

Machine Perception COMP3007

Feature Detection

Exercise 1 - Corner Detection

In this exercise, you will experiment with two corner detection methods. Write a program to detect strong corners in an image. You should start with the Harris detection method, then Shi-Tomasi. With each method, try to vary the parameters and observe the detection results. You will detect corners in three images

- An ideal checkerboard image;
- The same checkerboard image with gradual reduction of contrast;
- The same checkerboard image with both contrast reduction and additional blurring.

For each case, ask yourself what corners you would expect to see and inspect the detection results to see if it is the case. Observe how contrast reduction and blurring affect the detection.

Exercise 2 - Edge Detection

In this exercise, you will experiment with the Canny edge detection method. First, revisit the filtering exercise in the previous practical and obtain the convolution between the input image and each of the Prewitt or Sobel kernels. Test with the checkerboard image in Exercise 1 and see if the result makes sense. Then investigate how you would combine the obtained gradients to gradient magnitude, which is the preliminary step in the Canny edge detection method.

In the second part, you use OpenCV's Canny edge detection method to extract edges in an image. Vary the double thresholds to control the detected edges. Test edge detection with the following images

- The ideal checkerboard used in Exercise 1;
- A natural image of a vehicle.

Exercise 3 - Line Detection

In this exercise, you will experiment with the Hough transform. In the first part, you are asked to implement your own version of the Hough transform which allows you to obtain the accumulator array (you should export it as an intensity image to visualize it). Test your implementation with the checkerboard image in Exercise 1 and verify that the locations of the peaks are as expected. You may refer to the lecture slides and/or the following webpage for the Hough transform

<http://homepages.inf.ed.ac.uk/rbf/HIPR2/hough.htm>

In the second part of this exercise, you test the Hough transform-based line detection method on several images, including

- The ideal checkerboard used in Exercise 1;
- A diamond-shaped image;
- A natural image of a building.

You should vary the line section parameters and observe how they influence the detection results. Explain what the threshold means for line detection? How is it related to the properties of detected line segments in the image? Please note that edge detection is usually desired before line detection. What will happen if you forget this step?

Exercise 4 - Blob Detection

In this exercise, you will test blob detection using MSERs (Maximally Stable Extreme Regions). First, review the fundamentals of MSERs from the lecture notes and suggested references. Then you perform blob detection using the following images

- An image of several coins;
- An image of only a playing card;
- An image of a playing card lying on carpet;
- An image of a vehicle (reuse the image in Exercise 2).

For each image, examine the detected blobs. Based on the theory of MSER detection, are the results as expected? Does it detect the blobs you expect? Does it detect other blobs that you do not expect. What actually does the MSER detector return?

End of Practical.