

Date Information

- Due: 2023.01.06
- Last Modified: 2022.12.31

Environment Requirement

- python 3.5 or newer - for f-strings `f"Something {variable}"` and type hinting.
- Another requirements are written in `requirements.txt`, just type `pip install -r requirements.txt` in the terminal.
 - matplotlib
 - numpy
 - opencv-python == 4.5.5.62 (for auto-complete working on pycharm)
 - <https://stackoverflow.com/questions/73174194/opencv-autocomplete-not-working-on-pycharm>
 - tqdm

Execution

The main python code is `main.py`, type the following command and then you can run the program.

```
python main.py
```

There are some parameters in `main.py`.

Note that the program will always save all images in `Img`.

Warning: The program will always ask user whether user want to delete the existing folder `Img` and recreate it or not. The default behavior is **No**. You can only press **Enter** into the console, which also means No.

- `is_show`: Tell the program if you want to show the result on the screen or not.
 - `True`: Show the result on the screen.
 - `False`: Don't show. Save it only.

All the methods are implemented in `spatial_image_enhancement.py` and import in main as `sie`.

Technical Description

Sobel Operator

There are 4 kinds of Sobel operator. We define their names as their degrees.

- $\text{sobel_0} = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 0 \end{bmatrix}$
- $\text{sobel_45} = \begin{bmatrix} -2 & -1 & 0 \\ -1 & 0 & 1 \\ 0 & 1 & 2 \end{bmatrix}$
- $\text{sobel_90} = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$
- $\text{sobel_135} = \begin{bmatrix} 0 & 1 & 2 \\ -1 & 0 & 1 \\ -2 & -1 & 0 \end{bmatrix}$

We have 4 results using the operators shown above and we create the final result by averaging the 4 results.

Laplacian of a Gaussian (LoG)

We use the example 5 * 5 mask in Figure 10.14 in textbook.

