FINAL EXAM

Time: 180 minutes (13:30 – 16:30), 29/12/2024

1. (25 marks) – Object Counting

Given a color JPG image named '*Ex1.jpg*'.

(a) Read and display the original image.

(b) Binarize the original image using Otsu method and display the binary image.

(c) Fill small holes in the binary image and display the filled image.

(d) Perform the erosion on the binary image using a suitable structuring element and size.

(e) Apply region labeling on the eroded image to count number of stones in the original image. Print the result on the screen.

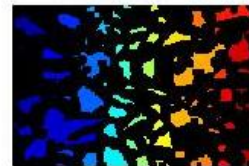**Number of objects: 96**

2. (25 marks) – Denoise and Deblur a Noisy Blurry Grayscale Image

Given a noisy and blurry grayscale PNG image named '*Ex2.jpg*'.

(a) Read and display the original image.

(b) Method 1: Apply a denoise filter (5x5 averaging kernel filter) then a sharpening filter (h = [0, –1, 0; –1, 6, –1; 0, –1, 0] / 2) to the original image. Display the restored image.

(c) Method 2: Apply the Wiener filter to denoise and deblur the original image. Assume the Gaussian

noise variance of the original image is σ=0.04. The estimated noise is calculated by the noise variance divided by the variance of the original image. The sharpening filter using the same with question b. Display the restored image.

(d) Perform the root mean square (rms) calculation in two methods between the restored image and the original image.

(a) Restoration 1 Restoration 2

Method 1 = 176.66

Method 2 = 175.49

3. (25 marks) – Edge Detection and Hough Transform

Given a color JPG image named '*Ex3.jpg*'.

(a) Read and display the original image in color and grayscale format.

(b) Apply Roberts filter in two directions (horizontal [1 0; 0 –1] and vertical [0 1; –1 0]). Display the logarithm of sum of edge magnitude response with a threhold value = 5000. Then, display the binary image based on this threshold.

(c) Apply Canny Edge Detector using a suitable standard deviation σ and a suitable threshold value.

(d) Apply Hough Transform using a ratio = 0.2 of max peak and NhoodSize = [49 49].

Original Image

Grayscale Image

Edge Magnitude

Magnitude > 5000

Canny Edge w. sigma = 0.14

Hough Transform

4. (25 marks) – Key point Detection

Given a color JPG image named '*Ex4.jpg*'.

(a) Read and display the original image in color and grayscale format.

Original Image

Grayscale Image

5.

(b) Use LoG to highlight the 100 strongest key points in the original image. Choose sigma value = 2*sqrt(2).

LoG Response

Thresholded LoG Response
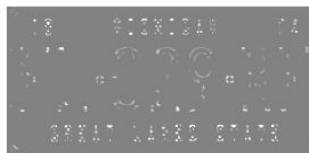

Local Extrema (Dilated)

Keypoints

6.

(c) Use DoH to highlight the 100 strongest key points in the original image. Choose sigma value = 3.

DoH Response

Thresholded DoH Response

Local Maxima (Dilated)

Keypoints

7.

(d) Use FAST to highlight the 100 strongest key points in the original image. Choose the threshold value = 0.2.

Fast Corners

Fast Corners, Non-max Suppressed

8.

All cases used Prewitt operator if needed. Other parameters are optional.

-------------------------------------- *End of Exam* --------------------------------------