Université de Genève

Imagerie Numérique
13X004

TP 11: 2D Discrete Fourier transform (DFT)

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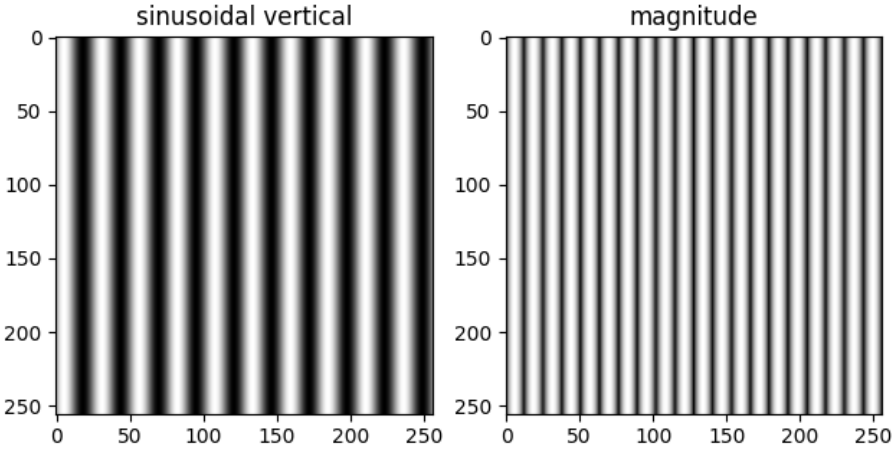
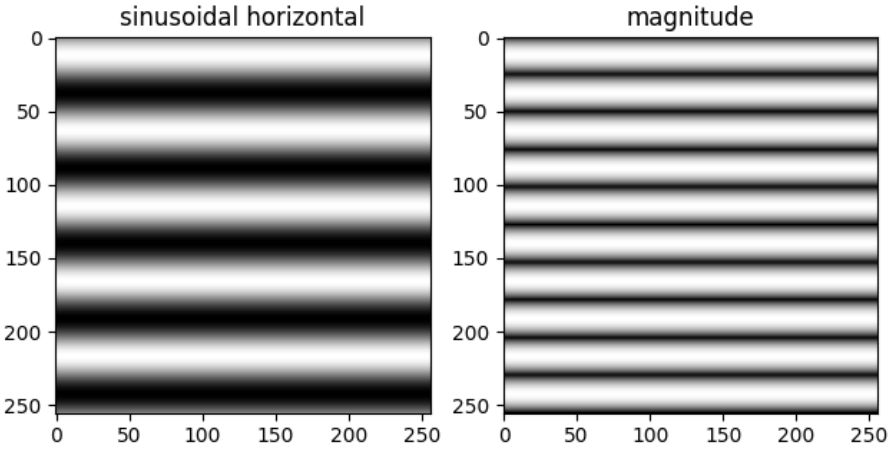
Exercise 1

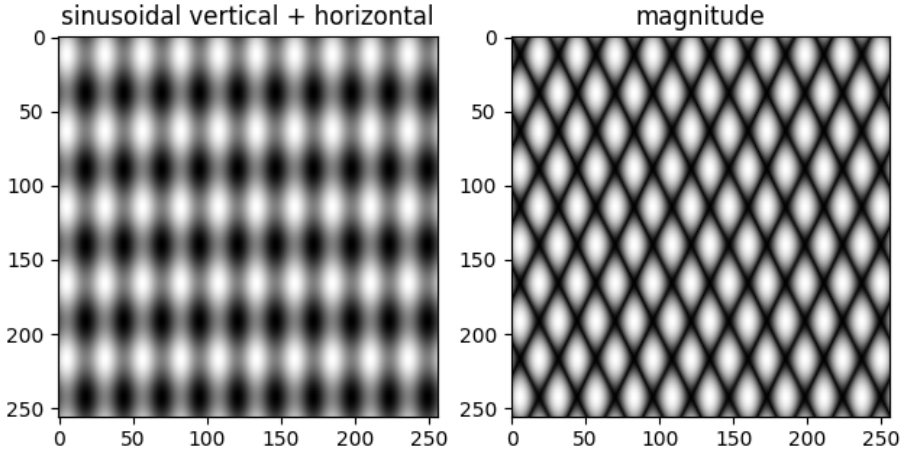
(a) on the left image we visualize the sinusoidal wave, and on the right image we can see that all the values that were negative, are now positive, which translates into a 'faster' wave.



