CPS 843 Problem Set 2

# Problem 1

|  |  |
| --- | --- |
| *A person riding a bicycle on a beach  Description automatically generated with medium confidence*  *a.* | *A picture containing text, screenshot  Description automatically generated*  *b.* |
| *A picture containing text  Description automatically generated*  *c.* | *A picture containing text, screenshot  Description automatically generated*  *d.* |

Figure 1) a – Original Image. b – Edge detection with Prewitt operator. c – Edge detection with Roberts cross operator. d – Edge detection with Sobel operator.

From the three different edge detections, the Roberts operator is the least effective as it fails to detect the land in the distance near the horizon. Both Sobel and Prewitt operators are similar, but the Sobel does seem to get the edges in more detail (for example it gets the edges of the multiple rings of the front bike tire better than the Prewitt operator).

# Problem 2

1st order derivative:

2nd order derivative:

|  |
| --- |
| Image: 6 6 6 6 5 4 3 2 1 1 1 1 1 1 6 6 6 6 6 |
| 1st derivative: 0 0 -1 -1 -1 -1 -1 0 0 0 0 0 5 0 0 0 0 |
| 2nd derivative: 0 0 -1 0 0 0 0 1 0 0 0 0 5 -5 0 0 0 |
|  |

# Problem 3

1. Blur the image
2. Get the mask which is the difference of the image and the blurred image
3. Add the mask to the image

*A person riding a bicycle on a beach

Description automatically generated with medium confidence*

*a.*

|  |  |
| --- | --- |
| *A person riding a bicycle on a beach  Description automatically generated with medium confidence*  *b.* | *A person riding a bicycle on a beach  Description automatically generated with medium confidence*  *c.* |

Figure 2) a – Original image. b – Unsharp masking, k = 1. c – High boost filtering, k = 5.

With k=1, we are just adding the unsharp masking to the original image which yields little to no effect. With k>1, as shown by Figure 2.c, it officially becomes known as high boost filtering. The sharpness of the image is drastically enhanced.

# Problem 4

*A person riding a bicycle on a beach

Description automatically generated with medium confidence*

*a.*

|  |  |
| --- | --- |
| *A person riding a bicycle on a beach  Description automatically generated with medium confidence*  *b.* | *A person riding a bicycle on a beach  Description automatically generated with medium confidence*  *c.* |

Figure 3) a – Image with gaussian noise applied. b – Average filter 5x5 applied. c – Gaussian filter with variance=2.5 applied.

As shown in Figure 3., the gaussian filter does a better job at removing gaussian noise. One consequence, however, is that the resulting denoised image is blurrier.

# Problem 5

1)

2)

|  |  |  |
| --- | --- | --- |
| 4 | 6 | 4 |
| 6 | 3 | -8 |
| 1 | -7 | -4 |

# Part 2

|  |  |
| --- | --- |
| *A picture containing text, outdoor, night  Description automatically generated*  *a.* | *A picture containing text, street, dark  Description automatically generated*  *b.* |

Figure 4) a – 1st Image. b – 2nd Image.

1)

|  |  |
| --- | --- |
| *A house with lights on at night  Description automatically generated with medium confidence*  *a.* | *A picture containing text, way, road  Description automatically generated*  *b.* |

Figure 5) a – 1st Image after dehazing algorithm applied. b – 2nd Image after dehazing algorithm applied.

2)

|  |  |
| --- | --- |
| *A house with lights on at night  Description automatically generated with medium confidence*  *a.* | *A street with cars parked on the side  Description automatically generated with low confidence*  *b.* |

Figure 6) a – 1st Image after dehazing algorithm applied with optional parameters. b – 2nd Image after dehazing algorithm applied with optional parameters.

3)

|  |  |
| --- | --- |
| *A house with lights on at night  Description automatically generated with medium confidence*  *a.* | *Calendar  Description automatically generated*  *b.* |

Figure 7) a – 1st Image after dehazing algorithm applied without any contrast enhancement. b – 2nd Image after dehazing algorithm applied without any contrast enhancement.

4)

|  |  |
| --- | --- |
| *A picture containing text, outdoor, silhouette  Description automatically generated*  *a.* | *A street with cars parked on the side  Description automatically generated with low confidence*  *b.* |

Figure 7) a – 1st Image after dehazing algorithm applied in LAB color space. b – 2nd Image after dehazing algorithm applied in LAB color space.

5)

|  |  |
| --- | --- |
| *A house with lights on at night  Description automatically generated with medium confidence*  *a.* | *A house with lights on at night  Description automatically generated with medium confidence*  *b.* |
| *A picture containing text, way, road  Description automatically generated*  *c.* | *A picture containing text, way, road, highway  Description automatically generated*  *d.* |

Figure 7) a – 1st Image after dehazing algorithm applied. c – 2nd Image after dehazing algorithm applied. b – 1st Image after being denoised after dehazing algorithm. d – 2nd Image after being denoised after dehazing algorithm.

6)

|  |  |
| --- | --- |
| *A picture containing text, outdoor, night  Description automatically generated*  *a.* | *A house on fire  Description automatically generated with medium confidence*  *b.* |
| *A picture containing text, street, dark  Description automatically generated*  *c.* | *A picture containing text, dark, bright, blurry  Description automatically generated*  *d.* |

Figure 7) a – 1st Image. c – 2nd Image. b – 1st Image’s illumination map. d – 2nd Image’s illumination map.

The image enhancement algorithm is an efficient algorithm for enhancing a low light image. It works in 2 main steps. Firstly, inverting the low light image then applying an optimized version of an image dehazing algorithm on the inverted low light image.

The first step involves applying the general dehazing algorithm to the low light images. In the second step we improve this algorithm further by applying some optional parameters such as boosting the contrast enhancement. In step three, we do the same but without any contrast enhancement which gives an overall better low light image. In the fourth step we convert our image to the LAB colorspace prior to applying the dehazing algorithm and convert it back to RGB, which unfortunately has poor results. Because low light images usually contain a significant amount of noise due to cameras having a higher focal length (lower focal length cameras produce more clear and less noisy low light images), in the fifth step we apply a denoising filter after dehazing. Lastly, in the sixth step we create an illumination map from the original images to see where most of the light is coming from shown by brighter colors in the heat map.