Computer Vision LAB-05
Robotics Engineering, Unversity of Genova

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0.1 Abstract

The Lab-05 focuses on Normalized cross-correlation and Harris corner detection. The NCC focuses on keypoints or corners of the image. Harris corner detection focuses on the corner, edge and plane detection.

0.2 Objective

1. NCC-based segmentation:
• Select a window around the red car on the street and apply the NCC (normalized cross correlation, normxcorr2), in order to find the template in all the 6 images (consider the same images of Lab4). Show the template. Show the position of the maximum of the score map and a box corresponding to the size of the template for all the 6 images. Do the same for the dark car that turns on the left.
• Compare the results of this Lab with the ones of Lab4 (color-based segmentation).
• Consider three different sizes of the window (centered around the dark car that turns on the left): discuss the results in terms of computation time and accuracy of detection.

2. Harris corner detection:
• Implement the Harris corner detector. Apply the developed corner detector on the "image i235.png". Show the partial derivatives of the image and the Gaussian filter. Show the R score map and the corner regions. Show the detected corners overlapped to the image.

0.3 Methodology

1.
•Using imread() function images load the images since the images are true rgb images they can't be converted into grayscle using (colormap gray) so instead use rgb2gray(img) to convert it into a grayscale img (fig.1). Using this first load all 6 images. Patch the red and black car respectively by selecting the matrix which define the cars.

Use command I(y1:y2, x1:x2) to patch the object needed. normx-corr2(patch,image) leads to give the corner or keypoint of the image.(fig.2-7)

• The Lab4 results were based on color segmentation i.e the rgb was first converted into hsv. A mask was created where if the hue is ¿0.97 and ¡1 the red card got detected. The blob of car was recognised but a proper boundary couldn't be made around the car and the results were a kind of salt and pepper noise.

Whereas in lab 05 intensity of the patched object in this case the cars got detected. A bright point was found in place of the object that had to be detected. Figures(8-17) will show the difference between both approaches.

• Considering three different sizes of window in black car. One window where some part of black car is patched, another with normal size of car being taken and the third window where some extra area is taken apart from the car. Window one and two shows a little difference in detecting the car the only difference that can be noticed is the intensity of area in the image, while the third window doesn't clear the position of car in the picture.(fig-9,10,11) are window patches

2.

• Steps to do Harris corner detector are:

a. Derivatives along x and y axis are found using sobel edge detector gradients.fig.(19,20)

b. products of all components with each other are taken and then sum of the products using conv2 is done using gaussian filter.fig.(21)

c. feature detection is done by first taking a 0 matrix of size of window that was produced using gaussian filter and convolution.

d. compute the response of each value of matrix and when the value exceeds 0.3*M (the threshold value of corners) we get corners detected.(fig.22) intensity points discribes the corner points.
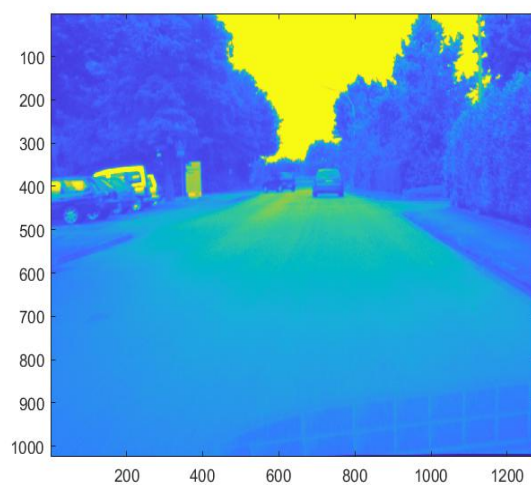
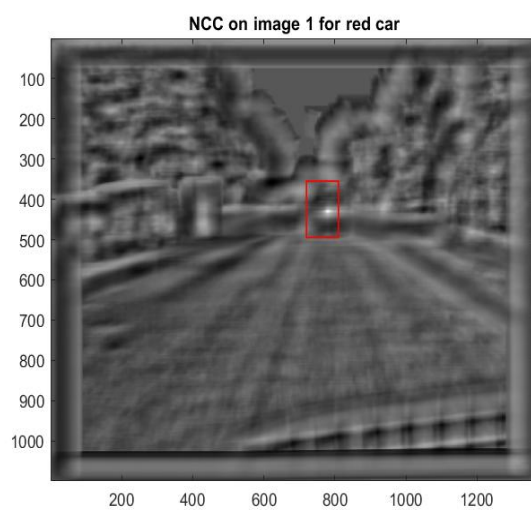## 0.4   Results

