Homework #2

Due. 4/20/2020 (Monday midnight)

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(Goal of Project)

Practicing K-L Transform, SVD and Comparing with DCT in sense of data compression.

(Tools)

1. DCT(Discrete Cosine Transform) matrix for 8*8 Block size of image.

   $S_N = \{s(m,n)\}_{m,n=0}^{N}$, where N=8

   $$s(m,n) = \sqrt{\frac{2}{N}}\, c(m)\cos[(2n+1)\frac{m\pi}{2N}]$$

   where, $c(0) = 1/\sqrt{2}$ and $c(m) = 1$ for $m > 0$

2. K-L Transform matrix.

   A with eigenvectors (u_i) of covariance matrix of image (C_{gg^T}))

3. Approximation by SVD(Singular Value Decomposition)

   $$\hat{g} = \sum_{i=1}^{k} \lambda_i^{\frac{1}{2}} u_i u_i^T, k < r$$

(Description of Project)

1. Get a grey level image which size is N*N. (For example, 256*256, however, N = 2^n), and partition to 8*8 sub images.
2. Apply DCT to these sub images, and get the transformed image D with DCT coefficients for elements.
3. From D, keep the coefficient values for only upper left triangular region and set zeros for lower right region to approximate the image. (That is, only half of data is used.)
4. Take Inverse DCT to get the approximated image.

2'. Get the covariance matrix (64*64) of sub images.

3'. Calculate the corresponding 64 eigenvectors and eigenvalues.

4'. Approximate the image by taking the 32 most dominant eigenvectors among 64 eigenvectors. (That is, only half of eigenimages are used.)

2". Get the matrices gg^T and g^Tg , and corresponding 8 eigenvectors $\boldsymbol{u}$ and $\boldsymbol{v}$.

3". Represent the original image with Singular Value Decomposition.

4". Approximate the image by taking off the 4 smallest eigenvalues among 8 eigenvectors. (That is, only half of information is used.)

5. Compare the images from 4 , 4' and 4".
6. Repeat same processes to another image which contains detail random texture smaller than 8*8 size.

(Please refer Brodatz Texture images: http://www.ux.uis.no/~tranden/brodatz.html)

7. Discuss the results.