

 POLITECNICO DI MILANO



MMSP 2nd Module – Lab5

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Image coding using DCT and KLT

EXERCISE 1

1. Load the image 'lena512color.tiff' and extract the luminance component
2. Consider the first 8x8 pixels block and compute its 8x8 DCT coefficients. Use different methods and compare them.
3. JPEG baseline coding
4. Reconstruct the image using only the DC component of the DCT
5. Consider blocks of dimension 8x8 and estimate the correlation matrix
6. Perform KLT coding

1. RGB to YCbCr:

$$\begin{pmatrix} x_Y \\ x_{Cb} \\ x_{Cr} \end{pmatrix} = \begin{pmatrix} 0.299 & 0.587 & 0.114 \\ -0.169 & -0.331 & 0.5 \\ 0.5 & -0.419 & -0.0813 \end{pmatrix} \begin{pmatrix} x_R \\ x_G \\ x_B \end{pmatrix}$$

2. Monodimensional DCT transform matrix T:

$$t_{kl} = \begin{cases} \sqrt{\frac{1}{N}} \cos\left(\frac{\pi}{2N}(k-1)(2l-1)\right) & k = 1 \\ \sqrt{\frac{2}{N}} \cos\left(\frac{\pi}{2N}(k-1)(2l-1)\right) & k = 2, 3, \dots, N \end{cases}$$

3. Separable transform: $Y = T^* X^* T$

4. 2D DCT transform:

$$g(n_1, n_2, k_1, k_2) = h(n_1, n_2, k_1, k_2) = \alpha(k_1) \cos\left[\frac{(2n_1+1)\pi k_1}{2N_1}\right] \alpha(k_2) \cos\left[\frac{(2n_2+1)\pi k_2}{2N_2}\right] \quad (16)$$

$$\alpha(k) = \begin{cases} \sqrt{\frac{1}{N}} & k = 0 \\ \sqrt{\frac{2}{N}} & k = 1, \dots, N-1 \end{cases} \quad (17)$$

$$T(k_1, k_2) = \sum_{n_1=0}^{N_1-1} \sum_{n_2=0}^{N_2-1} x[n_1, n_2] g(n_1, n_2, k_1, k_2)$$