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Edge Detection

Introduction

Edge detection is when the edges or boundaries of objects in an image are found by determining where the image brightness changes drastically. It can be used to determine the object's structure in an image.

Edge detection can be done by gradient edge detection, Gaussian edge detection, or Canny edge detection.

Gradient-based Edge Detection Techniques:

- Robert's Operator
- Sobel Operator
- Prewitt Operator

Gaussian Edge Detection Technique:

- Laplacian of Gaussian

The following sections are the results of the python program created to implement the aforementioned techniques and comparisons between them.

Figure 1 is the original image on which the edge detection methods were implemented.

Code can be found here:

<https://github.com/yaraamrsalah/Edge-Detection-Image-Processing>

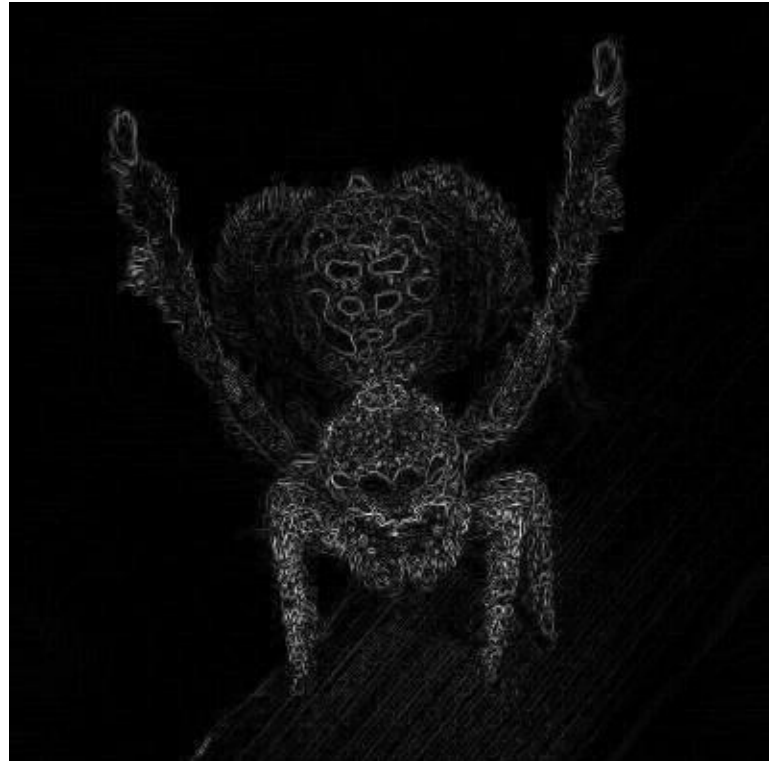
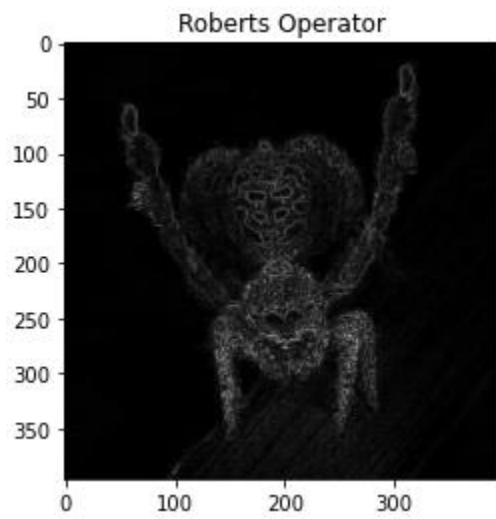


