COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Artificial Intelligence (Alamein Branch)

Lecturer : Dr. Mohamed Waleed Fakhr

Course Name : Digital Image Processing & Pattern Recognition

Course Code : IN 322 **Total Marks: 20**

Date 4-6-2023 **Time allowed: 90min**

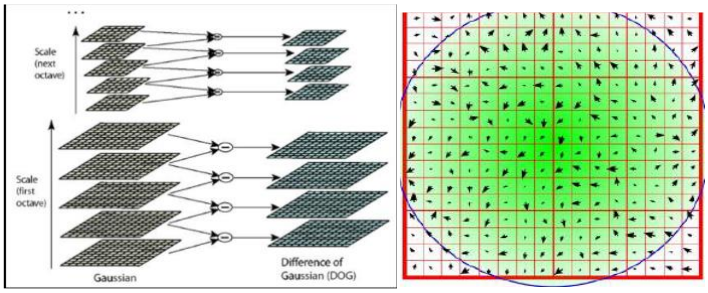
Question 1:

(a)

(i) Explain (and show the equations) **how** we use the **Canny edge detection approach**.

(ii) Compare using **appropriate equations** between the **Canny approach** versus using a **Sobel filter with Gaussian smoothing** for edge detection with respect to ***computation effort and expected accuracy***.

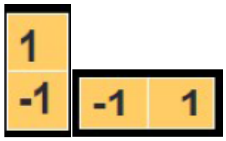
(b)



(i) Explain **how and why** the difference-of-Gaussians (DoG) approach is used to find the blobs in an image using the structure shown in the figure above.

(ii) Using the gradient orientations figure shown above (to the right), explain how we extract a 128-dimension SIFT feature vector for each interest point**.**

(iii)



(iii.1) The shown Kernels above are for the basic edge detection approach; which one correponsds to $\partial f/\partial x$ *and* $\partial f/\partial y$? Which one will show the Vertical edges and which will show the Horizontal edges in an image?

(iii.2) Apply the above Kernels to find the magnitude and direction (phase angle) of the gradient at pixel f(4,5)=45 in the (8-by-8) image block given above.

Question 2:

135	135	129	133	130	134	134	137
133	133	132	132	135	127	55	119
132	127	222	200	65	55	96	110
110	104	210	65	55	103	129	160
105	112	65	45	250	201	219	231
167	65	55	223	216	231	240	238
221	55	240	223	214	216	218	219
224	217	222	214	215	217	219	220

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(a) For the 8-by-8 image above, apply the given Gaussian filter on pixel **f(5,4)=45** and find the pixel's new value. Has it been smoothed? Is this smoothing good or bad and why?

0.075	0.124	0.075
0.124	0.204	0.124
0.075	0.124	0.075

(b) Explain the main idea of the Bilateral Filter and the Non-local-means filter approaches and show how they would avoid Blurring the edge in the above 8-by-8 block.

(c) The following equation represents the Bilateral Filter, also given below 8-by-8 image (above) and a 3-by-3 normalized Gaussian filter (above).

$$BF[I]_{\mathbf{p}} = \underbrace{\frac{1}{W_{\mathbf{p}}}}_{\text{normalization}} \sum_{\mathbf{q}\in S} \underbrace{G_{\sigma_s}(\|\mathbf{p}-\mathbf{q}\|)}_{\textbf{space weight}} \underbrace{G_{\sigma_r}(|I_{\mathbf{p}}-I_{\mathbf{q}}|)}_{\textbf{range weight}} I_{\mathbf{q}}$$

(new, not new, new)

Consider that the Bilateral filter is centered at pixel f(5,4)=45, Take $\sigma_r = 200$ and $W_p = 1.0$ Calculate the new value for pixel f(5,4)=45 (use the pixel values from the image, and the 3-by-3 Gaussian filter given, as well as the range weights that you should calculate).

(d) Explain the difference between low-pass, high-pass, band-pass and notch filters in their frequency domain characteristics. Which of them would you use to get rid of the periodic 50Hz supply noise effects?