MP5 Canny Edge Detector

In this homework, a Canny Edge Detector is implemented to generate the edge inside an image.

Canny Edge Detector

The Canny Edge Detector contains 5 different parts. They are Gaussian smoothing, Calculating image gradient, Suppressing non-maxima, Finding two thresholds, and Edge linking. For the first part, the function according to the equation $S(x,y)=G(x,y)\otimes I(x,y)$ to soothe the image. Next, the Image gradient function will generate an intensity change map that contains the magnitude and direction(angle) of intensity. In order to make a thinner edge, suppressing non-maxima is used to go through all the points on the gradient intensity matrix and find the pixels with the maximum value in the edge directions. Then generating two thresholds by checking the normal distribution, which can be used to define the pixels which have a high chance to contribute to the final edge, the pixels which have some chance to contribute to the final edge, and the irrelevant pixels. By comparing the strong and weak pixels, the function can connect broken lines together by iterating through all the pixels around the weak pixels and removing irrelevant noise from the map. In this case, the strong edges will be marked in the image.

Outputs for different test cases: (the sequence are image after smoothing, image gradient, suppress non maxima, threshold low/high, connect edge)

| smoothing | Image Gradient | suppress non maxima |
| threshold_Low | threshold_High | connect edge |
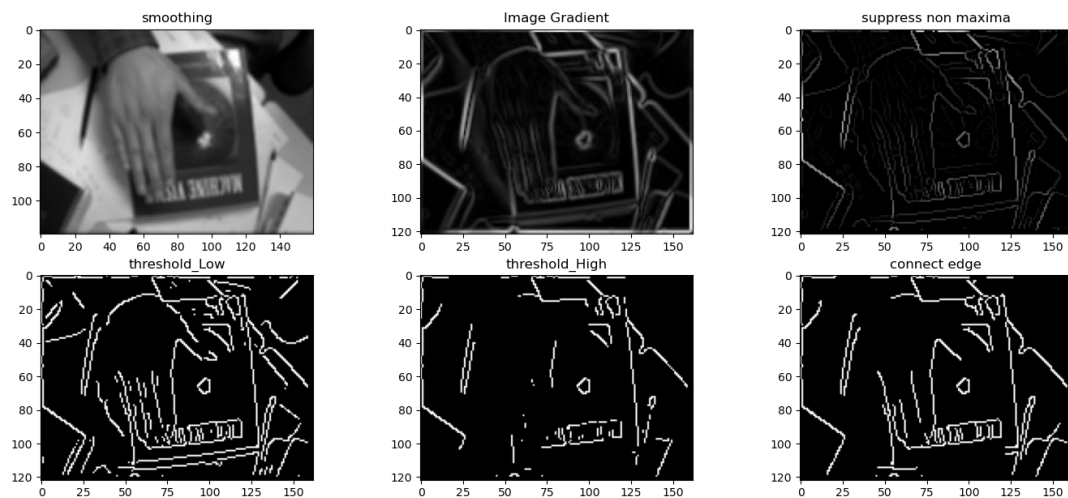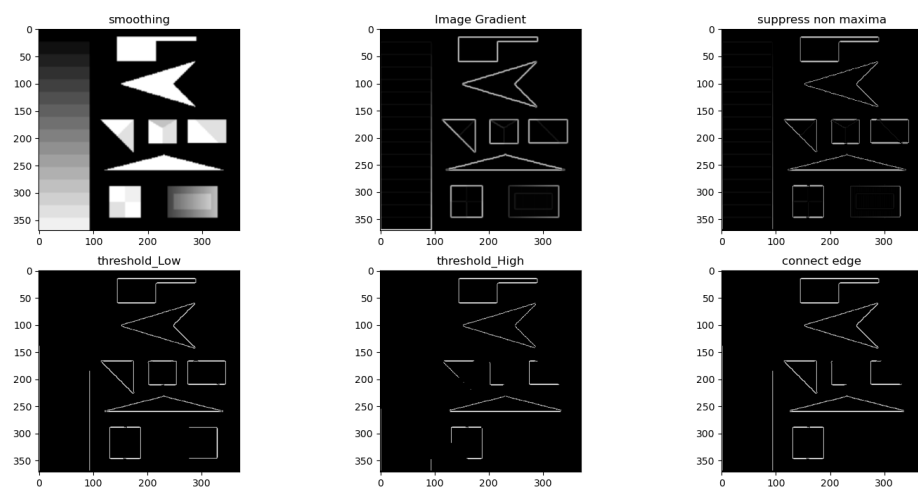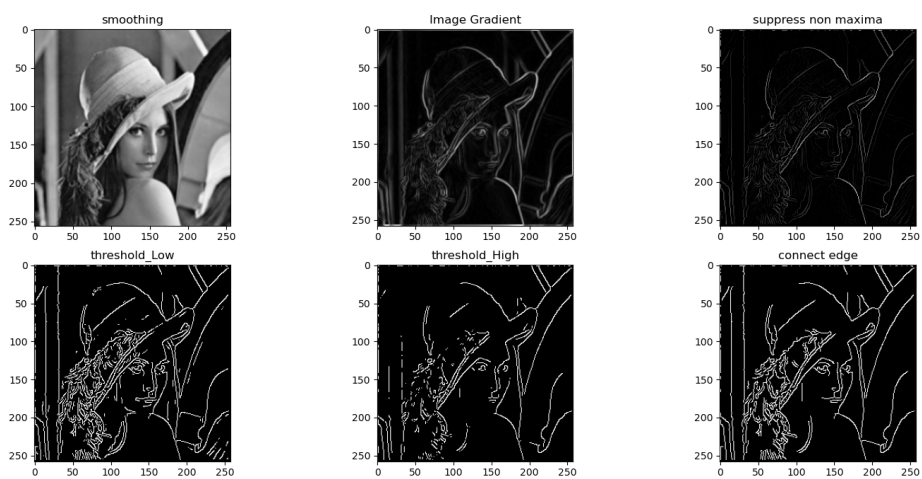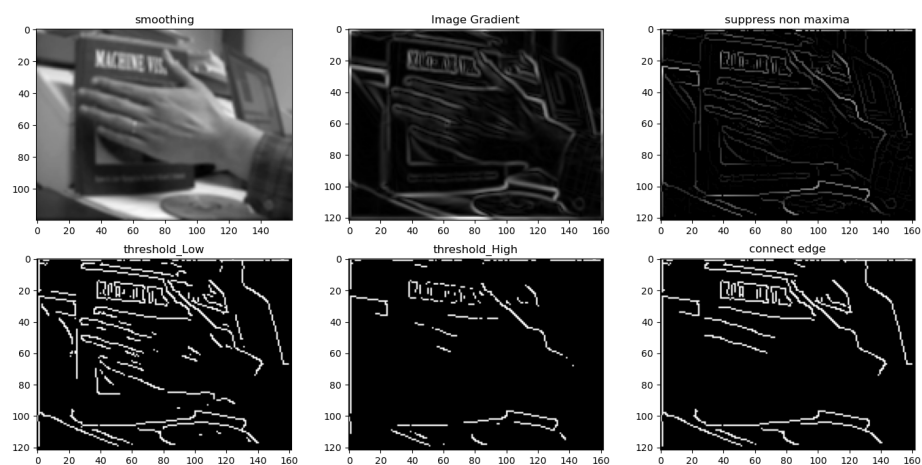
The result should mark the edge of the object inside the image. According to all the results, we can see the edge detector can detect most edges in the image. Due to the threshold setting, some edges are ignored.