Figure 1: sample image
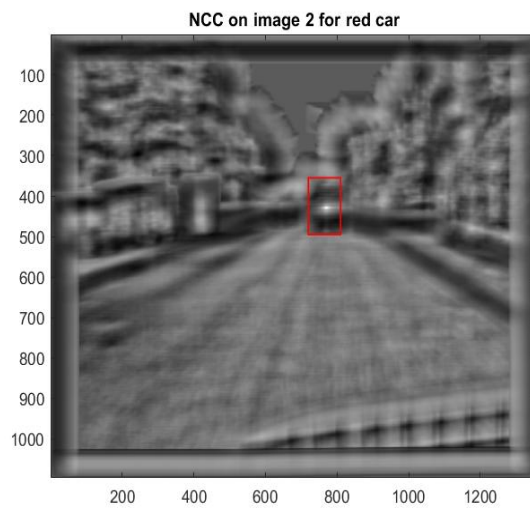

Figure 2: NCC of red car for image 1

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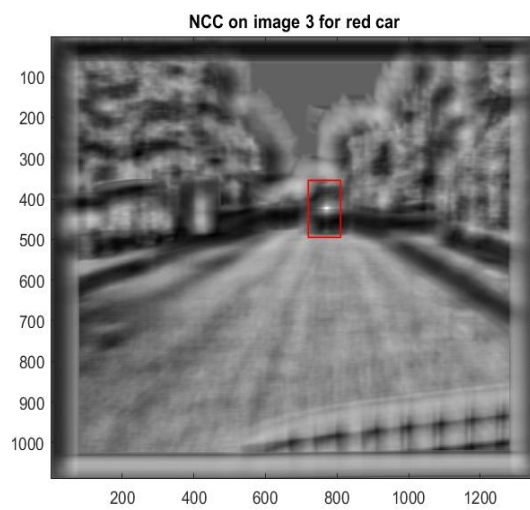Figure 3: NCC of red car for image 2
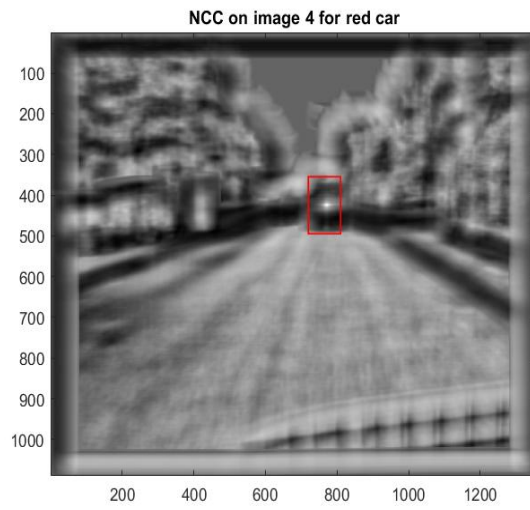

