

Digital Image Processing - CS 663

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Harris Corner Detection

1. The image was zero-padded before calculating structure tensor to account for boundary conditions
2. Structure Tensor weighted by Gaussian was evaluated for each pixel and stored in a 4D matrix A, the first two dimensions stored the pixel location and 3rd and 4th dimension corresponded to 1st and second dimensions of Structure Tensor Matrix
3. Eigen value of structure tensor and Cornerness measure (stored in imgC1), was found for each pixel

```
1  for a1 = 1:m
2      for a2 = 1:n
3          B(1,1) = A(a1,a2,1,1);
4          B(1,2) = A(a1,a2,1,2);
5          B(2,1) = A(a1,a2,2,1);
6          B(2,2) = A(a1,a2,2,2);
7
8          V = eigs(B);
9          imgEigenP(a1,a2) = V(1);
10         imgEigenQ(a1,a2) = V(2);
11         imgC1(a1,a2) = V(1)*V(2) - k*(V(1) + V(2))*(V(1) + V(2));
12     end
13 end
14
```

4. Non-Maximal Suppression - if a pixel had any of its neighboring pixel cornerness value greater than its, the pixel cornerness was suppressed. I have suppressed by giving those pixel the lowest value of cornerness, so that they do not appear in the final cornerness plot
5. Gaussian standard deviation and k was tuned such that the corners have cornerness $C > 0$
6. A thresholding was applied to the output cornerness, to obtain a limited number of points

Image

Parameters used-

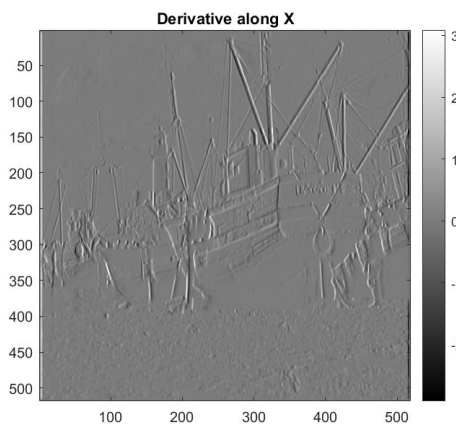
1. Gaussian to smooth image
 - Standard Deviation (σ) = 0.5
 - Window size = 5
2. Gaussian for the weighted average to compute the structure tensor
 - Standard Deviation (σ) = 0.9
 - Window size = 7
3. k (Cornersness measure) = 0.22