Change parameters:

For the Lena test case, the Sigma changed from 1 to 3, N changed from 3 to 7, and the percentage of non edge is changed from 0.8 to 0.7. This makes the function generate less edges than original setting:
Figure1 (old setting) Figure2 (new setting)
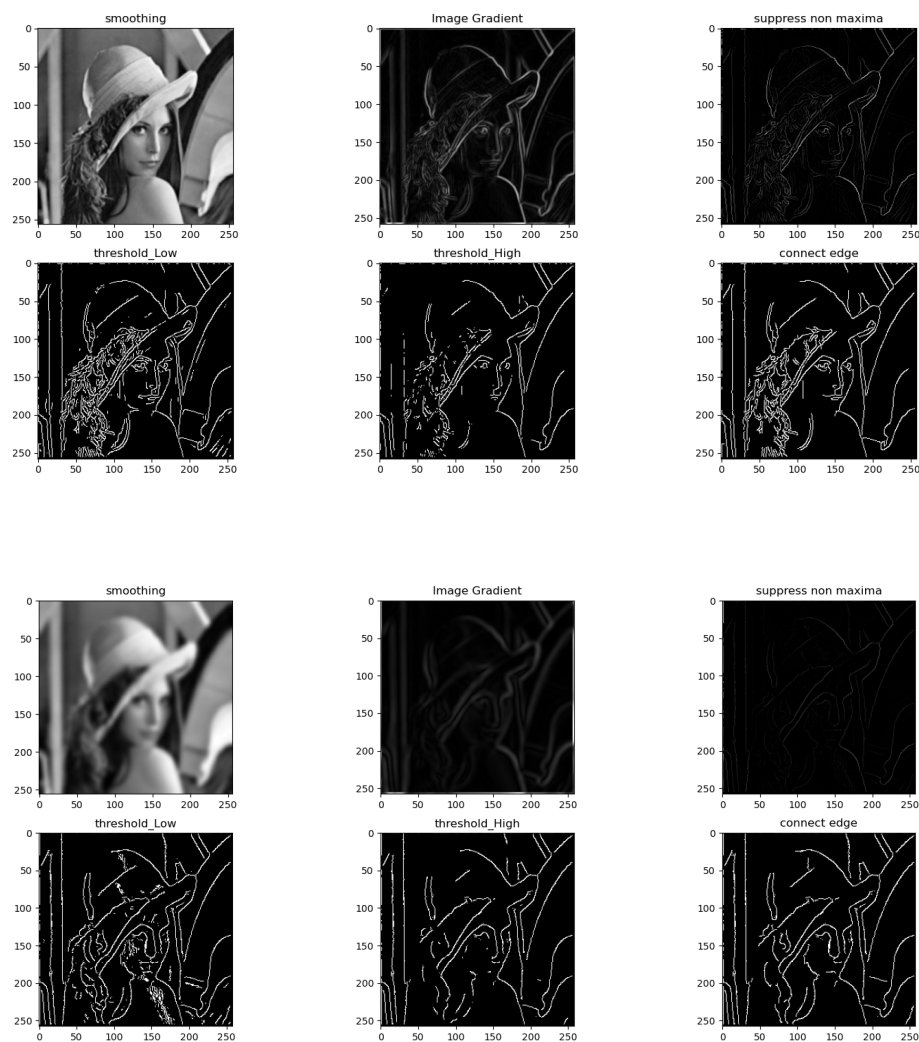
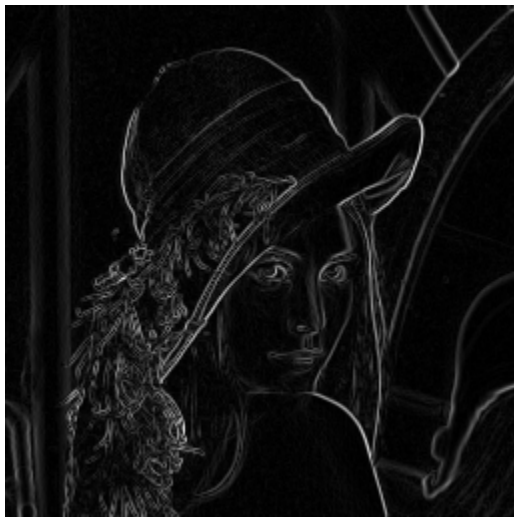Compare with other edge detection methods:

CED:

Sober:

Zerocross:

Roberts:

Other methods have worse performance than CED one.