

Image Processing and Computer Vision - Lab 3



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Fourier Transform

- Today and next week
 - 3 hours
- Text of the exercises/tasks
 - on the Teaching Portal
- Today: you need two still images
 - get them from the Teaching Portal
- Next week: another image (choose freely)
- Goal
 - Check the theory behind the Fourier transform (and its inverse)



Fourier Transform

- Four exercises
 1. apply the discrete Fourier transform (DFT) to a sin function image and a circle image; then anti-transform both
 2. apply the DFT to an image of your choice, and add a high-pass filter as a mask
 3. apply the DFT to an image of your choice, and add a low-pass filter as a mask
 4. apply the DFT to an image of your choice, and add a band-pass filter as a mask



DFT

```
complex_image_result =  
cv2.dft(complex_image_src,  
flags=cv2.DFT_COMPLEX_OUTPUT)
```

where both the source and destination images are complex images

To have a “normal” (source) image as a complex one you should:

- `np.float32(img)`



Show the DFT result

- DFT output image is complex
- We can print/visualize its magnitude, only!

```
magnitude = cv2.magnitude(real_part,  
                           imaginary_part)
```

where:

- the real and imaginary part are the first and second "channel" of the complex image (DFT output)



Visualize the magnitude

- Values in the magnitude matrix can be in different orders of magnitude
 - ... we need to move them in a log scale
 - `np.log()`
- Also, the image must be shifted to the center, to analyze its spectrum
 - its four quadrants are inverted, by default!



Inverse DFT

```
complex_image_dst =  
cv2.idft(complex_image_src)
```

where both the source and destination images are complex images, as before



*-band filters

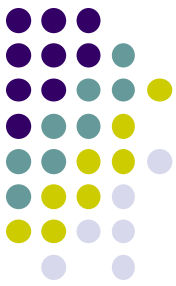
- First, compute the DFT, up to the magnitude (as before)
- Then, create the mask/filter:
 - `np.zeros()`, `np.ones()` can be useful to get started
 - compute the circular area(s) in the middle of the mask (this could be a bit tricky; it involves numpy quite heavily)
 - the last two links in the text of the lab can really help on this
 - apply the mask by multiplying (`*`) the DFT output and the mask
 - finally, perform the inverse DFT (as before)



Fourier Transform

- In the first session: you should be able to complete the first exercise
- Hints, insights, links, etc. are in the text of the exercises
 - I am here for you...
 - ... please ask if you need any help or clarification

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