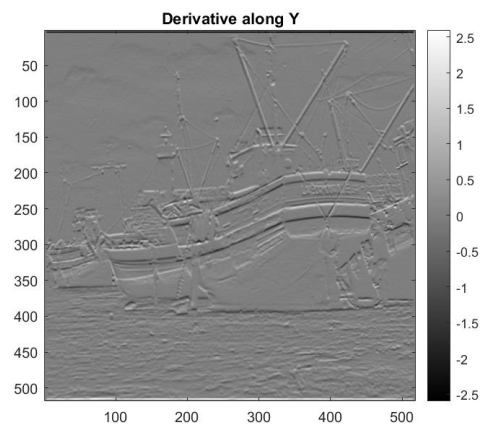
(a) Original image



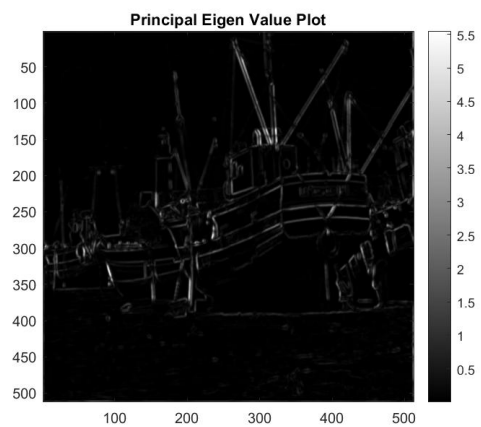
(b) Blurred Image



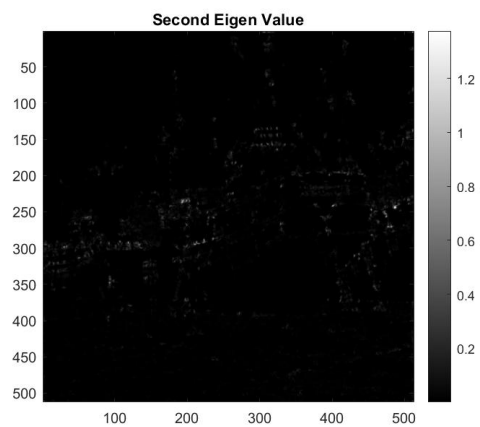
(a) Derivative along X axis (Vertical edges)



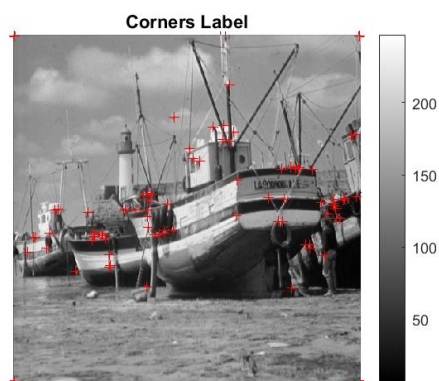
(b) Derivative along Y axis (Horizontal edges)



(a) Principal Eigen Value



(b) Second Eigen Value



(a) Marking corners on Image

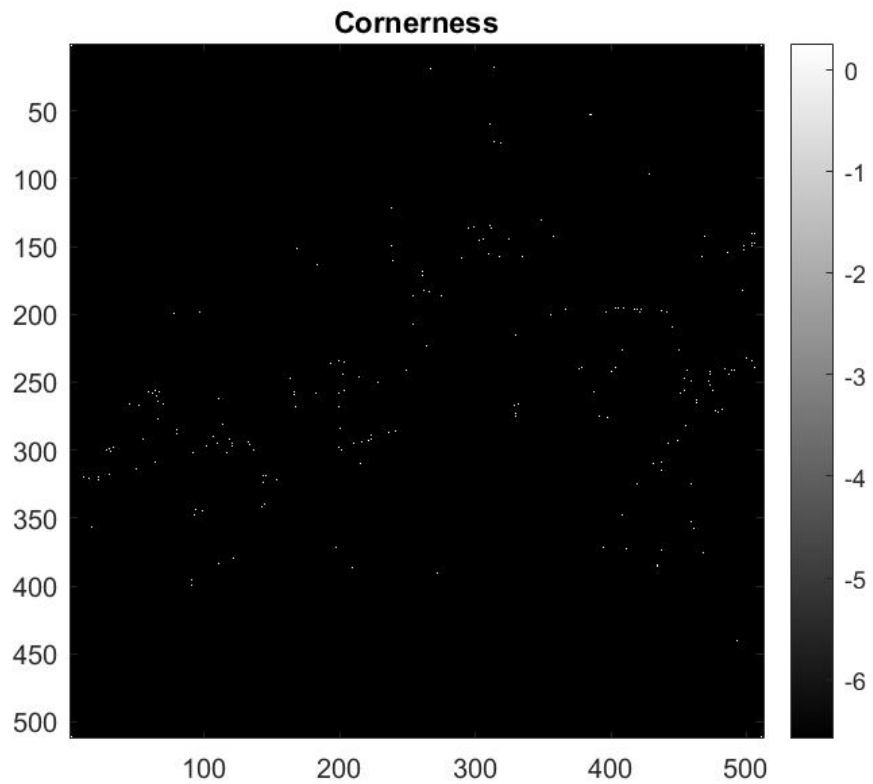


Figure 5: Cornerness Plot

Observations and comments on corners

1. The black and white cornerness plot has been threshold-ed to obtain the main corners of the image