Fourier Transform (IV)
— 2D DFT

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Image Representation

PRIORI BASIS FOR NATURAL IMAGES

Discrete Fourier Transform

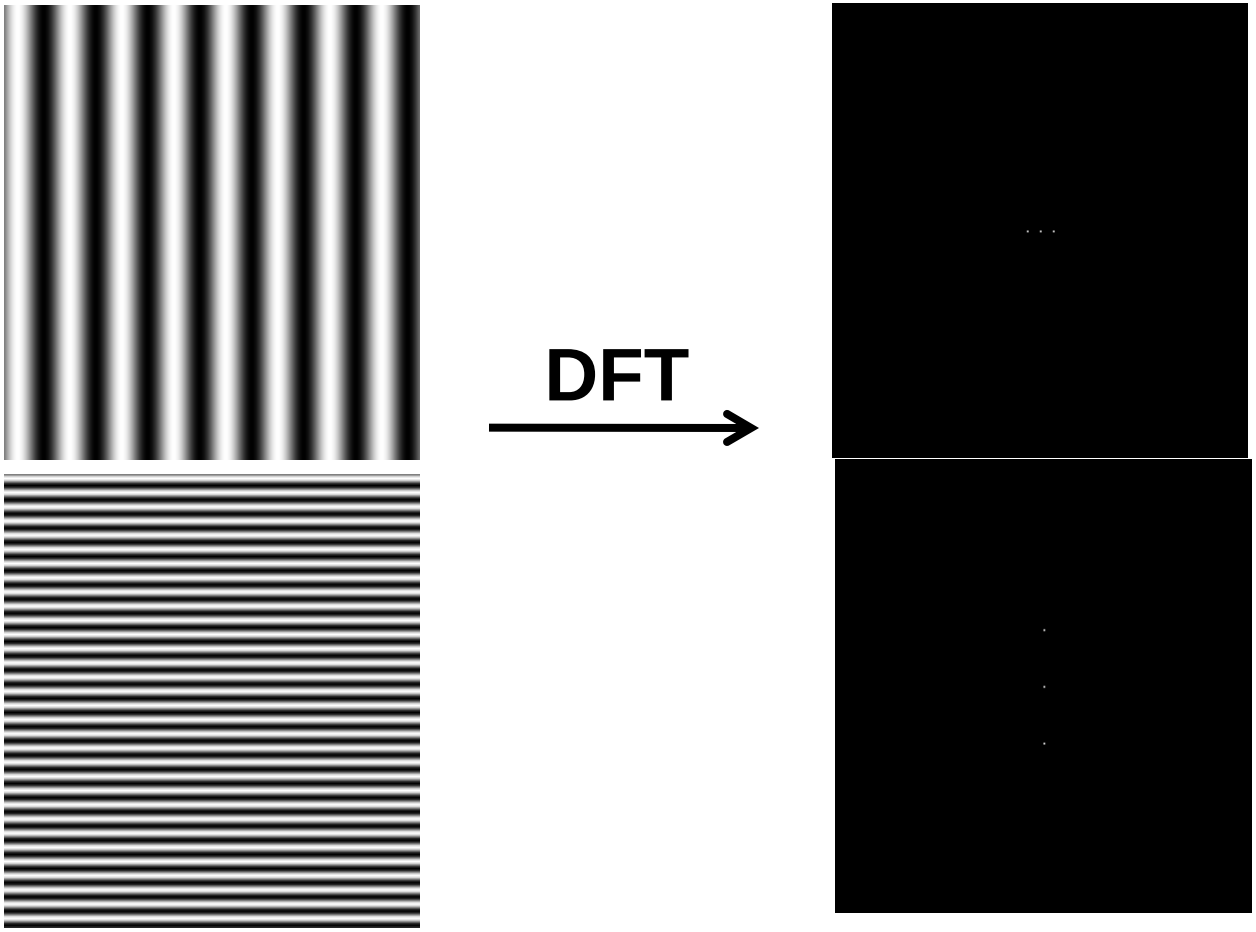
- Forward transform (Analysis)

$$X(k_1,k_2)=\sum_{n_1=0}^{N_1-1}\sum_{n_2=0}^{N_2-1}x(n_1,n_2)\exp\left(-jk_1\frac{2\pi}{N_1}n_1-jk_2\frac{2\pi}{N_2}n_2\right)$$

