UNIVERSITY OF CALGARY
SCHULICH SCHOOL OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ENEL 697 DIGITAL IMAGE PROCESSING
FALL 2014 SESSION, TEST NO. 1
4 November 2014

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: Write mathematical expressions to define the zeroth-order and first-order entropies of a digital image. Explain how you would compute or estimate the required information from a given digital image. Explain how the procedure can be extended to compute the n-th order entropy. (3 marks)

Question 2: Write mathematical expressions to define the mean-squared error and the Laplacian mean-squared error between two digital images. Explain the differences between the two in terms of how they are computed and the characteristics of the images that they represent. (3 marks)

Question 3: Explain the notion of acutance. Give an equation to define any one type of acutance and explain how it may be computed or estimated. (3 marks)

Question 4: You are given a one-dimensional signal expressed in vectorial form as $\mathbf{f} = [3, 2, 1]^T$. The signal is processed using a linear shift-invariant filter with its impulse response expressed in vectorial form as $\mathbf{h} = [1, 0, -1]^T$. Prepare the matrix $\mathbf{h}$ such that $\mathbf{g} = \mathbf{h}\,\mathbf{f}$ will provide the output of the filter. Verify your result. Provide notes to distinguish between linear and circular convolution. (5 marks)

Question 5: Write a mathematical expression to define the output of Lee's local linear minimum mean-squared error filter. Give mathematical expressions to define each value or parameter required to perform the filtering operation. Explain how the method performs adaptive filtering. (6 marks)

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