Figure 1: Original Image

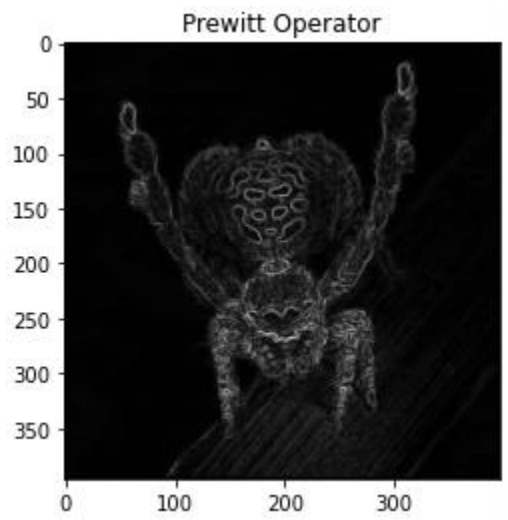
Results

Gradient Edge Detection

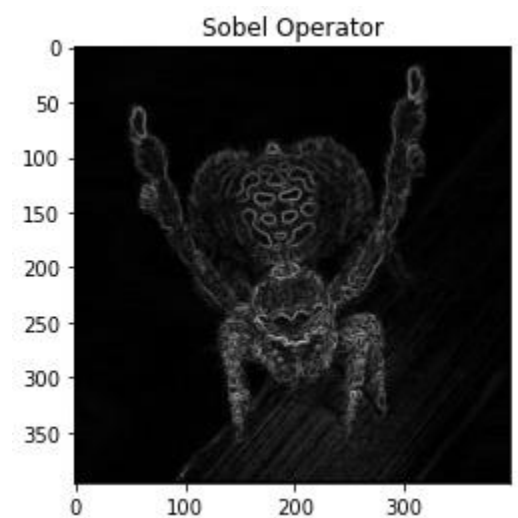
1. Using Roberts



2. Using Sobel

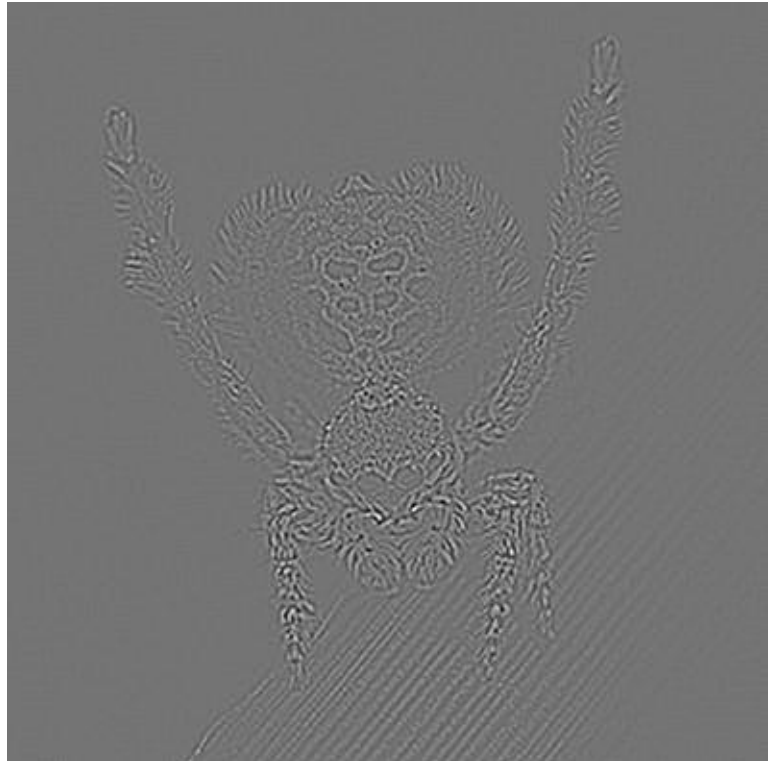
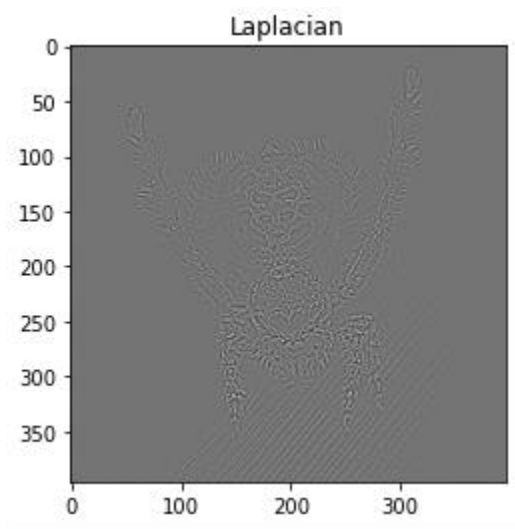