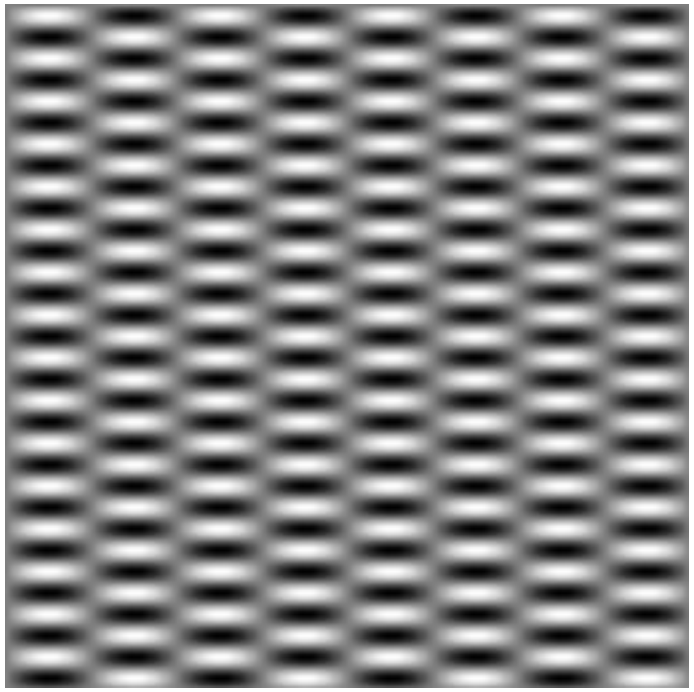
- Inverse transform (Synthesis)

$$x(n_1,n_2)=\frac{1}{N_1N_2}\sum_{k_1=0}^{N_1-1}\sum_{k_2=0}^{N_2-1}X(k_1,k_2)\exp\left(jk_1\frac{2\pi}{N_1}n_1+jk_2\frac{2\pi}{N_2}n_2\right)$$

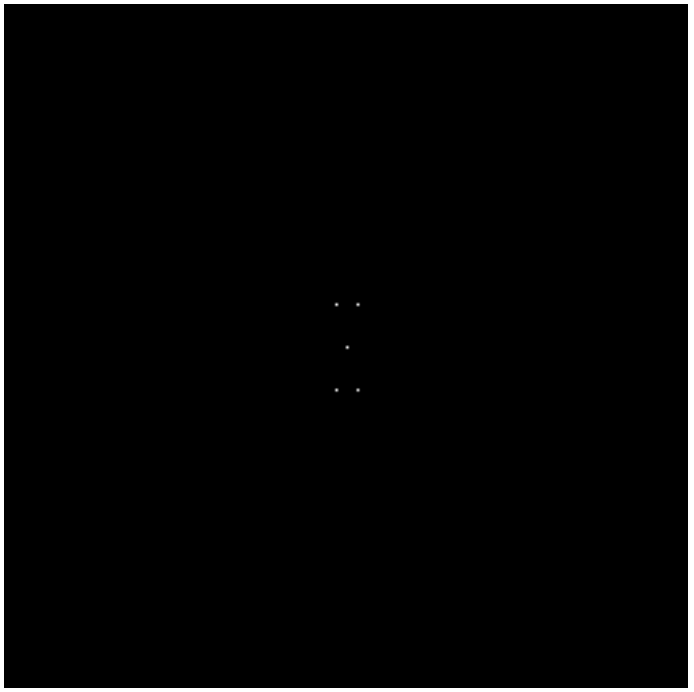
Synthesized 2D images and their magnitude spectrums



Synthesized 2D image and its magnitude spectrum (II)