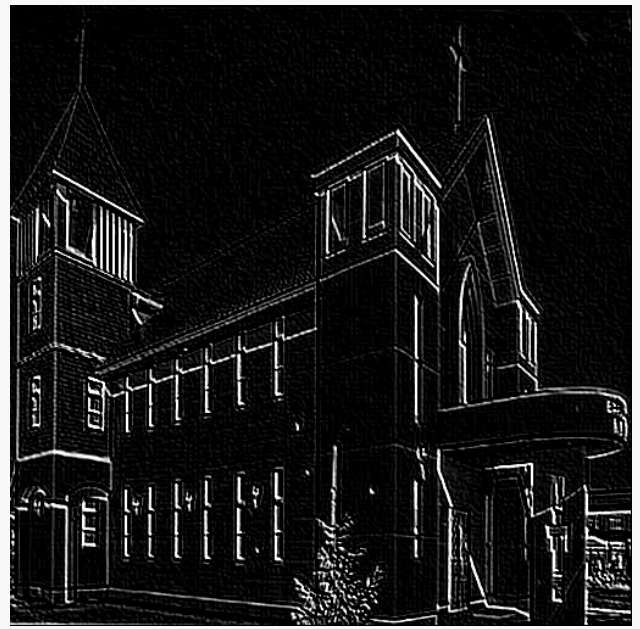
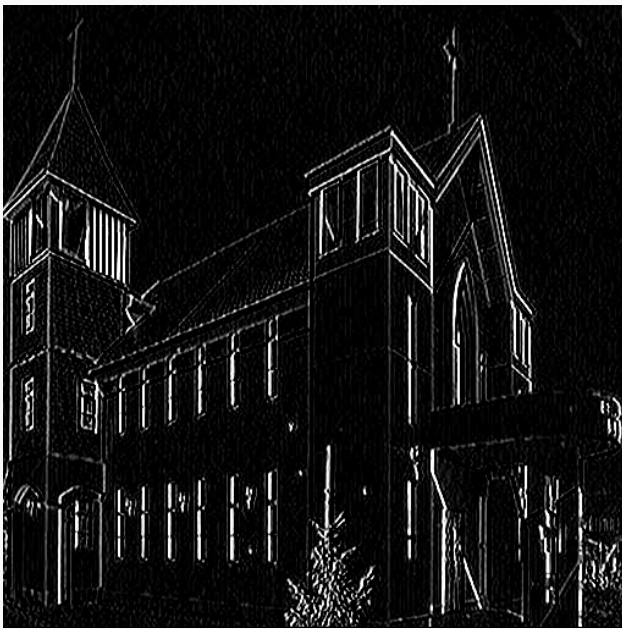
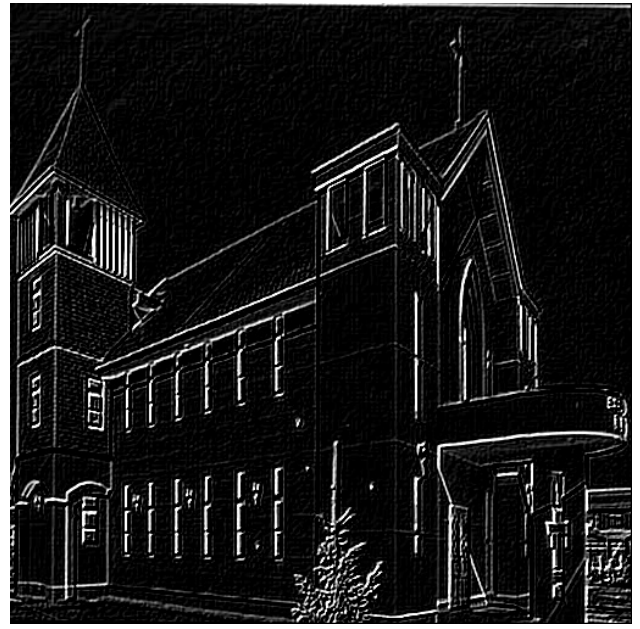
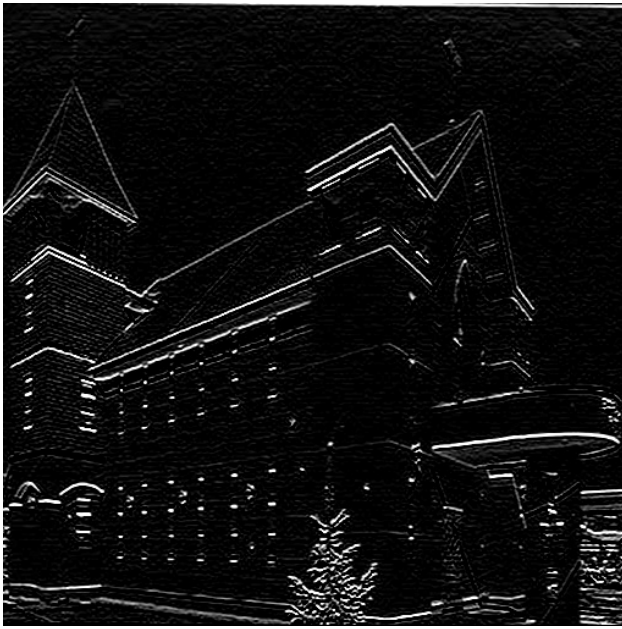
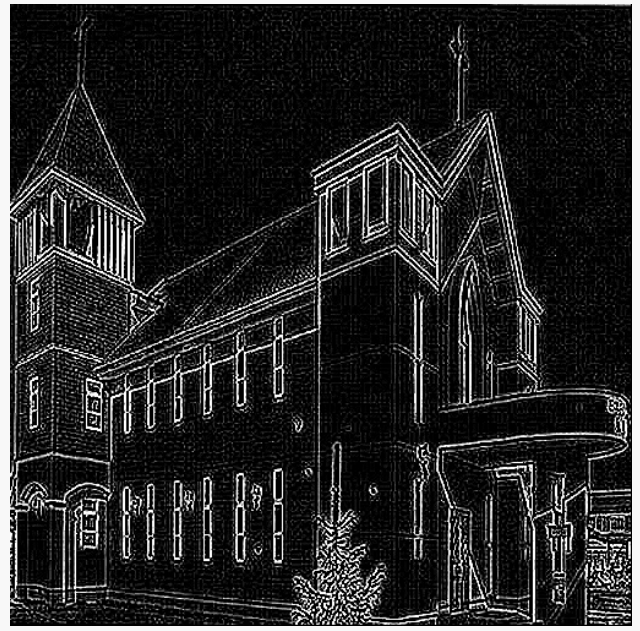
- $\text{LoG} = \begin{bmatrix} 0 & 0 & -1 & 0 & 0 \\ 0 & -1 & -2 & -1 & 0 \\ -1 & -2 & 16 & -2 & -1 \\ 0 & -1 & -2 & -1 & 0 \\ 0 & 0 & -1 & 0 & 0 \end{bmatrix}$

Experimental results

The order of the permutation is described below.

