

HW10 Report

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Introduction

This program implements the following Zero-crossing operators for image edge detection:

Laplacian mask (2 types), Minimum Variance Laplacian, Laplacian of Gaussian, Difference of Gaussian.

Each of these methods defines its masks to calculate gradient magnitude for every pixel to generate the output image.

Usage

Place the source image and main.py under the same directory. Run the following command in the terminal.

```
python3 main.py -s <source> -m <method> -t <threshold>
```

Parameters

- s <source> : the file path of source image, default = `lena.bmp`
- m <method> : the method for edge detection, default = `L4`
 - *Options:
 - L4 : Laplacian mask (0, 1, 0, 1, -4, 1, 0, 1, 0)
 - L8 : Laplacian mask (1, 1, 1, 1, -8, 1, 1, 1, 1)
 - MVL : Minimum Variance Laplacian
 - LoG : Laplace of Gaussian
 - DoG : Difference of Gaussian
- t <threshold> : the threshold for edge detection, default = `15`

Laplacian Mask (0, 1, 0, 1, -4, 1, 0, 1, 0)

1. Mask

0	1	0
1	-4	1
0	1	0

2. The result (threshold=15 for example) is saved as `laplacian_4.png` as shown on the right.



Laplacian Mask (1, 1, 1, 1, -8, 1, 1, 1, 1)

1. Mask

$\frac{1}{3}$	1	1	1
	1	8	1
	1	1	1

2. The result (threshold=15 for example) is saved as `laplacian_8.png` as shown on the right.

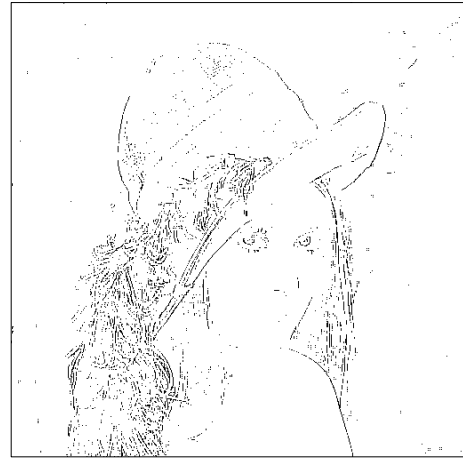


Minimum Variance Laplacian

1. Mask

$$\frac{1}{3} \begin{bmatrix} 2 & -1 & 2 \\ -1 & -4 & -1 \\ 2 & -1 & 2 \end{bmatrix}$$

2. The result (threshold=20 for example) is saved as **MVL.png** as shown on the right.



Laplacian of Gaussian

1. Mask

0	0	0	-1	-1	-2	-1	-1	0	0	0
0	0	-2	-4	-8	-9	-8	-4	-2	0	0
0	-2	-7	-15	-22	-23	-22	-15	-7	-2	0
-1	-4	-15	-24	-14	-1	-14	-24	-15	-4	-1
-1	-8	-22	-14	52	103	52	-14	-22	-8	-1
-2	-9	-23	-1	103	178	103	-1	-23	-9	-2
-1	-8	-22	-14	52	103	52	-14	-22	-8	-1
-1	-4	-15	-24	-14	-1	-14	-24	-15	-4	-1
0	-2	-7	-15	-22	-23	-22	-15	-7	-2	0
0	0	-2	-4	-8	-9	-8	-4	-2	0	0
0	0	0	-1	-1	-2	-1	-1	0	0	0



2. The result (threshold=3000 for example) is saved as **LoG.png** as shown on the right.

Difference of Gaussian

1. Mask (inhibitory $\sigma = 3$, excitatory $\sigma = 1$, kernel size=11)

-1	-3	-4	-6	-7	-8	-7	-6	-4	-3	-1
-3	-5	-8	-11	-13	-13	-13	-11	-8	-5	-3
-4	-8	-12	-16	-17	-17	-17	-16	-12	-8	-4
-6	-11	-16	-16	0	15	0	-16	-16	-11	-6
-7	-13	-17	0	85	160	85	0	-17	-13	-7
-8	-13	-17	15	160	283	160	15	-17	-13	-8
-7	-13	-17	0	85	160	85	0	-17	-13	-7
-6	-11	-16	-16	0	15	0	-16	-16	-11	-6
-4	-8	-12	-16	-17	-17	-17	-16	-12	-8	-4
-3	-5	-8	-11	-13	-13	-13	-11	-8	-5	-3
-1	-3	-4	-6	-7	-8	-7	-6	-4	-3	-1



2. The result (threshold=1 for example) is saved as **DoG.png** as shown on the right.