

LAB-06: Spatial Filtering

Objective:

The objective of this lab is to apply different spatial filters on images with different filter size.

Theory:

Different **spatial filters** allow us to enhance the details in an image as per our requirement. Median filter can help remove salt and pepper noise while applying max and min filter can affect the boundaries of different objects in an image. For example, when max filter is applied, the boundaries of dark objects will recede while the boundaries of light objects will expand. The effect of min filter will be reverse.

In order to find out the boundary of objects in an image or edge detection, **Sobel** filters come in handy. Sobel filter calculates the first order derivative of the image.

Horizontal Sobel filter is used to find out the edges along x-axis as it calculates the derivative of an image in x direction while Vertical Sobel filter is used to find out the edges along y-axis. The edges obtained from applying both this filters can then be added to obtain all the edges in an image.

Applying the **Laplacian filter** gives the 2nd order derivative of the image. The edges can become more pronounced as compared to Sobel filter in some cases.

Some Useful Commands:

1. To sort a list: `my_list_sorted = my_list.sort()` OR `numpy.sort(my_list)`
2. To get the median of the list: `my_median = numpy.median(my_list)`
3. To convert a n-dimensional matrix into a vector/1D array = `numpy.ravel(my_array)` OR `numpy.flatten(my_array)`
4. To apply a filter on an image using OpenCV: `filtered_image = cv2.filter2D(my_image, ddepth, mask)`

ddepth refers to the bit level depth of the filtered_image. As it will be the same as the source image, so this argument will be set to **-1**.

Lab Tasks:

Lab Task 1:

Apply the following filters with size 3, 15 and 31 on images Fig01.tif and Fig02.tif:

- Median
- Min
- Max

Lab Task 2:

Apply Horizontal Sobel and Vertical Sobel separately on the Fig03.tif. Display the results. Then add the images obtained by Horizontal Sobel and Vertical Sobel together and display the resultant image with all the edges.

-1	-2	-1
0	0	0
1	2	1

-1	0	1
-2	0	2
-1	0	1

Lab Task 3:

Apply the following Laplacian mask to image Fig03.tif. Then add the filtered image to the original image for a sharpening effect.

-1	-1	-1
-1	8	-1
-1	-1	-1

Conclusion:

This lab gives an understanding of applying different masks to images to obtain the desired result.