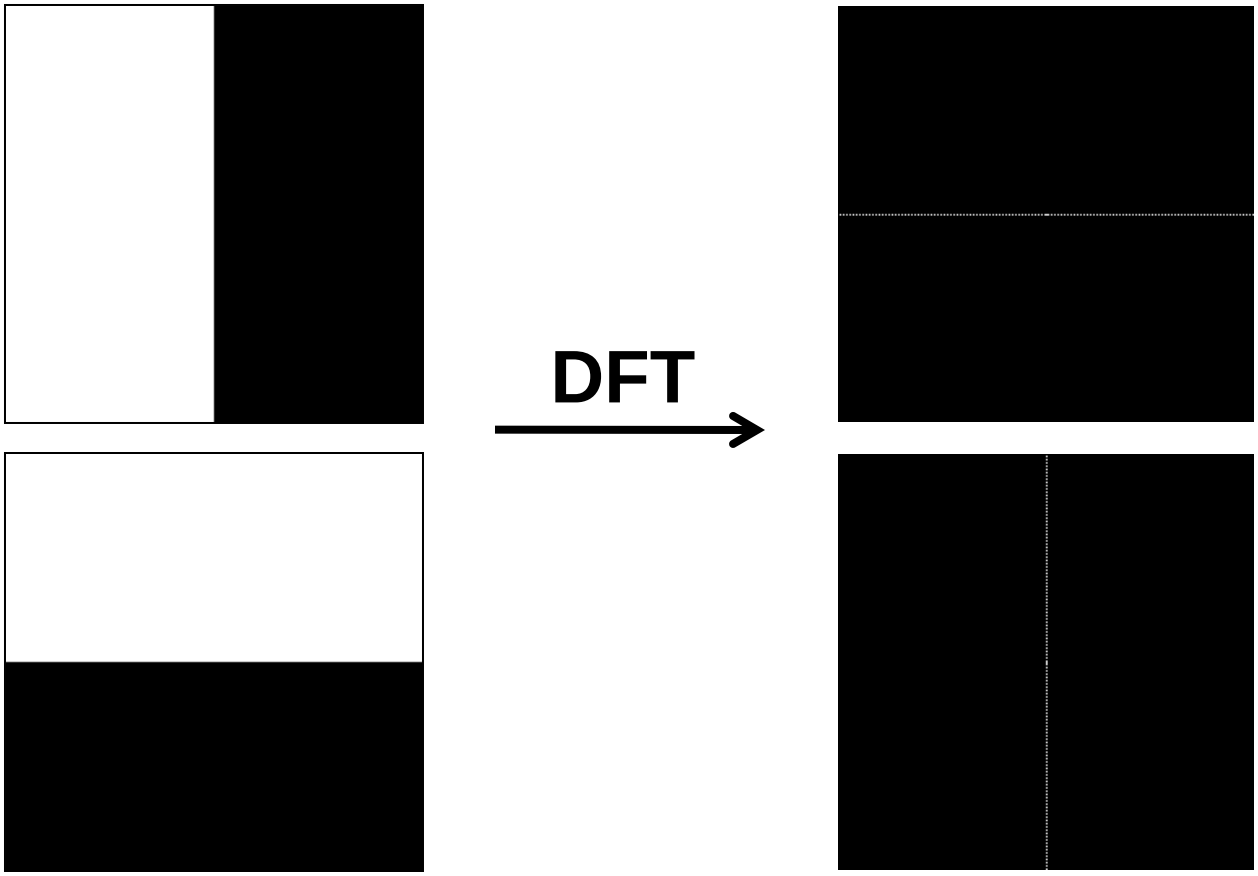


(a) This image exclusively has 4 cycles horizontally and 16 cycles vertically.