Figure 4: NCC of red car for image 3
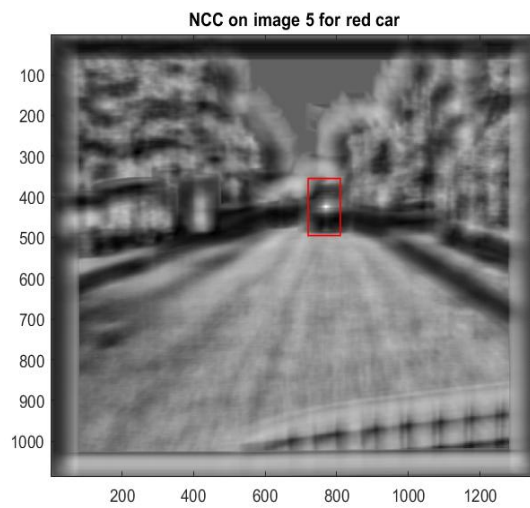
Figure 5: NCC of red car for image 4

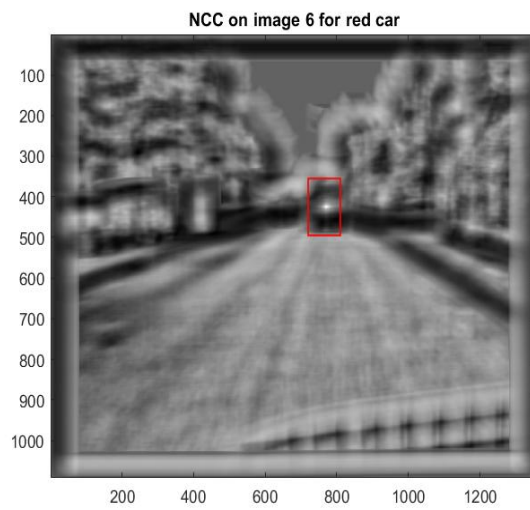Figure 6: NCC of red car for image 5
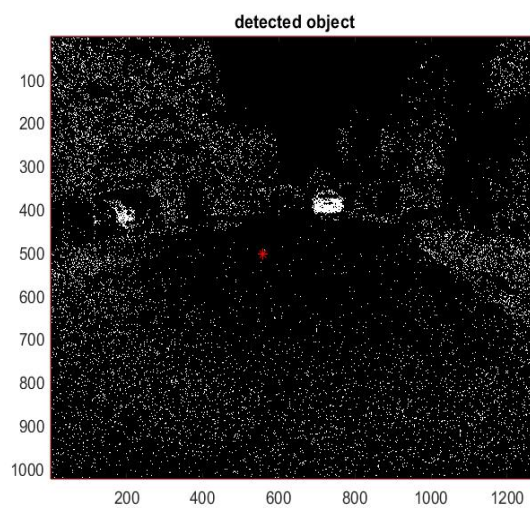
Figure 7: NCC of red car for image 6
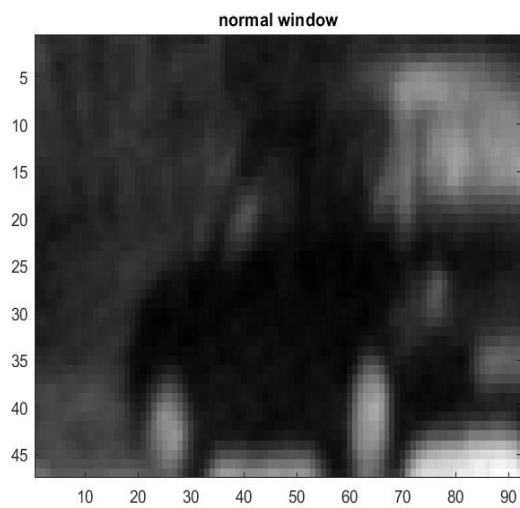

