Department of Computer Science and Engineering

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CS4043 IMAGE PROCESSING
ASSIGNMENT SET 2

Date of posting assignment : 20/2/17
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1. An image matrix is given by

$$f(m,n) = \begin{bmatrix} 1 & 1 & 2 & 1 \\ 2 & 1 & 1 & 2 \\ 1 & 3 & 2 & 1 \\ 2 & 1 & 2 & 1 \end{bmatrix}$$

   Find the 2D Hadamard transform for this image matrix.

2. Determine the Hadamard matrix of order N=8 and obtain its inverse.

3. You are given an image patch

$$\begin{bmatrix} 12 & 4 & 2 & 6 \\ 5 & 10 & 12 & 24 \\ 6 & 8 & 10 & 12 \\ 14 & 12 & 8 & 10 \end{bmatrix}$$

   Compute the 2D DCT for the image patch. Then reconstruct the original patch by neglecting the last four cofficients in 2D DCT. Comment on the observed result.

4. Obtain the DCT matrix for N=4 and verify that it obeys the orthogonality property.

5. Obtain the KL transform basis for the following matrix of samples:

$$\begin{bmatrix} 1 & 2 & 1 & 0 \\ 2 & -1 & 1 & 2 \end{bmatrix}$$

6. The 4 x 4 Hadamard matrix is given by

$$H = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix}$$

Check whether premultiplication of the matrix H by the matrix

$$S = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

puts the row in the Walsh sequency order.

NOTE: Sequency refers to the number of sign changes. The sequency for a Walsh matrix of order 4 is given below

$$\begin{bmatrix} 1/4 & 1/4 & 1/4 & 1/4 & \textbf{Zero sign change} \\ 1/4 & 1/4 & -1/4 & -1/4 & \textbf{One sign change} \\ 1/4 & -1/4 & 1/4 & -1/4 & \textbf{Three sign change} \\ 1/4 & -1/4 & -1/4 & 1/4 & \textbf{Two sign change} \end{bmatrix}$$