EE5175: Image Signal Processing

Lab-7

DFT, Magnitude-Phase Dominance, and Rotation Property

1. Implement 2D DFT using row-column decomposition.

2. Compute DFTs $F_1(k,l) = |F_1(k,l)|e^{j\phi_1(k,l)}$ and $F_2(k,l) = |F_2(k,l)|e^{j\phi_2(k,l)}$ of I_1(`fourier.pgm`) and I_2 (`fourier_transform.pgm`) respectively. Arrive at two new images I_3 and I_4 such that their DFTs are, respectively, $F_3(k,l) = |F_1(k,l)|e^{j\phi_2(k,l)}$ and $F_4(k,l) = |F_2(k,l)|e^{j\phi_1(k,l)}$.

3. *(Optional)* Verify the rotation property of 2D DFT using `peppers_small.pgm`.

   step 1: Compute rotated form of 2D DFT, $F(k,l) = \sum_m \sum_n f(m,n) e^{-j\frac{2\pi}{N}\underline{m}^T R \underline{k}}$, where $\underline{m} = [m\ n]^T$, $\underline{k} = [k\ l]^T$, and $R = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$.

   step 2: Rotate the input image f by θ and compare it with 2D IDFT of F.

Note 1: For the first two experiments, you may use built-in functions to compute 1D DFTs

Note 2: For the third experiment, all operations (computation of 2D DFT, rotation of 2D DFT, computation of 2D IDFT, and rotation of f in spatial domain) should be done such that the origin is at the center of the image.

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