3. Using Prewitt

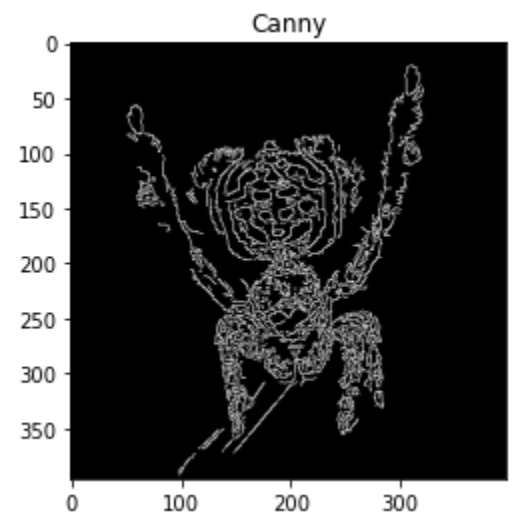
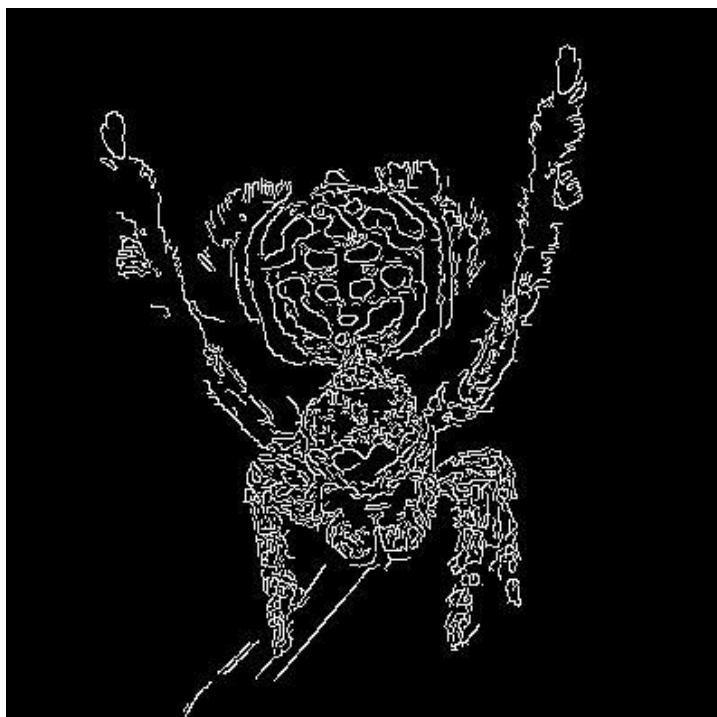


Gaussian Edge Detection

Using Laplacian



Canny Edge Detection

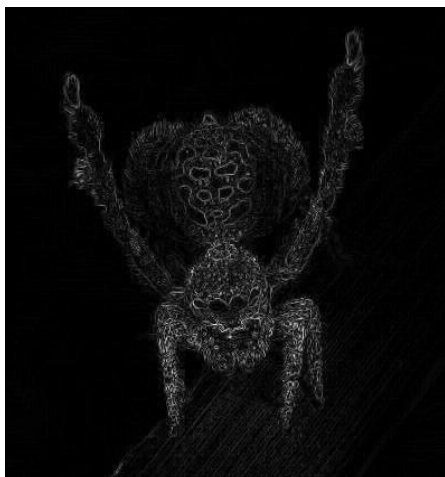


Comparisons

Roberts vs Sobel vs Prewitt

Gradient Edge Detection Techniques		
Technique	Advantages	Limitations
Robert's	Simplest technique	Very Noise-sensitive Frequent inaccurate edge detection
Sobel	Simple	Noise-sensitive Less frequent inaccurate edge detection
Prewitt	Simple	Noise-sensitive Less frequent inaccurate edge detection

Observations:



Robert's



Sobel



Prewitt

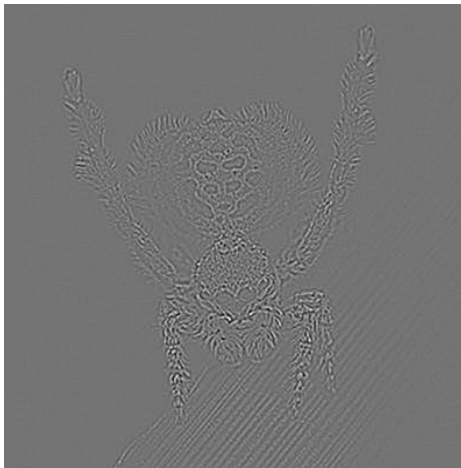
According to the above results, the following observations can be conducted:

- Robert's operator detects less edges than Sobel and Prewitt.
- Robert's operator has the most noise and is the darkest of them all.
- Sobel and Prewitt provided almost identical results, with Prewitt seemingly slightly sharper.

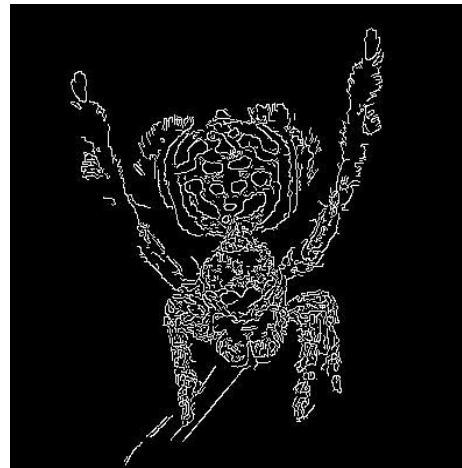
Laplacian vs Canny

LoG vs Canny		
Technique	Advantages	Limitations
Laplacian of Gaussian	Easy edge detection Fixed characteristics in all directions	Very Noise-sensitive
Canny	Best edge detection Minimal noise sensitivity	Complicated Time-consuming False zero crossing

Observations:



Laplacian of Gaussian



Canny

According to the above results, the following observations can be conducted:

- Laplacian of Gaussian is very unclear, the picture can barely be seen.
- Canny detected most of the edges accurately.