Figure 8: Lab04 result for red car
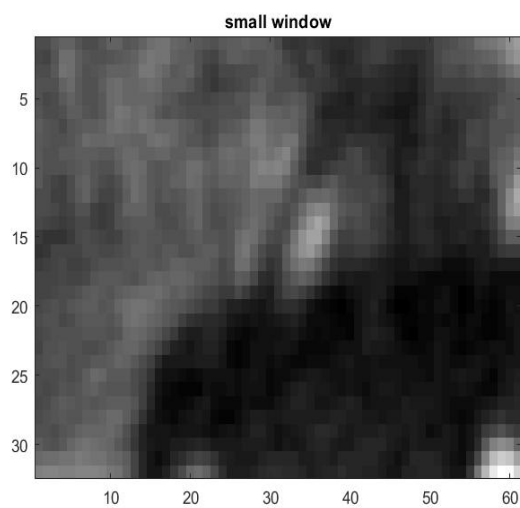
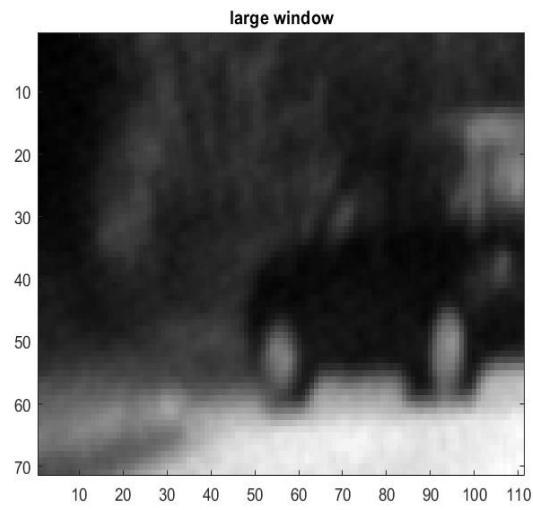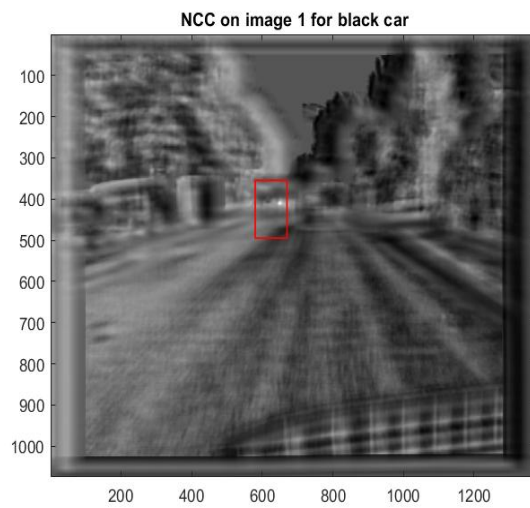Figure 9: normal window patch black

Figure 10: small window patch black

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Figure 11: large window patch black
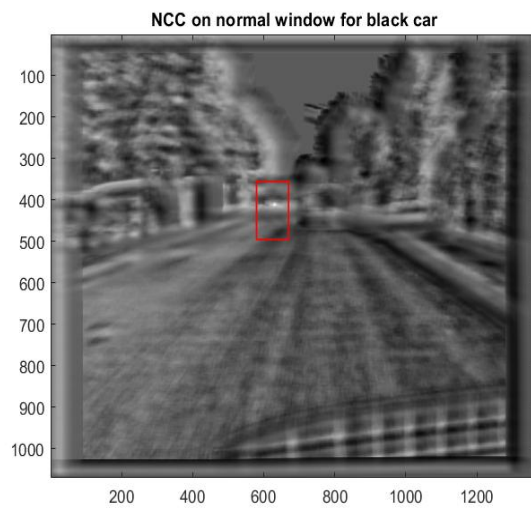

