UNIVERSITY OF CALGARY
SCHULICH SCHOOL OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ENEL 697 DIGITAL IMAGE PROCESSING
FALL 2013 SESSION, TEST NO. 2
5 December 2013

Instructions:

1. This is a closed-book, closed-notes test.

2. Calculators and other electronic devices are not permitted.

3. Answer all five questions.

4. Total marks = 20.

5. Time permitted = 75 minutes.

Question 1: Give an equation to stretch the gray levels in an image in the range $[l_1, l_2]$ to the range $[0, 255]$, with the values below and above the limits l_1 and l_2 being set to 0 and 255, respectively. (3 marks)

Question 2: Give the two 3×3 masks that define the Sobel gradient operators. Give equations to derive the gradient magnitude and angle from the results of the two masks. (3 marks)

Question 3: Give the 3×3 mask for unsharp masking. Give an equation or formula to generalize this procedure so as to use local statistics computed using any neighborhood. (3 marks)

Question 4: Give a block diagram or flowchart to describe the process of (multiplicative) homomorphic filtering for image enhancement. Give mathematical expressions or equations relating the various entities and functions at each step in the process. State the conditions under which the method will lead to image enhancement. Describe the nature of the enhancement achieved. (5 marks)

Question 5: (a) Describe the general approach of the Hough transform to detect objects in images.
(b) Give parametric equations to apply the Hough transform for the detection of (i) straight lines and (ii) circles in images. Describe the relationship between the image space and the Hough space in each case.
(c) Give a step-by-step algorithm to detect circular objects starting with a gray-scale image. Describe how you would set up the parameters of the method for this application. (6 marks)

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