CANADIAN BOARD OF EXAMINERS FOR PROFESSIONAL SURVEYORS

C7 - REMOTE SENSING & PHOTOGRAMMETRY   March 2015

Although programmable calculators may be used, candidates must show all formulae used, the substitution of values into them, and any intermediate values to 2 more significant figures than warranted for the answer. Otherwise, full marks may not be awarded even though the answer is numerically correct.

Note: This examination consists of ten questions on two pages.

Q. No		Time: 3 hours	Value	Earned
1.	a)	What is the maximum number of independent rotation angles needed to define a two-dimensional rotation matrix? Why?	2	
	b)	Do we need Fiducial Marks in metric digital cameras? Why?	2	
	c)	What are the main characteristics/differences between supervised and unsupervised classification strategies? Tabulate your answer.	4	
	d)	One can argue that digital cameras can see through shadow. Do you agree with this statement? Why?	2	
2.	a)	What are the parameters that are solved for in the following photogrammetric problems: 1) Single photo resection; 2) Photogrammetric intersection; 3) Bundle adjustment; 4) Bundle adjustment with self-calibration; 5) Dependent relative orientation for a stereo-pair; and 6) Independent relative orientation for a stereo-pair?	6	
	b)	Aerial images have varying scale. Use a sketch to illustrate this fact. Sketch a special case where the scale in a photograph is considered constant.	2	
	c)	How many ground control points are needed to establish the relative orientation between the images of a stereo-pair? Why?	2	
3.	a)	Briefly explain the following terms together with the factors that control them for a given digital imaging system: 1) Radiometric resolution, 2) Spectral resolution, 3) Geometric resolution, and 4) Temporal resolution.	6	
	b)	Explain how you can use the spectral reflectance curve to identify the moisture content in vegetation and soil.	2	
	c)	What are the key information items you expect to have in a camera calibration certificate for a metric analog camera?	2	
4.	a)	What is the EM radiation waveband used in RADAR remote sensing systems? Are they active or passive systems?	2	
	b)	What are the advantages of RADAR remote sensing systems?	2	
	c)	What are the quantities measured by a GPS/INS system onboard an imaging platform? What are the main requirements for relating these measurements to the exterior orientation parameters of the exposure stations?	4	
	d)	What are the main differences between the scene acquisition procedures for frame and line cameras?	2	
5.	a)	What are the alternative methodologies for establishing the exterior orientation parameters of an imaging system?	3	
	b)	What are the alternative methodologies for deriving the Interior Orientation Parameters (IOP) of a photogrammetric camera? Which one would you prefer to adopt? Why?	4	
	c)	Classify and describe the types of points based on their role in a photogrammetric bundle adjustment procedure.	3	

6.	a)	What is the conceptual basis of the photogrammetric Coplanarity condition?	2	
	b)	What is the conceptual basis of the photogrammetric Collinearity equations?	2	
	c)	Describe the conceptual basis of image smoothing in the frequency domain.	2	
	d)	Describe the conceptual basis of image sharpening (enhancement) in the frequency domain.	2	
	e)	What is the MINIMUM number of ground control points needed to establish the absolute orientation of a 3D model? Why?	2	
7.	a)	What is meant by accuracy and precision?	2	
	b)	What are the factors affecting the precision of the outcome from a photogrammetric bundle adjustment procedure?	2	
	c)	What are the factors affecting the accuracy of the outcome from a photogrammetric bundle adjustment procedure?	2	
	d)	How would you evaluate the precision and the accuracy of the outcome from a photogrammetric bundle adjustment procedure?	2	
	e)	You have a digital B/W (8 bits/pixel) and a color (24 bits/pixel) image. Comment on the radiometric and spectral resolutions of these images (i.e., which one has higher radiometric and which one has higher spectral resolution).	2	
8.	a)	You are given a stereo-pair with thirty-nine tie points identified. List the balance between the observables and the unknown parameters in a bundle adjustment procedure to solve for the exterior orientation parameters as well as the ground coordinates of tie points. Can you estimate the involved unknown parameters? Why?	4	
	b)	A distance between 2 points on a map at a scale of 1:75,000 is 31.85 mm. The distance between the same points on a vertical photo taken with a 152.04 mm focal length camera is 42.19 mm. If both points lie at an elevation of 122 meters, compute the flying height above datum.	4	
	c)	What are the advantages of LiDAR remote sensing systems?	2	
9.	a)	List the required input and necessary steps for generating an orthophoto using differential rectification.	4	
	b)	How are the image coordinate systems defined in: a. an analogue photograph acquired by an analogue metric camera, b. a digital image scanned from an analogue photograph captured by an analogue metric camera, and c. a digital image acquired by a digital metric camera?	3	
	c)	Give a brief definition of the following entities: Nadir point, principal point, principal distance, focal length, principal planes, as well as optical axis of a lens system.	3	
10.	a)	Where is the perspective center of the lens assembly for a digital camera system?	2	
	b)	How many ground control points are needed to establish the relative orientation between the images of a stereo-pair? Why?	2	
	c)	Explain how the image aberrations and distortions affect the precision and accuracy of the outcome from the photogrammetric reconstruction.	2	
	d)	Where in the image is there no radial lens distortion? Why?	2	
	e)	Where in the image is there no relief displacement? Why?	2	
		Total Marks:	100	