

Lab 4:Detectors

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1 Introduction

In this lab session,i explored methods for the detection of points of interest (PoI) in the scene/Image.

2 Scale space detectors

2.1 Exercise 1

2.2 Laplacian Detector:-

For the laplacian detector, i tried 3 set of parameters for different runs mentioned in table 1 [1](#). The noctave parameter defines the number of octaves in the scale space. i.e if nocavte is 4 and nscales is 8 then there will be 8 down scaled versions of the image and 4 such sets exists in the scale space. The sigma0=1 is the size of the gaussian kernel standard deviation. The npoints defines the number of maxima and minima points in the image. For a given npoint value the algorithm will consider the mentioned number of points and suppress the others. For the the 1st run It selected lesser number of maxima and minima when compared to 2nd and 3rd run.[1](#)

Run	noctave	nscales	sigma0	npoints
1st run	4	8	1	100
2nd run	3	10	1	200
3rd run	4	10	1	200

Table 1

2.3 Hessian Detector:-

The hessian detector is obtained calculating the determinant of hessian matrix. The main difference between LOG and DOH is that, determinant of the Hessian operator has better scale selection properties under affine image transformations than the Laplacian operator. In the hessian detector i observed that there are saddle points which affect the location of local extremum points. In the 3rd run where the number of octave and number of points are more we can see more distinctive features in the image are detected.[2](#)

Run	noctave	nscales	sigma0	npoints
1st run	4	10	1	100
2nd run	3	9	1	200
3rd run	5	10	1	300

Table 2



(a) 1st run output



(b) 2nd run output



(c) 3rd run output

Figure 1: Points of interest detected using Laplacian detector

2.4 Exercise 2

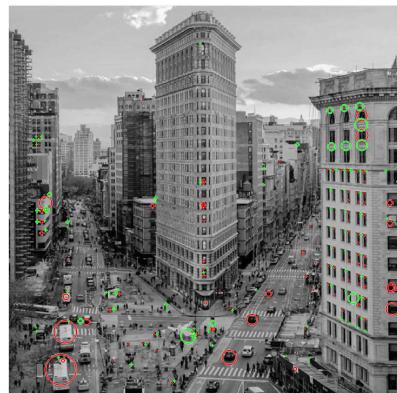
Difference of Gaussian(DoG)- The difference of gaussian operator takes the difference of two successive gaussian kernel and then the image is convolved with that difference kernel to obtain the final image. I used parameters like nscales=10, nocatve=4, sigma0=1 and got below output. 3. The error between the DoG and LoG is 0.0179/pixel. Since the size of DoG is smaller, the execution time is faster.

2.5 Exercise 3

Rescaled level curve curvature detector (kdetector.m and extractkGivenSigmas.m) using the determinant of Hessian. The results of the rescaled level curve curvature detector, on a scale-space obtained using 3 octaves, 10 scales and 1 as initial sigma are shown below. It can be seen that the detected



(a) 1st run output



(b) 2nd run output



(c) 3rd run output

Figure 2: Points of interest detected using Hessian detector

points are accurate and detected at lower scale. The figure 4a and 4b below depicts the top-500 maxima points.⁴



(a) 1st run output



(b) 2nd run output

Figure 3: Difference of gaussian detector output.

3 Non-Linear Scale space detectors

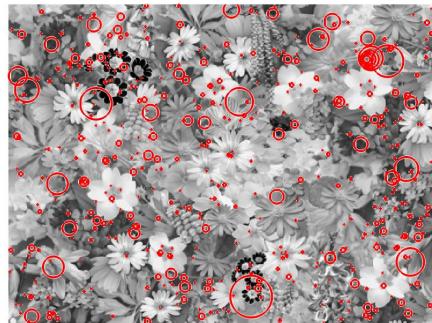
The run time of non-linear HoG, is more. However the detected points are exact. The detected points by non-linear HoG were similar to previous results.⁵ Green points in the image are saddle points.

3.1 Exercise 4

4 Handcrafted detectors

4.1 Exercise 6

SURF:- Speeded Up Robust Feature detector. SURF will detect landmark points in an image, and describe the points by a vector which is robust against (a little bit) rotation, scaling and noise. It can be used in the same way as SIFT (Scale-invariant feature transform). The scale space construction was not clear. The positions of the PoI were the same when compared to HoG. In the end the output was the positions, scales and types of the detection of the points in interest. ⁶



(a) 1st run output.



(b) 2nd run output.

Figure 4: Output of Rescaled level curve curvature detector.



Figure 5: Output of non-linear scale space HoG.



Figure 6: Output of SURF detector.