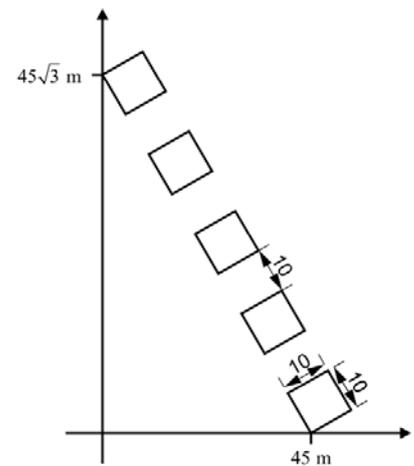


Video Processing

Date: 04/07/2016

Ex.1.[14 Pt] An aerial image presents a set of five square buildings whose side is 10m and the distance between them is 10m as depicted in figure (every side of the square is represented in the image by hundreds of pixels). In order to estimate their principal orientation we decide to use the Hough transform. Analyzing the resulting Hough transform where will be placed the global maxima? How many global maxima will be present? Analyzing the further local maxima, (whose magnitude is just below the global maxima) where are they placed in the Hough transform?



Es.2. [8 pt] A CCD sensor is able to detect in a specific configuration of light intensities ranging from 1 to 1000 lux. An observer is looking at the acquired gray scale image (from a device that is able to completely represent the intensities range of the CCD). Assuming that his visibility threshold constant is 0.01, how many gray values will he be able to distinguish?

Es.3. [11 pt] Given the black and white image *trees_bw.bmp*, we know it has been obtained from the truecolor image *trees.jpg* with 8 bit per channel. Find the value of the black and white threshold that has been used. Proceed as follows:

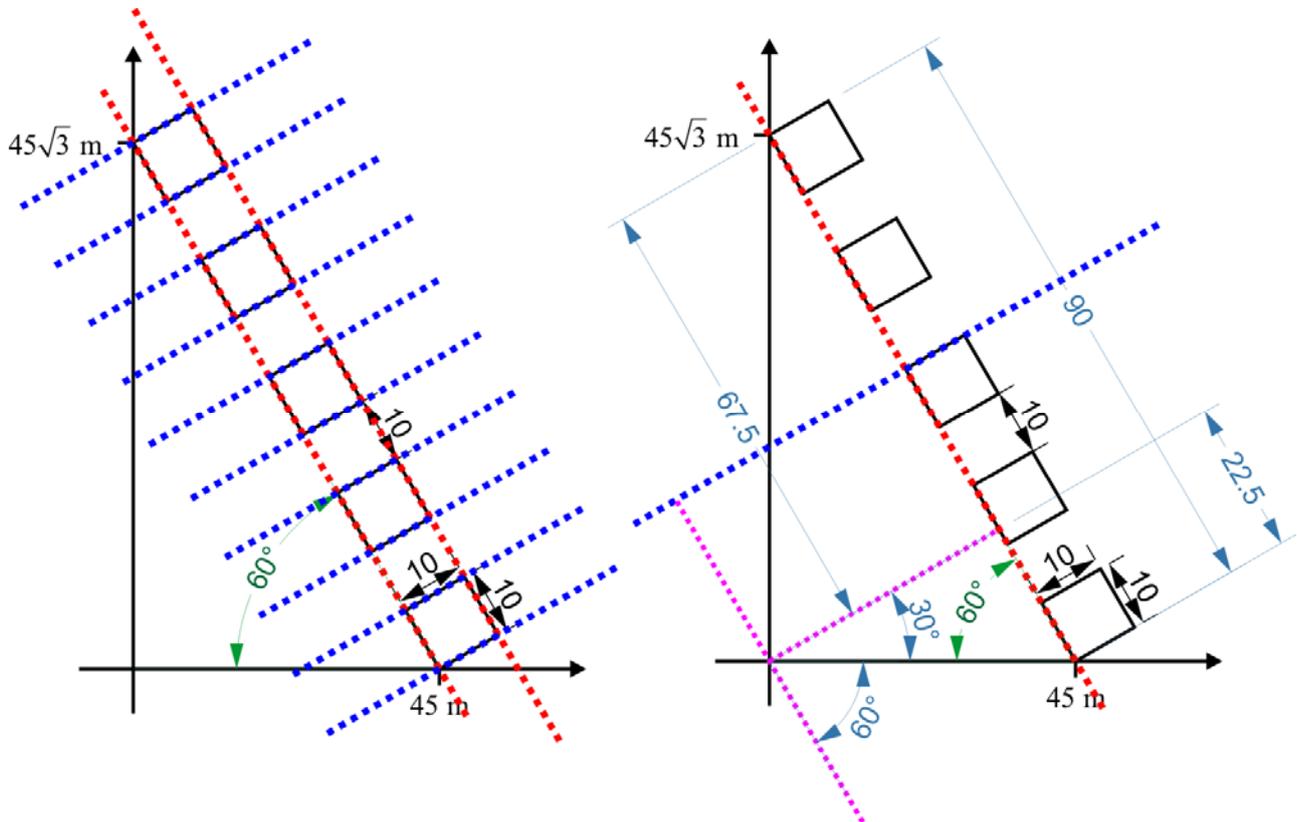
- read, load and visualize the two images;
- convert the RGB image in a grayscale image;
- find the number of black pixels and the number of white pixels in the BW image.
- Find the value of the threshold that, applied to the grayscale image, gives the desired BW image. To do so:
 - analyze the histogram of the grayscale image and find the gray value threshold that has exactly the desired number of black pixels below (and the desired number of white pixels above);
 - or
 - [Optional] given the BW image, find all the pixels of the grayscale image that have to be converted to black. Among these pixels, find the highest gray vale and convert it to the desired threshold.
- apply the black and white threshold and visualize the result.

Matlab List of functions

```
figure
im2double
im2bw
rgb2gray
fspecial
imread
imresize
imrotate
imfilter
imnoise
fft2
ifft2
imshow
imagesc
getimage
size
zeros
find
abs
angle
conj
double
max
```

Solutions

Ex.1 Applying the Hough transform we will find two global maxima and 10 local maxima (whose value is just below the global maximum value).



On the left image the two red lines represent the dual of the two global maxima of the Hough transform while the 10 blue lines represent the local maxima.

For the first global maximum, on the right we represent in purple the line represented according to the Hough notation $\rho = \frac{45}{2}\sqrt{3}$ and $\theta = \frac{\pi}{6}$, for the second global maximum $\rho = \frac{45}{2}\sqrt{3} + 10$

While for the local maxima we will have: $\theta = -\frac{\pi}{3}$ and $\rho = 90 - \frac{45}{2} - 10 \cdot k = 67.5 - 10 \cdot k$ where $0 \leq k \leq 9$

Ex.2

According to the Weber's law we get: $\frac{I_{MAX}}{I_{MIN}} = \frac{1000}{1} = (1 + 0.01)^k \rightarrow k = 694$ gray levels.