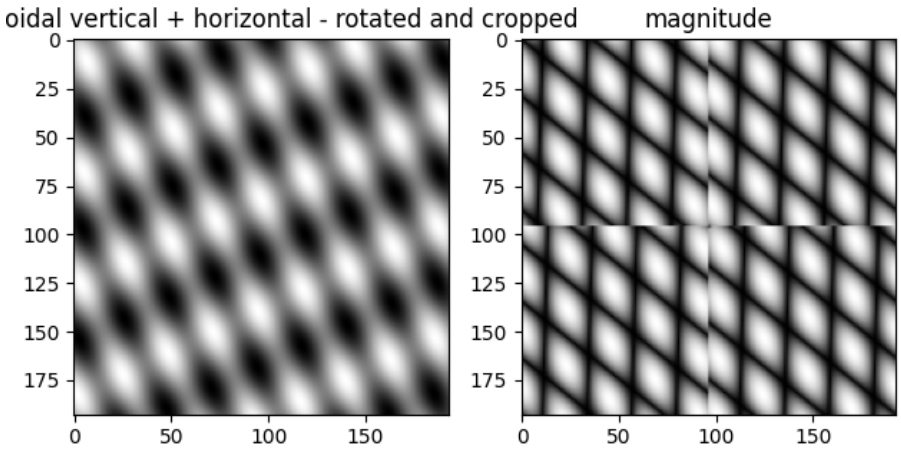
(b) since the period is smaller we have less waves, we see the same effect in the magnitude as in point (a).



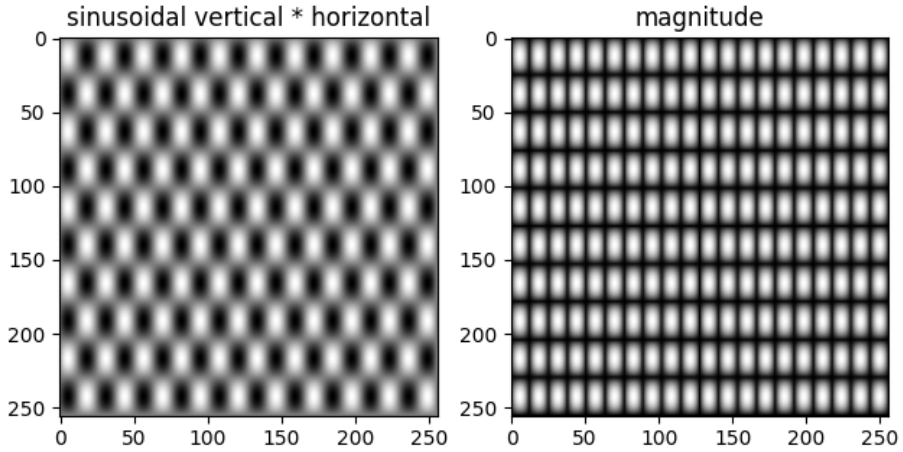
(c) since in this exercise we add horizontal and vertical waves, we have an uneven terrain, if we were too see it in 3d, we'd see many mountains, and like before, in the magnitude image, there would just be more of these mountains.



(d) As expected, by rotation an image, we also rotate it's DFT.