Original Image	LoG
Sobel_0	Sobel_45
Sobel_90	Sobel_135
Final_Sobel_Result	(Remain Blank)

image 1



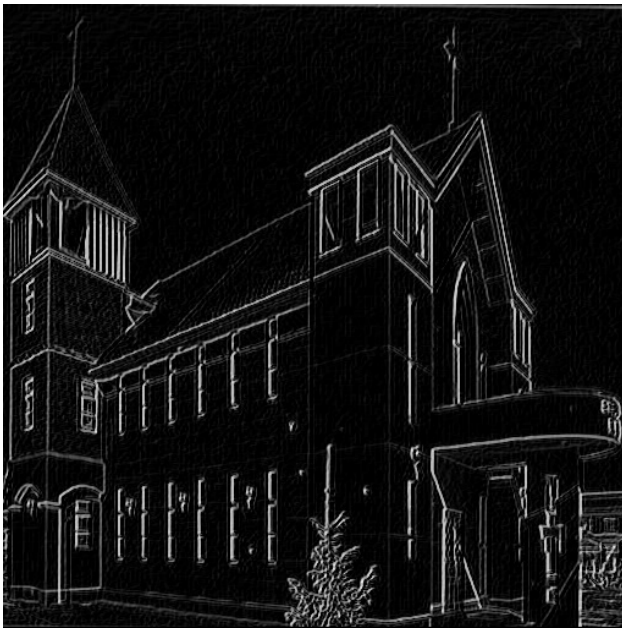
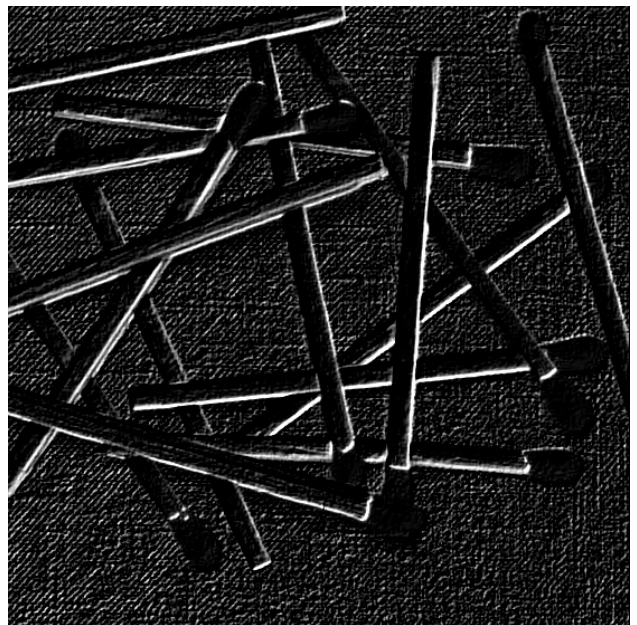
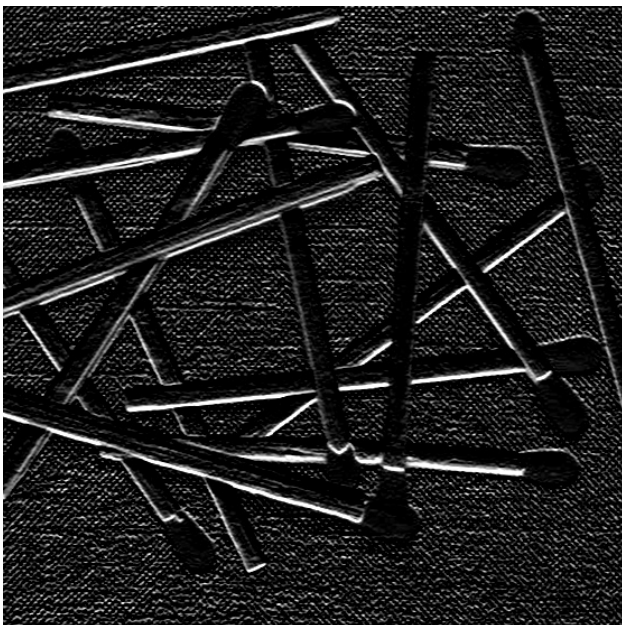
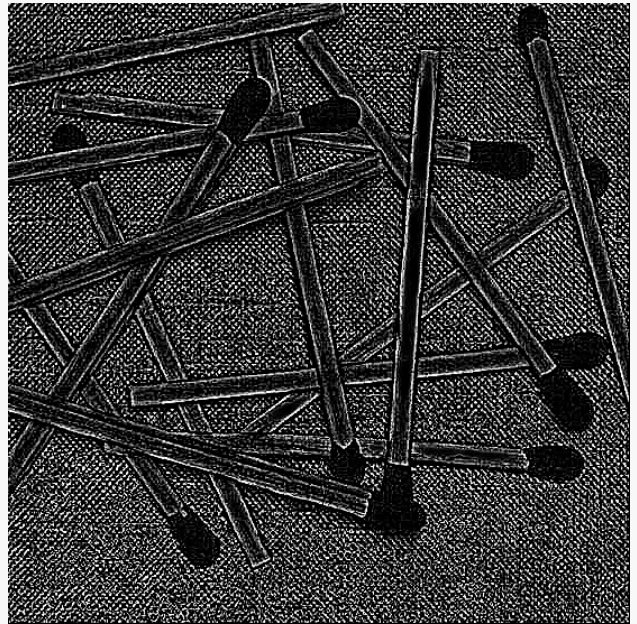