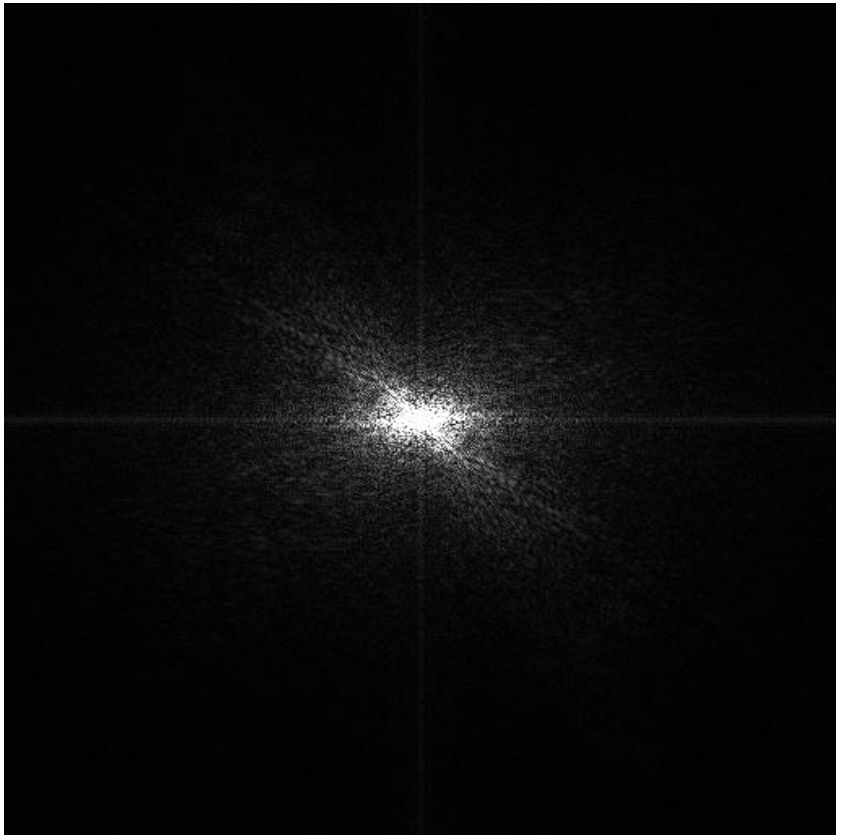


(b) Magnitude spectrum of the image

Two step images and their magnitude spectrums

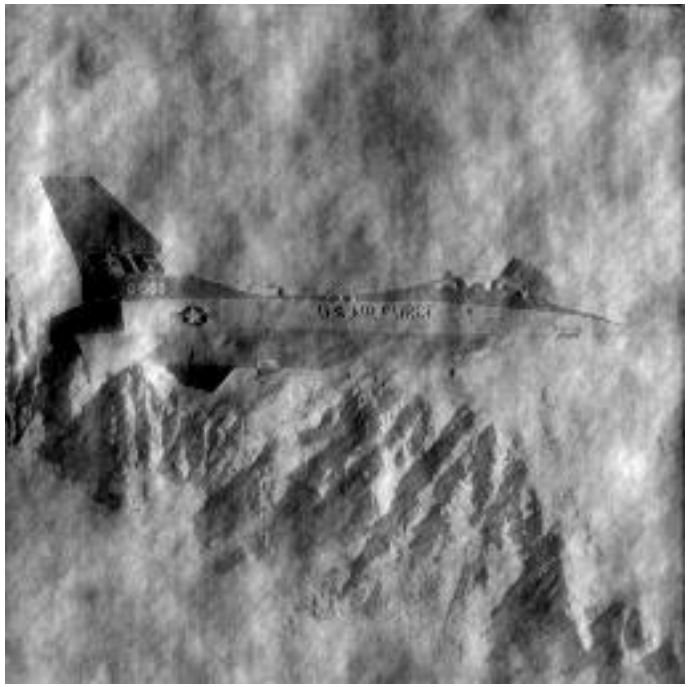


The **Magnitude** (DFT of Lena)



To Combine the Magnitude of One Image and the Phase of the Other Image

Resulting



Hint: fft2, abs and angle in the Matlab™.

References

- [1] A. V. Oppenheim, A. S. Willsky and I. T. Young, Signals and Systems, Prentice-Hall, 1983.

Thank You!

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