UNIVERSITY OF CALGARY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
SCHULICH SCHOOL OF ENGINEERING
ENEL697 DIGITAL IMAGE PROCESSING
TEST NO. 2
WINTER 2011 SESSION
13 April 2011

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 = 90 minutes.

Question 1: Explain the general notion of homomorphic filtering of images combined by multiplication. Give the equations and the procedure to convert a multiplicative combination of two images to a linear combination of the related Fourier spectra.

Explain how the method may be used to enhance the contrast in an image with variable intensity or an image with shadows. Describe any assumptions made and their effects.

(4 marks)

Question 2: Explain the formulation of the Hough transform for the detection of circles. Describe the relationships between the image space and the Hough parameter space.

Give a step-by-step algorithm to detect circles in an image. State any assumptions made.

(4 marks)

Question 3: Given a contour in terms of the coordinates of its points, $\{x(n), y(n)\}$, $n = 0, 1, 2, \ldots, N - 1$, give equations to define the following:
(a) The centroid of the contour.
(b) A signature of the contour.
(c) The Fourier descriptors of the contour.

(4 marks)

Question 4: Give a step-by-step algorithm to perform region growing using an additive tolerance.

Explain how the algorithm could be used to obtain multiple regions corresponding to several objects in a given image, assuming that all objects of interest are brighter than the background.

Explain how the algorithm may be changed to use a multiplicative tolerance.

(4 marks)

Question 5: Explain the notion of fuzzy region growing. Give an equation for a suitable fuzzy membership function and relate its parameters to the characteristics of the image to be processed and the expected results.

(4 marks)

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