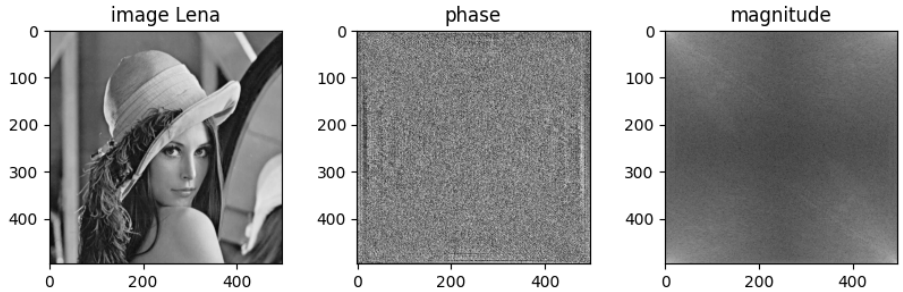


(e) With this point to point multiplication, we have this chess like effect, because we multiplied values of different symbols, because of this, in the top row we have as many negative values, as we have in the vertical sinusoidal from point(a). Again, this is all cancelled out with the magnitude.



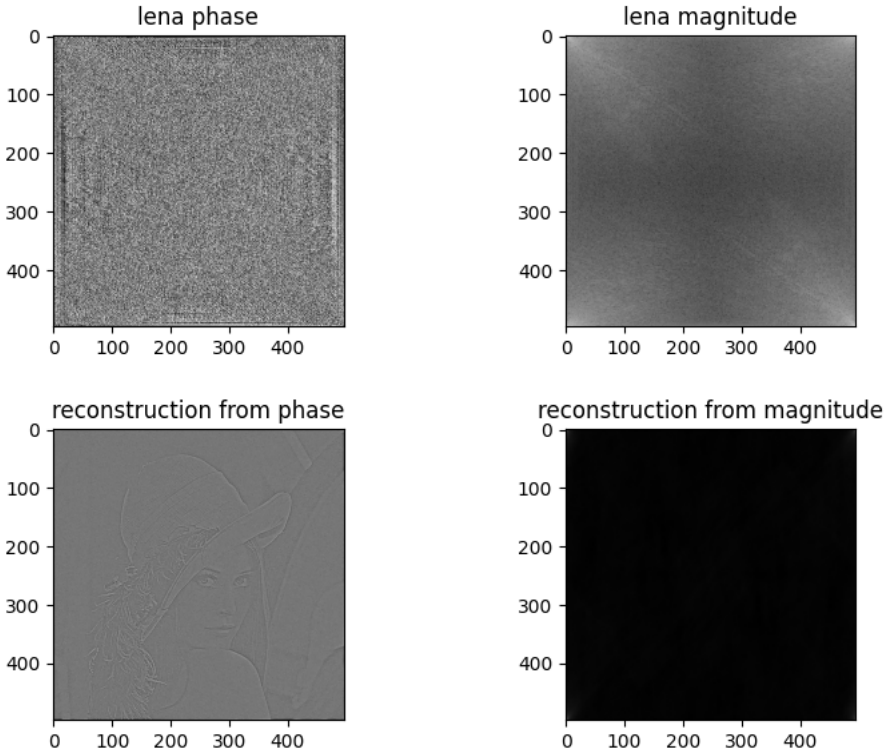
Exercise 2

(a) I choose Lena.



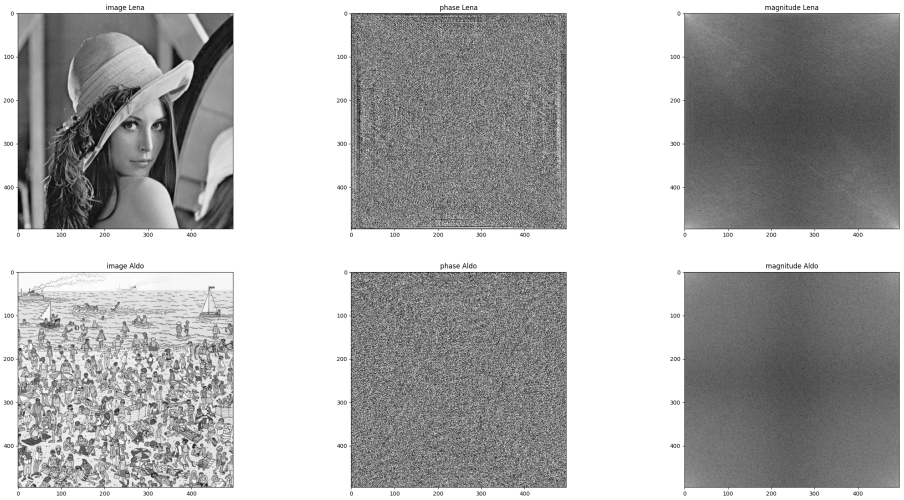
(b) We can clearly see Lena when we reconstruct it with only the phase, we can clearly see the image details, which was expected, as it is the phase that holds the information when colors change from a pixel to another. The same cannot be said to the second reconstruction, as we can't see anything. However, this

is only true because magnitude was set to 1, if it was set to 0 we wouldn't be able to see anything. In a weird way we can say that phase holds the detail, but magnitude holds the power.

