Video Signals

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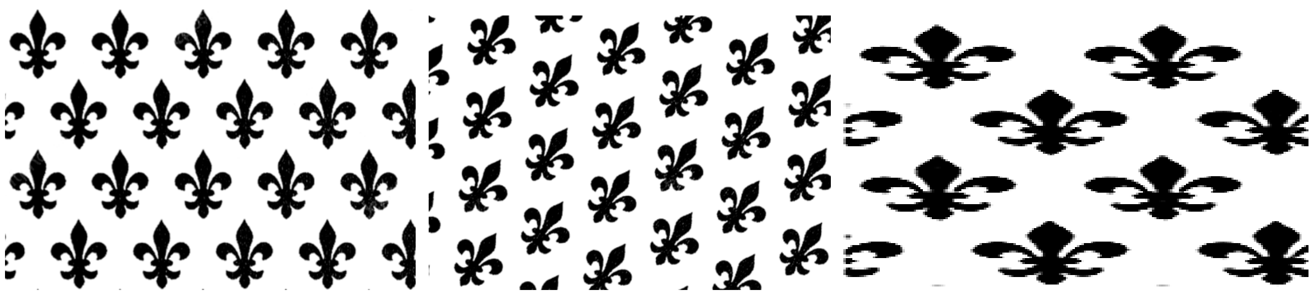
Ex.1.[11 Pt]

The B/W logo on the left presents a specific noise, indicate a possible sequence of morphological operations aimed at reducing that noise. In particular, detail the structuring element adopted for these operations, the obtained results and possible drawbacks of the proposed approach.

Es.2. [11 pt] We want to define a system that, using the 2D Discrete Fourier Transform, is able to classify the first two textures (the same texture, just rotated) as belonging to the same class, while the texture of the third image as belonging to another class.



Define a possible algorithm that, properly combining the properties of the 2D FFT, is able to provide the desired result.

.**Es.3 [11 pt] MATLAB** Given a color image in the file image.bmp, implement in Matlab the following operations:

- Read the image, load it in the workspace, convert it to 256-levels grayscale and visualize it.
- Compute the mirror image with respect to the *y axis*, that is, the pixel order in each row of the image is reversed. Compute also the mirror images with respect to the *x axis*, and with respect both x and y axes.
- Create a composite image: double of the size of the original image. Put the original image in the upper left corner, the y-reflected in lower left corner, the x-reflected on the upper right and the last image (flipped on both axes) in the lower right corner.
- Compute the Fourier transform via FFT for the composite image and visualize the log modulus of the transform. Ensure that the zero frequency component (DC) is always at the center of the image.
- Due to the particular symmetry of the final image, what property will have its Fourier Transform?

Matlab
List of functions

```
abs
double
figure
find
fft2
fftshift
imagesc
imopen
imread
imresize
imrotate
imshow
log
rgb2gray
size
zeros
```

Solutions

Ex.1

Ex.2

Applying a 2D Discrete Fourier Transform and taking its modulus we get a texture descriptor that is invariant to translation. Applying to this result a Cartesian to polar coordinates transform centered at the zero frequency we get a descriptor that, when the original image is rotated circularly shift along the angle axis. A further 2D Discrete Fourier Transform applied to this last feature and evaluating its module will provide a texture descriptor invariant to rotation (the invariance to translation was already obtained from the DFT transform).
This last descriptor will give very similar results for the first two textures since the second one is just a rotated version of the first one while the third one, which is a stretched version of the first one, will be quite different from the first two transforms.

Ex.3