Figure 12: NCC of black car for image 1
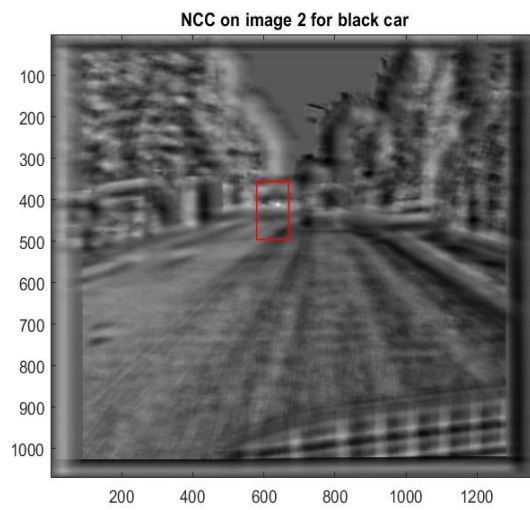
Figure 13: NCC of black car for image 2
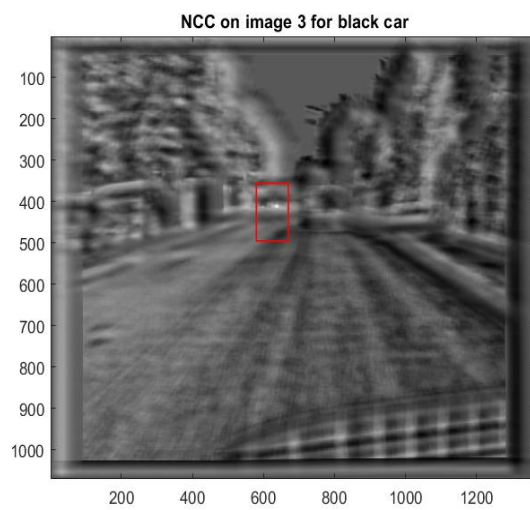
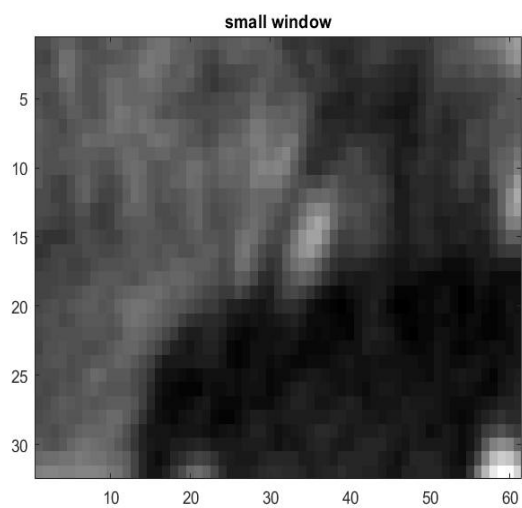Figure 14: NCC of black car for image 3

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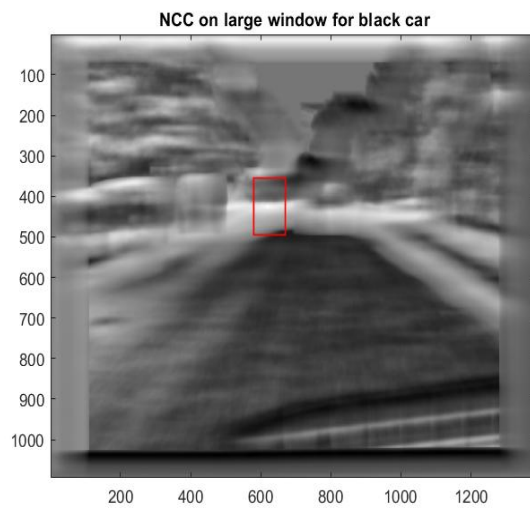Figure 15: normal window black car

Figure 16: small window patch black
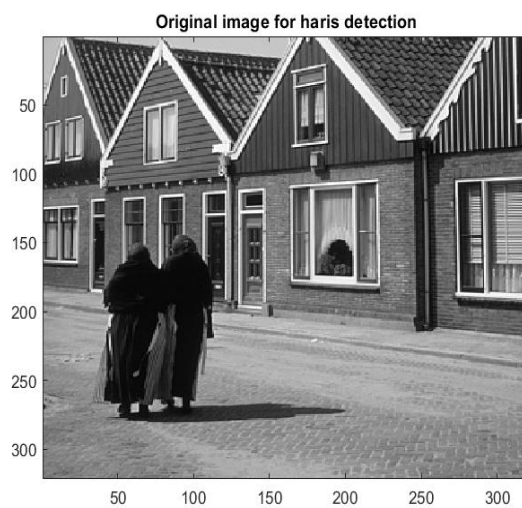
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Figure 17: Large window Black car

