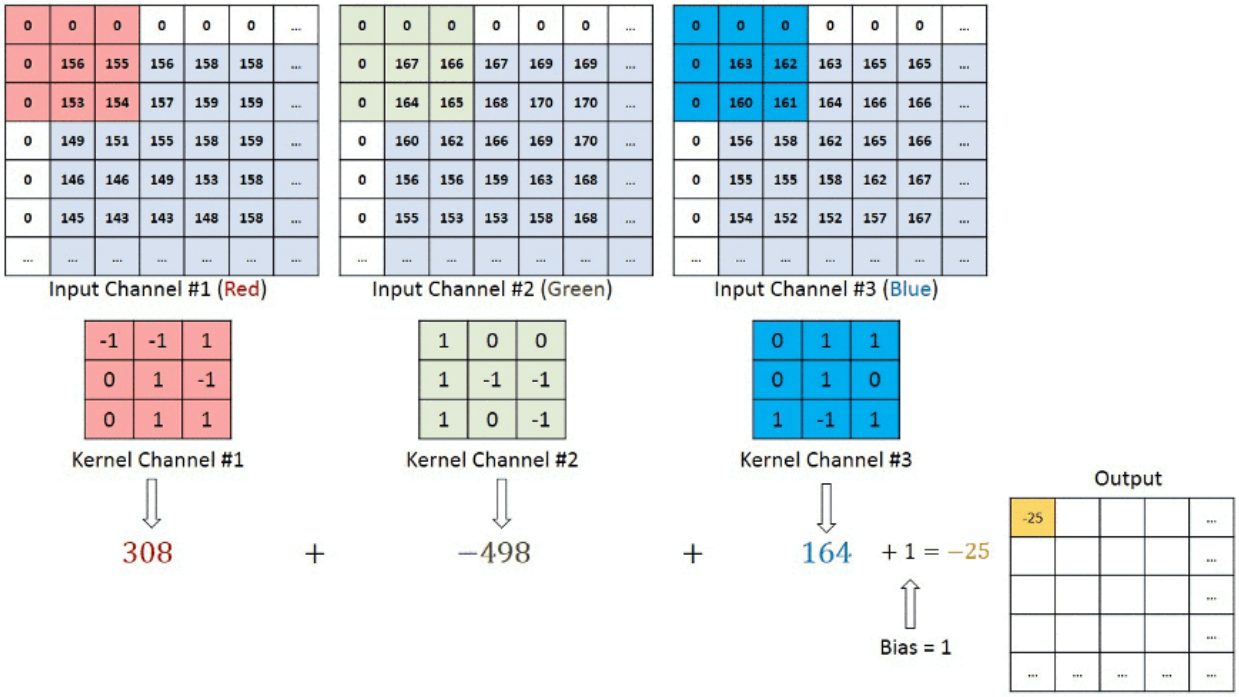
Image Processing for Computer Vision
Session 10

High Pass Filter



Pylessons

Topics

- High Pass filters
- Image Sharpening
- Sobel, Laplacian Filter
- Canny Edge detection algorithm

Common High-pass Filters:

1. Sobel Filter:

- Detects edges by calculating the gradient of image intensity in both horizontal and vertical directions.
- uses two 3x3 kernels (one for detecting horizontal changes, another for vertical changes)
- Sobel operators is a joint Gaussian smoothing plus differentiation operation
- more resistant to noise
- The term "Sobel" is derived from the names of its inventors, Gilberto Sobel and Gary Feldman.

Horizontal Sobel kernel:

```
[[-1, 0, 1],  [[5, 1, 1],  [[0, 0, 0],
[-2, 0, 2],    [5, 1, 1],   [0, 0, 0],
[-1, 0, 1]]    [5, 1, 1]]   [0, 0, 0]]
```

Vertical Sobel kernel:

```
[[-1, -2, -1],
[ 0,  0,  0],
[ 1,  2,  1]]
```

cv.Sobel(src_img, ddepth, dx, dy, ksize=kernel_size)

ddepth: data type of the output image, when ddepth=-1, the output image will have the same depth as the source.
https://docs.opencv.org/3.4/d4/d86/group__imgproc__filter.html#filter_depths
dx: order of the derivative in the x-direction.
dy: order of the derivative in the y-direction.

2. Laplacian Filter:

- A second-order derivative filter that detects edges based on changes in intensity.
- sensitive to noise
- provides detailed edge information

$$\texttt{dst} = \Delta \texttt{src} = \frac{\partial^2 \texttt{src}}{\partial x^2} + \frac{\partial^2 \texttt{src}}{\partial y^2}$$

cv.Laplacian(src_img, ddepth, ksize)
ksize Aperture size used to compute the second-derivative filters. **must be positive and odd**.

If ksize = 1, it is 3x3 kernel

[[0, 1, 0], [[1, -2, 1],
[1, -4, 1],   [1, -2, 1],
[0, 1, 0]]   [1, -2, 1]]

If ksize>1 then the function calculates the Laplacian of the source image by adding up the second x and y derivatives calculated using the above equation.