Ph21 Assignment 2

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1 Original Images

2 Edge Detection

2.1 Gaussian Gradient Kernel

The Gaussian gradient kernel described by the equation $-\frac{2(x+y)}{\sigma}e^{-(x^2+y^2)/\sigma}$ was convoluted with the image. The following images are the results with different values of σ and a Gaussian Blur radius of 0.2. With increasing values of σ, the edges produced by the kernel increase in thickness and the images have a lower signal-to-noise ratio.

(a) $\sigma = 0.1$

(d) $\sigma = 3.0$

(b) $\sigma = 0.5$

(e) $\sigma = 5.0$

(c) $\sigma = 1.0$

2.2 Applying Different Kernels

Kernels implementing the Prewitt, Scharr, Sobel and Roberts operators were convoluted with the image. A Gaussian Blur filter with radius = 0.2 was used.

The Sobel, Scharr and Prewiit operators give similar results, with emphasis on edges and a high signal-to-noise ratio. The Roberts operator gives less well defined edges and with a lower signal-to-noise ratio.

(a) Prewitt operator.

(c) Sobel operator.

(b) Scharr operator.

(d) Roberts operator.

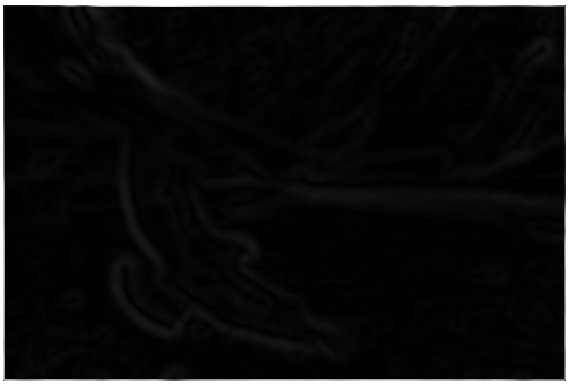
2.3 Varying Blur Radii

The Sobel operator was applied to an image with varying Gaussian Blur radii. With increasing blur radius, the level of detail detected along decreases while the signal-to-noise ratio increases.

(a) Gaussian Blur radius = 0.

(c) Gaussian Blur radius = 1.

(b) Gaussian Blur radius = 0.5.



(d) Gaussian Blur radius = 5.

2.4 Other

(a) Edge detection with the Sobel operator and a 0.2 Gaussian Blur radius.

(b) Edge detection with the Scharr operator and a 0.2 Gaussian Blur radius.

3 Thoughts

Edge detectors can be used to defeat CAPTCHAs by extracting text from the images. The text is then segmented and recognized by an algorithm. Edge detection algorithms can be used in traffic analysis in order to distinguish vehicles from surrounding objects. They are also used in self-driving cars to detect obstacles on the road.