UNIVERSITY OF CALGARY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
SCHULICH SCHOOL OF ENGINEERING
ENEL697 DIGITAL IMAGE PROCESSING
TEST NO. 1
WINTER 2009 SESSION
2 March 2009

Instructions:

1. This is a closed-book, closed-notes test.
2. The use of only a nonprogrammable calculator with no text storage facilities is permitted.
3. Answer all five questions.
4. Total marks = 20.
5. Time permitted = 90 minutes.

Question 1: Write the definition of the Laplacian operator as applicable to a continuous image function $f(x, y)$.

Explain how the continuous-domain Laplacian operator is converted into a 3×3 mask for application to a digital image.

Explain the effects and application of the operator in image processing.

(5 marks)

Question 2: Explain how the modulation transfer functions (MTFs) of several components of an imaging and/or image processing system may be used to derive a measure of acutance.

Give an equation for one of the MTF-based measures of acutance and interpret its application to an imaging system.

(3 marks)

Question 3: Give the definitions of the mean squared error (MSE) and the Laplacian mean squared error (LMSE) to compare two images $f(m, n)$ and $g(m, n)$.

Explain the use of MSE and LMSE in image processing.

Explain the significant differences between MSE and LMSE, and indicate their relative advantages and disadvantages.

(4 marks)

Question 4: Starting with the mathematical expression for the two-dimensional discrete Fourier transform (DFT), explain how the same may be computed as a series of one-dimensional DFTs.

State the properties of the DFT kernel function that facilitate the steps you demonstrate in your answer.

(3 marks)

Question 5: Give a step-by-step algorithm for the application of the mean and median filters to a digital image.

Specify and justify the neighborhood that you recommend for each type of filter.

What type of noise can each of the filters remove effectively? Explain your answer.

(5 marks)

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