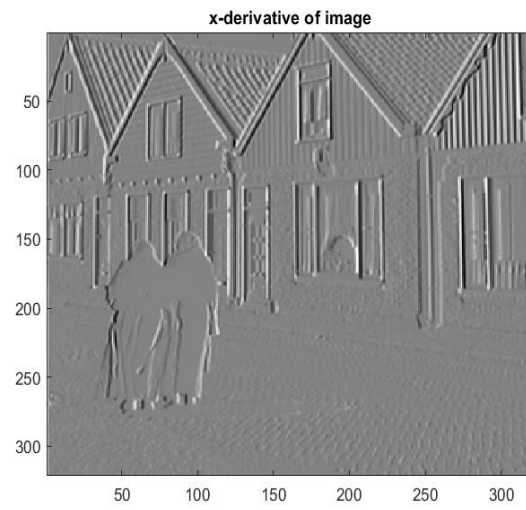Figure 18: Original image for Harris Corner detection

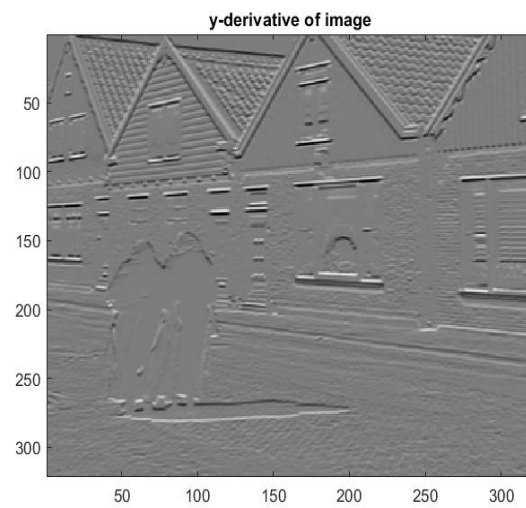Figure 19: x-derivative of image
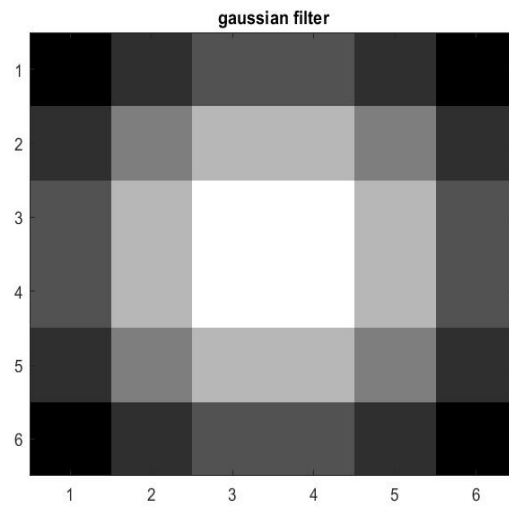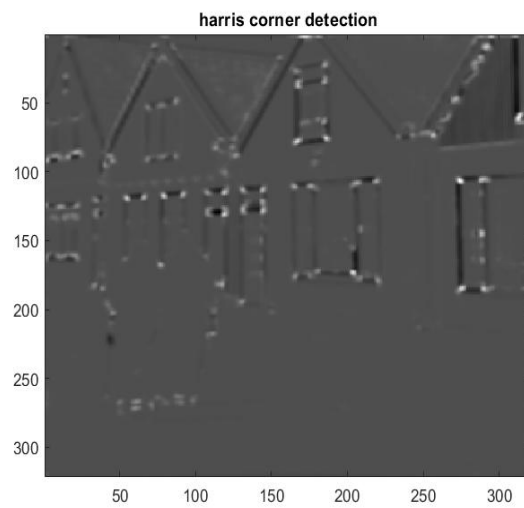

Figure 20: y-derivative of image

Figure 21: Gaussian filter

Figure 22: Harris corner detection