Practical works – n^{o}5

Discrete Fourier Transform

• **Exercice 1** – *2D frequency plan*

1.1 Define an image as follows (or similar):

```
N=64;
Ts=1/N; Fs=N; df=Fs/N% sampling
Im(N/8:N/4,N/4+1:N/2) =1;
Im(1:N/4,N/2+1:N) = Im;
Im(N/4+1:N/2,:)  = Im;
Im(N/2+1:3*N/4,:)  = Im(1:N/4,:);
Im(3*N/4+1:N,:)  = Im(1:N/4,:);
```

Display the image.

1.2 Compute the $I_f = DFT\{I_m\}$ of the image and display real and imaginary parts $(a + jb)$, modulus and phase (in degrees) $[\rho, \theta]$. Do not forget to apply `fftshift`.

1.3 Discuss about the frequency axes in the images. Interpret the different images (modulus and phase).

1.4 Plot $|I_f(u, 0)|$ and $|I_f(0, v)|$ with the correct frequency range. Discuss about these results. What does $I_f(u, v)$ represent.

• **Exercice 2** – *Reconstruction form modulus and/or phase*

2.1 Load a gray image I_{m1} and display this image.

2.2 Compute and display the $I_{f1} = [\rho_1, \theta_1] = DFT\{I_{m1}\}$ with $\rho_1 = |I_{f1}|$ and $\theta_1 = \arg[I_{f1}]$ of this image Apply a $log(\rho_1 + 1)$ transformation to display the low amplitudes. Display the phase in degrees.

2.3 Thanks to the DTF^{-1}, reconstruct an image from $I_f(\rho_1, 0)$ and another from $I_f(1, \theta_1)$. Display the real parts of these reconstructions.

2.4 Load a second gray image I_{m2} and display this image.

2.5 Compute and display the $I_{f2} = [\rho_2, \theta_2] = DFT\{I_{m2}\}$ with $\rho_2 = |I_{f2}|$ and $\theta_2 = \arg[I_{f2}]$ of this image.

2.6 Reconstruct an image from $[\rho_2, \theta_1]$ and another from $[\rho_1, \theta_2]$. Display these reconstructions. Conclusion ?