EE5175: Image Signal Processing

Lab-8

Data De-correlation properties of WHT and DCT for Markov-1 process

1. Assume a Markov-1 process with covariance matrix R of size 8×8 and $\rho = 0.91$. Compute the Energy Packing Efficiency and De-correlation Efficiency of the Walsh-Haddamard Transform and Discrete Cosine Transform for the above process. What is your observation about the eigenvectors of R in relation to the DCT basis?

2. Find $\beta^2 R^{-1}$, where $\beta = \dfrac{1-\rho^2}{1+\rho^2}$. Does $\beta^2 R^{-1}$ have a tridiagonal structure?. Is it close to the tridiagonal matrix Q given by,

$$\mathbf{Q} = \begin{bmatrix} 1-\alpha & -\alpha & 0 & 0 & 0 & 0 & 0 & 0 \\ -\alpha & 1 & -\alpha & 0 & 0 & 0 & 0 & 0 \\ 0 & -\alpha & 1 & -\alpha & 0 & 0 & 0 & 0 \\ 0 & 0 & -\alpha & 1 & -\alpha & 0 & 0 & 0 \\ 0 & 0 & 0 & -\alpha & 1 & -\alpha & 0 & 0 \\ 0 & 0 & 0 & 0 & -\alpha & 1 & -\alpha & 0 \\ 0 & 0 & 0 & 0 & 0 & -\alpha & 1 & -\alpha \\ 0 & 0 & 0 & 0 & 0 & 0 & -\alpha & 1-\alpha \end{bmatrix}$$

where $\alpha = \dfrac{\rho}{1+\rho^2}$

Try diagonalizing $\beta^2 R^{-1}$ and Q using the DCT matrix. What is your observation.?

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