CSE 527 - Computer Vision Homework-1

Google link -
https://drive.google.com/drive/folders/1olvtY8CS3ozIblEVkfadWNnP9k5g8yF7?usp=sharing

1.
   a. genGaussianKernel : Calculated the middle point in row and column as mean.From the mean calculated the distances of all other points and used the gaussian formula to obtain the values. Normalising it such that the sum of all elements is 1.
   a. PSNR : Calculated the mean of squared differences of two images. Using the max intensity to be 255, PSNR has been calculated as per formula.
   b. Observations :Increasing the Gaussian kernel size, increases the blurring of the image.
   When the image gets blurred, the noise is reduced and PSNR increases.
2.
   a. addSaltPepperNoise : For all i,j in the matrix, I used a uniform random variable from (0,1).If the value of random value is less than probability then add salt or pepper noise to it. This logic will retain the probability since it is being dependent on uniform random variable. Addition of salt and pepper is based on random choice among {0,1}. If its 0, pepper is added or else salt.
   b. medianFilter : Calculating the median of window and running the window over the whole image.
   c. Observations :As Salt and Pepper is added with 0.1 probability, the image as PSNR p which decreases when we reduce the noise using a median or a gaussian filter since blurring is reducing the intensities and creating a greater difference with the original image, decreasing PSNR. With increasing probability of noise, the PSNR increases when blurred out using median or gaussian filters. Observed this when p=0.3.

3.
   a. **Observations :Gaussian filters separable such that a 2D filter can be separated as 2 1D filters of same size. Applying 1D gaussian in x and y directions produce similar results as**

applying 2D filter. The maximum difference observed between the two is 1 implying the similarity in images.

b. **Observations for DoG :Filtering the image with Difference of Gaussian Filter will enhance features. This happens because of the difference between a blurry(gaussian sigma) image with another more blurry image(gaussian k*sigma)**

4.

a. get_histogram: This function creates bins of all the unique values present in the image and adds the count to it. It returns a histogram and number of pixels in the image.

b. histogram_equalization: After converting the image to HSV, the Value component needs to be equalised to produce uniform contrast images. To equalise the image, we first get the pdf of image. Next, we calculate the cdf of original image. The goal is to find the cdf of the transformed image which is linear to the cdf of original image. Normalising the transformed pixels and assigning these values to obtain transformed image.

c. **Observations :Histogram equalization brightens the dark images and uniforms the contrast.**

5.

a. apply_fourier_transform: This function applies fourier, then masks the image and performs inverse fourier to return the magnitude.

b. histogram_equalization: After converting the image to HSV, the Value component needs to be equalised to produce uniform contrast images. To equalise the image, we first get the pdf of image. Next, we calculate the cdf of original image. The goal is to find the cdf of the transformed image which is linear to the cdf of original image. Normalising the transformed pixels and assigning these values to obtain transformed image.

c. low_pass_filter: First channels are splitted from the original image. Mask is created where high frequency components are 0. So, the center area of given size is masked as 1 and other all as 0. Each channel is then applied fourier transform. Merging each channel and displaying the output.

d. High_pass_filter: The important feature of this function is to produce mask i.e., all low frequency components should be masked as 0. Each channel is then applied fourier transform.

e. **Observations :The low pass filter blurs out the image i.e., the high frequency components are removed. The high pass filter removes the low frequency components of the image i.e., extracts edges.Mixing the high pass filter with original image will produce sharpened edges and clear high frequency components/artifacts.Hence mixing images with HP filter, sharpens the image.**