image 2



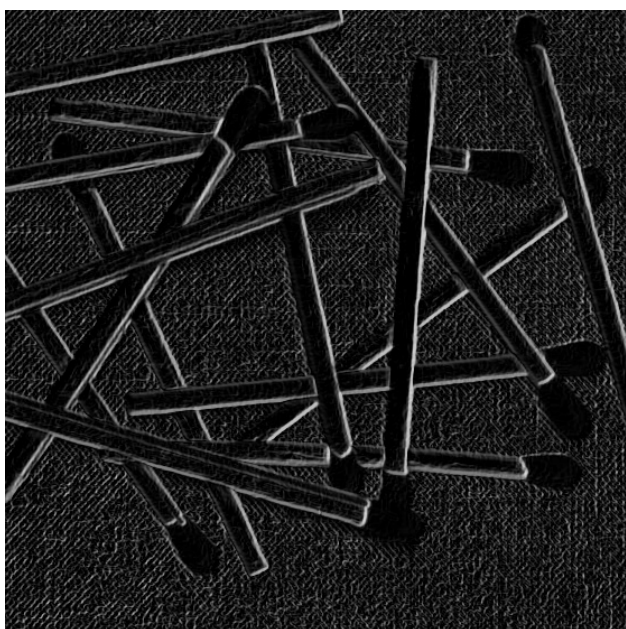
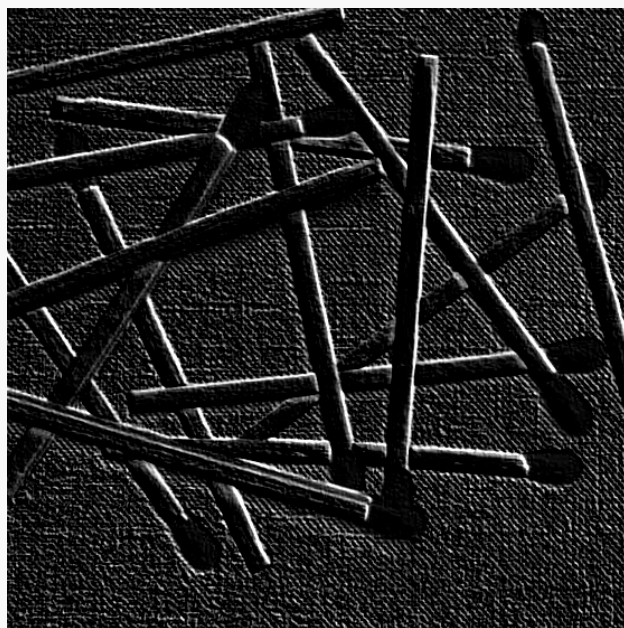
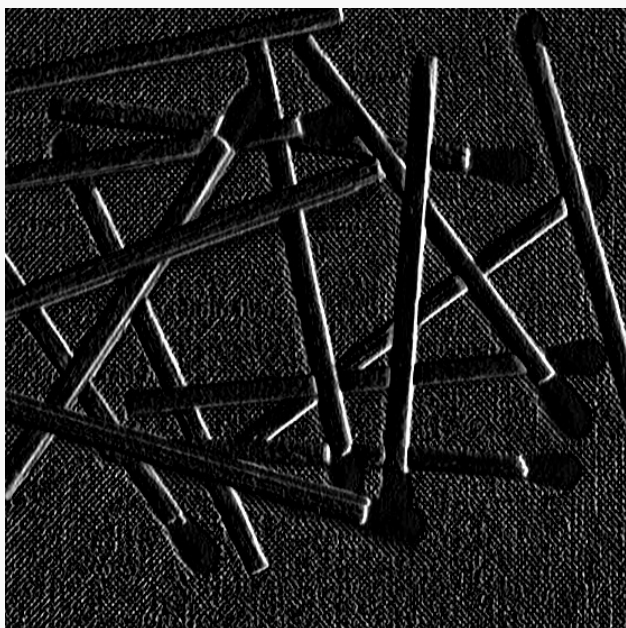
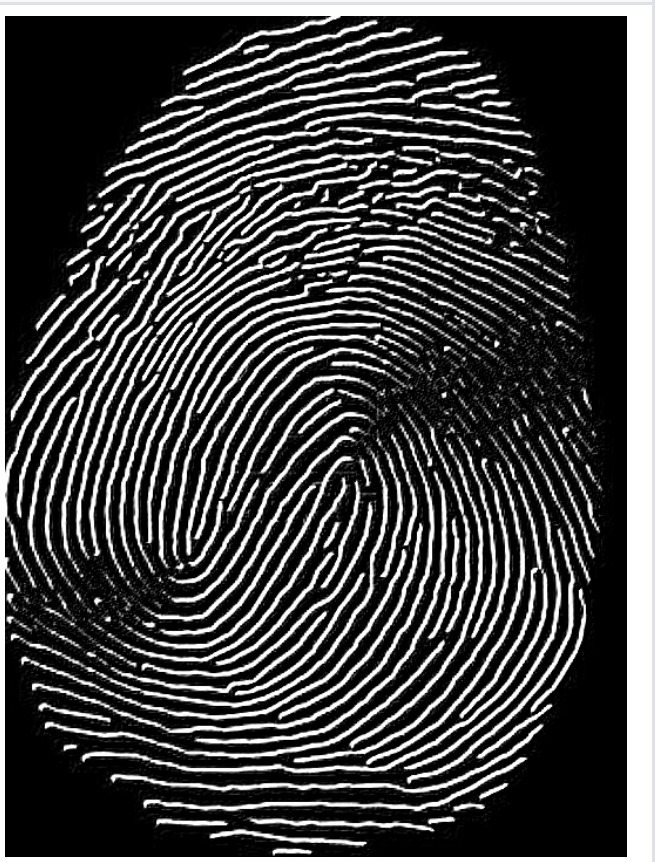
