Mid Year 2006 Final Examination

University of South Australia

Student ID:		Student Name:	

DIVISION OF
INFORMATION TECHNOLOGY, ENGINEERING & THE ENVIRONMENT

SCHOOL OF NATURAL & BUILT ENVIRONMENTS

Subject Area:	GEOE	Catalogue Number:	2012

EARTH OBSERVATION SCIENCE 1

Examination Day: Monday	**Examination Date: 26 June 2006**
Examination Time: 14.00hrs	**Length of Exam: 2 hours + 10 minutes reading time**

Examination Venue:	Royal Banquet

Instructions to Candidates

Attempt ALL questions.

Marks (percentages) for each question are as indicated.

This is an open book examination.

Programmable calculators are permissible.

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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. 2006) 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 2006 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 2006 imagery and 8-parameter rectification for the 1975 imagery. The terrain heights in the area of interest can be taken to vary from 0 metres ASL (above sea level) to 12 metres ASL (with the average being 6 metres 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.

Year of photography	Scale of Photography	Focal length of camera	Maximum radial distance from principal point to extremity of area of interest on the photograph
1975	1:40,000	88.65 mm	91.2 mm
2006	1:20,000	153.15 mm	75.4 mm

QUESTION 2 (30 marks)

a) Mathematically the functional models for many photogrammetric solutions are "non-linear" in the unknown elements and as a consequence we linearise the models using truncated Taylor series in order to solve for those unknowns. In what way does this characterise the solution of such photogrammetric procedures and what should we be concerned about when using photogrammetric software based on this method?

b) Discuss any **ONE** of the following topics

1. ***Image matching*** is used in digital photogrammetry for the processes of automatic DTM extraction from stereo-pairs of digital photographs AND automatic tie point extraction from multiple overlapping imagery.

2. ***Polynomial rectification*** is a useful technique for correction of image distortions for small scale aerial photography and satellite imagery but is very much dependant on the array of ground control points.

3. ***Image coordinate refinement*** is necessary for attaining the highest order of accuracy from photogrammetric measurement.

4. ***Stereo-superimposition*** is a very useful facility of most digital photogrammetric workstations. Describe how it is achieved and briefly discuss its usefulness particularly in regard to the editing of raw digital terrain models (DTM).

QUESTION 3 (20 marks)

In the manual (i.e. not automatic) triangulation of a block of stereoscopic aerial photography by way of the "bundle method" we undertake the sequential procedures of interior orientation (IO) and then exterior orientation (EO).

For **each of these procedures** 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 4 (25 marks)

a) 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 kilometres long by 6.7 kilometres wide and has terrain variations from 100 metres to 420 metres with the average being 260 metres.

The camera to be used is a wide angle camera of focal length 153.15 mm and format of 230 mm by 230 mm and the forward and side overlap are to be 60% and 25% 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 7.5% of the coverage of a single photograph determine the number of photographs required to completely cover the area of interest stereoscopically.

b) A 60 metre tall communication tower could exist anywhere in the photography described in a) above. Estimate (i.e. calculate) the maximum amount it might appear to "lean over" in any photograph at average scale.