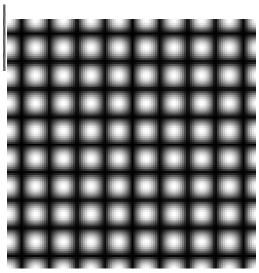
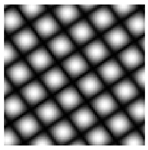
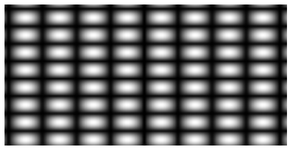
Video Processing

Date: 26/6/2013

Ex.1.[11 Pt] Describe the CIE standard device and how every color can be obtained from Reference Light sources.
Furthermore describe why using only the 3 primary colors we are able to represent all colors perceived by the human eye.
Describe why, in the CIE experiment, a specific reference color has to be used as “negative” in order to get some specific color.

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

Es.3. [11 pt] Given a grayscale image in the file *image.tif* with 256 levels of gray, implement in Matlab the following operations:

- Read the image, load it in the workspace, rescale the values to the interval [0,1] and visualize it.
- Add a Gaussian noise with zero mean and 0.1 variance. Ensure that all the pixel values are still in the interval [0,1]
- Apply to the resulting image an average filter and a median filter, both of size 5x5.
- Compute the signal-to-noise ratios (SNRs) for the resulting images, taking as a reference signal the original image. What ratio you expect to be higher, and why?

Matlab
List of functions

```
figure
filter2
find
fspecial
im2double
im2gray
imopen
imread
imshow
mean
medfilt2
randn
size
sqrt
sum
zeros
```

Solutions

Ex. 1

Refer to course's slides.

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

1.

```
img_gray = im2double(imread('image.tif'));
figure, imshow(img_gray);
```

2.

```
noise = 0.1 * randn(size(img_gray));
img_noise = img_gray + noise;
img_noise(img_noise > 1) = 1;
img_noise(img_noise < 0) = 0;
```

3.

```
av = fspecial('average', 5);
img_noise_av = filter2(av, img_noise);

img_noise_med = medfilt2(img_noise, [5 5]);
```

4.

```
eff_noise_av = img_noise_av - img_gray;
SNR_av = sum(img_gray(:))^2 / sum(eff_noise_av(:))^2;

eff_noise_med = img_noise_med - img_gray;
SNR_med = sum(img_gray(:))^2 / sum(eff_noise_med(:))^2;
```

We expect the first SNR to be higher, because the average filter is good at removing Gaussian noise, while the median filter is better at removing "impulsive" noise, like for example salt and pepper noise.