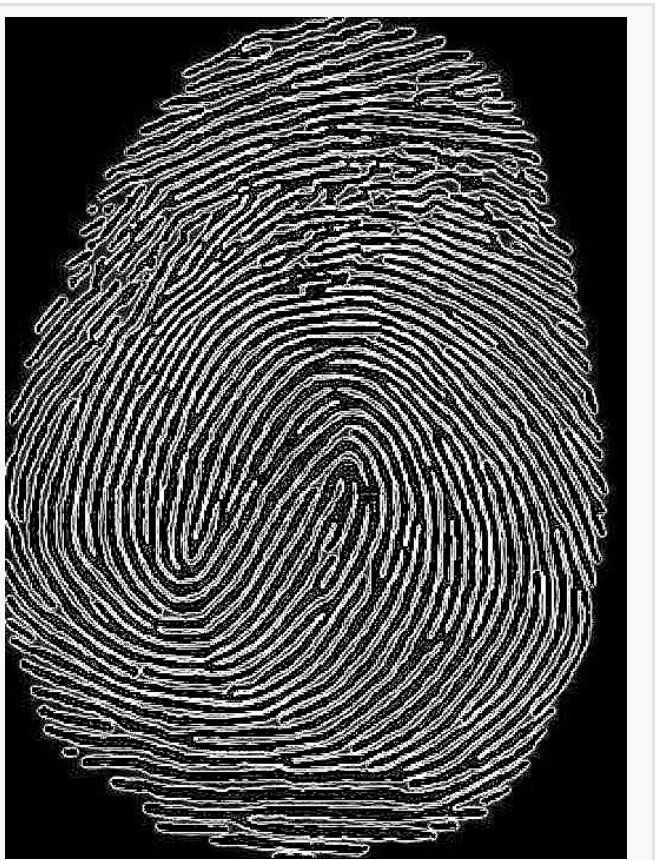
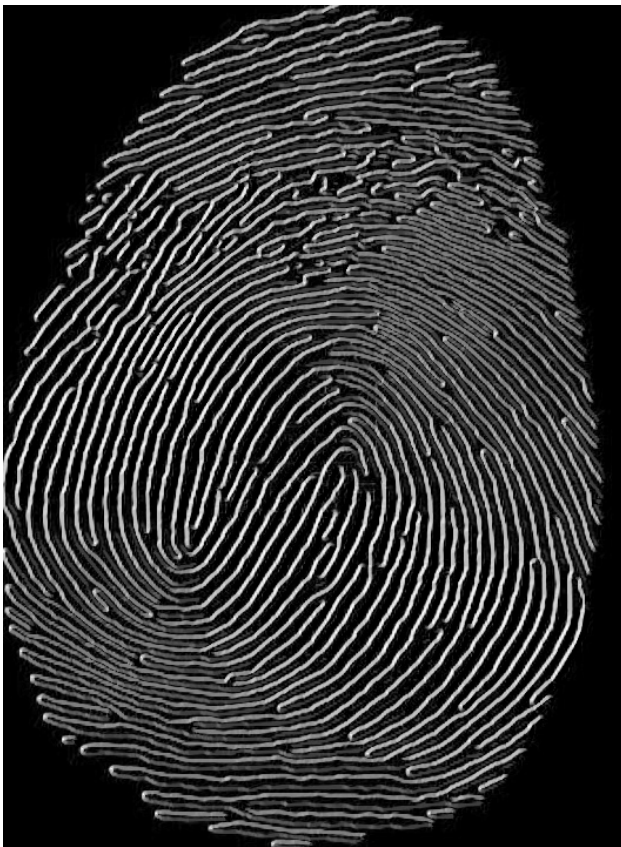
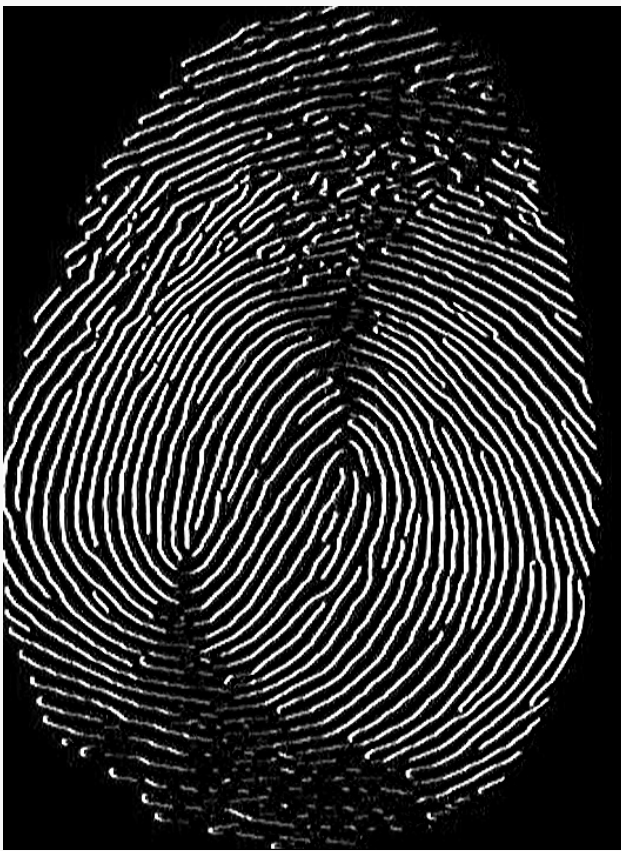


image 3





Discussions

- The result is pretty great.
- The Sobel operator works better than the LoG.

Reference

- Digital Image Processing, 4e (Rafael C. Gonzalez): Figure 10.14