Aim: To Processing Image with OpenCV3

Objective: To Conversion between different color spaces, The Fourier Transformation , high pass filter, Low pass filter

Theory:

Converting between different color spaces

Here are more than 150 color-space conversion methods available in OpenCV. But we will look into only two, which are most widely used ones:

BGR ↔ Gray and BGR ↔ HSV.

For color conversion, we use the function cv.cvtColor(input_image, flag) where flag determines the type of conversion.

For BGR →Gray conversion, we use the flag **cv.COLOR_BGR2GRAY**.

Similarly for BGR → HSV, we use the flag **cv.COLOR_BGR2HSV**. To get other flags, just run following commands in your Python terminal:

```
>>> import cv2 as cv
>>> flags = [i for i in dir(cv) if i.startswith('COLOR_')]
>>> print( flags )
```

The Fourier Transformation

The Fourier Transform is an important image processing tool which is used to decompose an image into its sine and cosine components. The output of the transformation represents the image in the Fourier or frequency domain, while the input image is the spatial domain equivalent. In the Fourier domain image, each point represents a particular frequency contained in the spatial domain image.The Fourier Transform is used in a wide range of applications, such as image analysis, image filtering, image reconstruction and image compression. In the frequency domain image, each point represents a particular frequency contained in the spatial domain image. if an image has more high-frequency components (edges, stripes, corners), there will be a number of points in the frequency domain at high-frequency values.

High pass filter

In this example for High Pass Filter, we shall execute following sequence of steps.

- Read an image. This is our source.
- Define a high pass filter. In this example, our high pass filter is a 3×3 array, which is kernel variable in the below program.
- Apply convolution between source image and kernel using cv2.filter2D() function.

Python Program

```
import numpy as np
import cv2


#read image
img_src = cv2.imread('sample.jpg')
```

```
#edge detection filter
kernel = np.array([[0.0, -1.0, 0.0],
                   [-1.0, 4.0, -1.0],
                   [0.0, -1.0, 0.0]])


kernel = kernel/(np.sum(kernel) if np.sum(kernel)!=0 else 1)
#filter the source image
img_rst = cv2.filter2D(img_src,-1,kernel)
#save result image
cv2.imwrite('result.jpg',img_rst)
```

Low pass Filter

LPF helps in removing noises, blurring the images etc.

OpenCV provides a function **cv2.filter2D()** to convolve a kernel with an image. As an example, we will try an averaging filter on an image. A 5x5 averaging filter kernel will look like below:

$$K = 1/25 \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

Operation is like this: keep this kernel above a pixel, add all the 25 pixels below this kernel, take its average and replace the central pixel with the new average value. It continues this operation for all the pixels in the image.

Conclusion:

In this experiment we studied the use of the OpenCV library in python which is used for providing various functions on image processing such as Conversion between different color spaces, The Fourier Transformation , high pass filter, Low pass filter and many others. The Fourier Transform is an important image processing tool which is used to decompose an image into its sine and cosine components. Low-pass and high-pass filters are two fundamental types of filters used in signal processing.