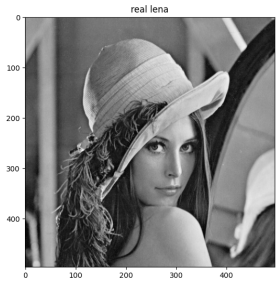


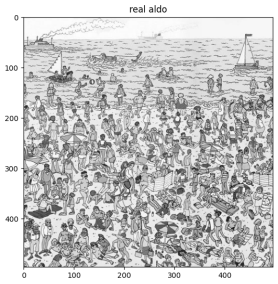
Exercise 3

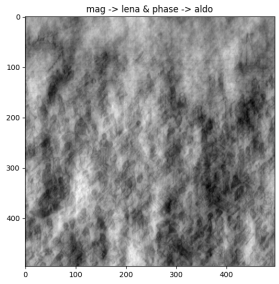
(a) I choose Lena and an image from ou est charlie, and scaled down so they would have the same size, so that the reconstruction would be possible.

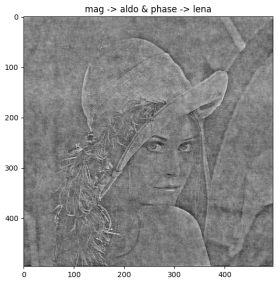


(b) in both reconstructions, it is the image of which we took the phase from that is visible, when we mix the magnitude of Charlie image, and phase of lena, we can clearly see Lena as if there was just an even noise in the image. Thinking of exercise 2, this was to be expected, as before, phase was able to express itself visually where magnitude couldn't.



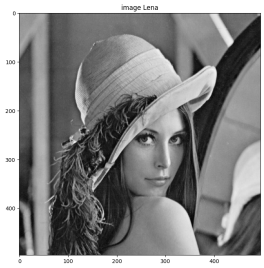


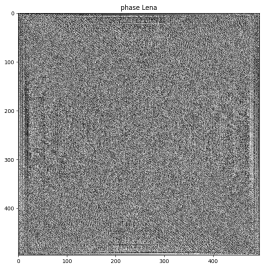


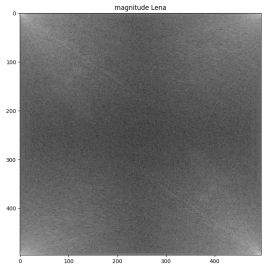


Exercise 4

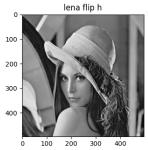
(a) I choose Lena again.

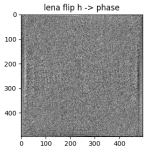


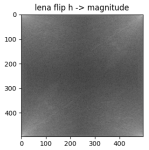


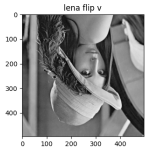


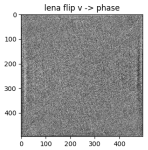
(b) Well, since we rotated an image and inspected it's DFT, yes I was expecting the DFT to just be flipped as well.

