometers long by 6.7 kilometers wide and has terrain variations from 120 meters to 440 meters with the average being 280 meters.

The camera to be used is a wide angle camera of focal length 152.85 mm and format of 230 mm by 230 mm and the forward and side overlap are to be 60% and 30% respectively.

- (i) Determine the flying height of the aircraft and the variation in scale due to relief (i.e. the maximum and minimum scales).
- (ii) Compute the ground coverage dimensions and area of a typical neat stereo-model.
- (iii) Based on the average photographic scale and applying a factor of safety of 10% of the coverage of a single photograph determine the number of photographs required to completely cover the area of interest stereoscopically.
- (iv) Provide an annotated sketch showing the flight lines and exposures as well as the extent of stereoscopic coverage.

**QUESTION 4**

(18 marks)

A rectangular block of hard copy (i.e. film) aerial photography consisting of 6 parallel flight lines each of 18 exposures is to be triangulated using *automatic aerial triangulation*. The camera used is a typical wide angle survey camera and the forward and side laps are 60% and 25% respectively. The scale of the photography is 1:25,000. Ground control points are to be selected off the photography.

Discuss each of the steps involved in this process starting with the acquired film imagery and finishing with the exterior orientations (and precisions thereof) for all of the images.

**QUESTION 5**

(12 marks)

Two key advantages of digital photogrammetry are *stereo-superimposition* and *image matching*. Describe what each of these processes are and how they are achieved in addition to giving a brief discussion of their typical use and/or application in aerial photogrammetric practice.