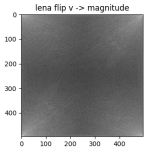


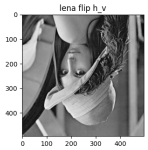


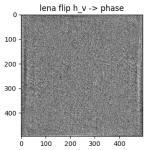


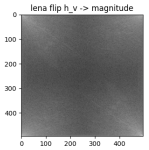








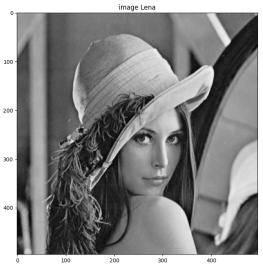


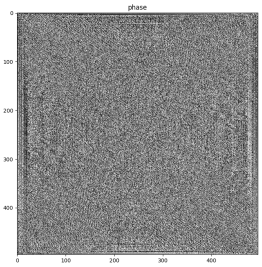


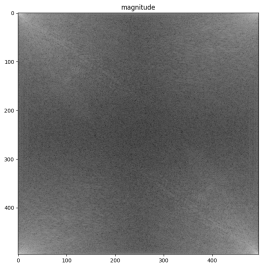
(c) I must admit I was surprised, but while thinking about it, it is a normal result, every phase value, is represented by a real and imaginary part. this value can be seen as a vector, when multiplied by -1, it keeps all its values it just changes sign.

Exercise 5

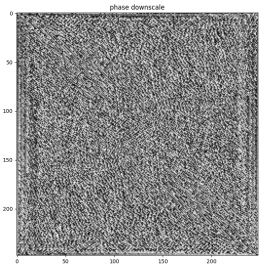
(a) I choose Lena again.

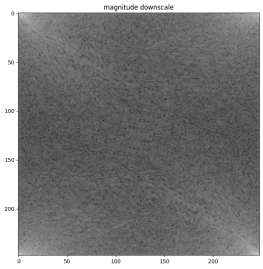




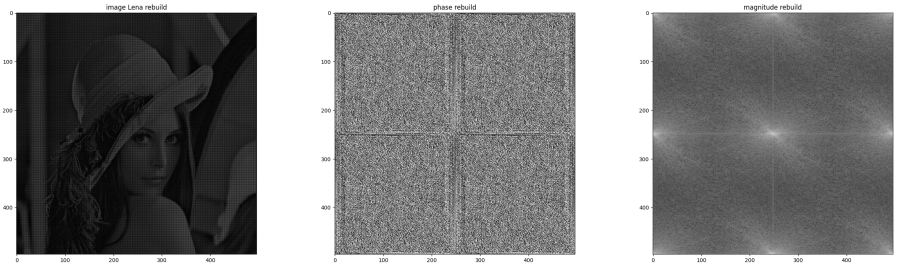


(b) Because the differences between each pixel and it's neighbours are more important in the down-sample, we see that play an effect in the phase that is much less even. the same can be said for the magnitude. This is due to the simple fact that we are just deleting information. we can also think about the fact that this operation causes a loss of information, where rotation and flip operations were lossless.



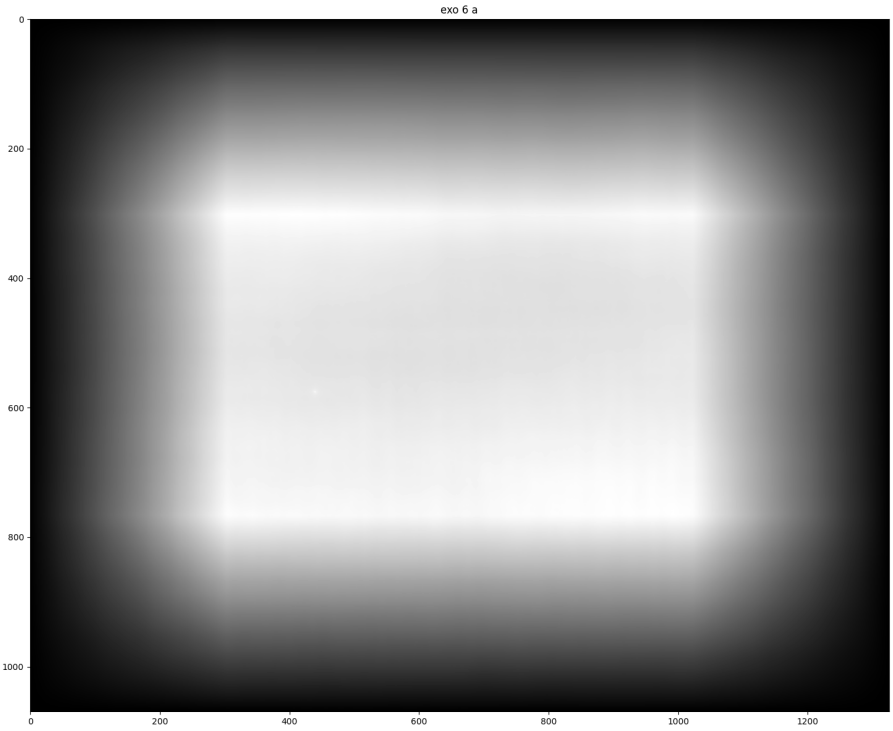


(c) As seen in class, we observe distortion effect when up-sampling.

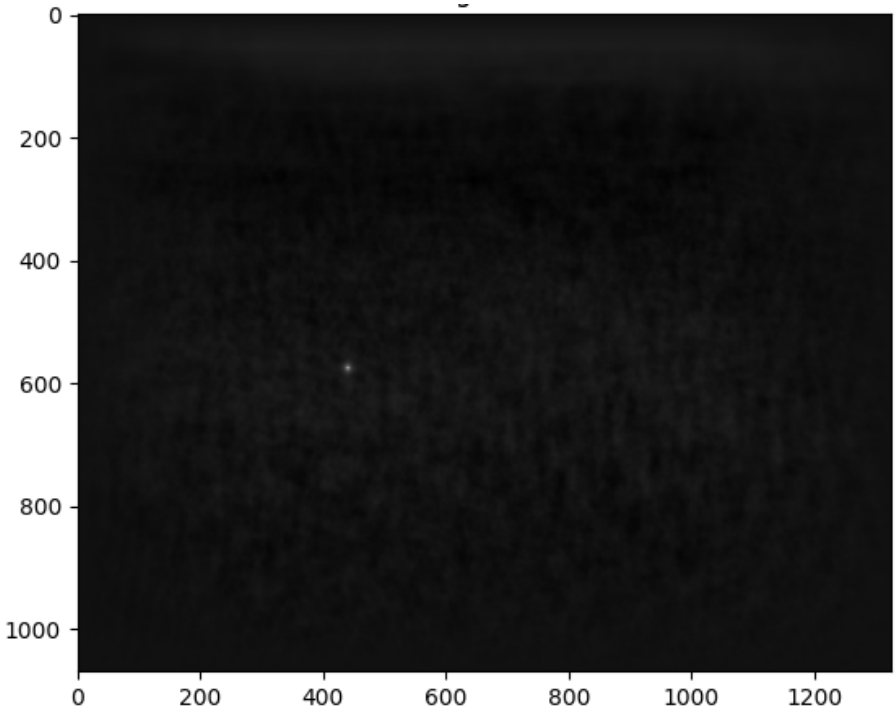


Exercise 6

(a) I couldn't find the correct threshold to only have the expected point light up. This operation finds the good result, but finds bad results as well, which is a problem. This implementation would work well to identify letters in text.



(b) The solution here is perfect, but it is a much slower operation, cf point 6.c.

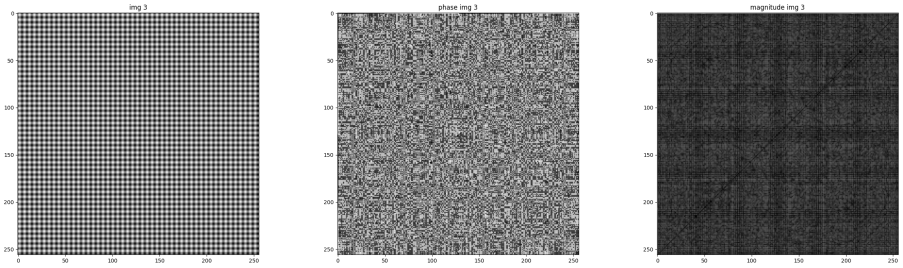


(c) Our implementation wasn't perfect, but it was faster.

```
A :   0.40000057220458984
B :   409.81471133232117
```

Exercise 7

(a) Chaotic phase



(b)

(c)