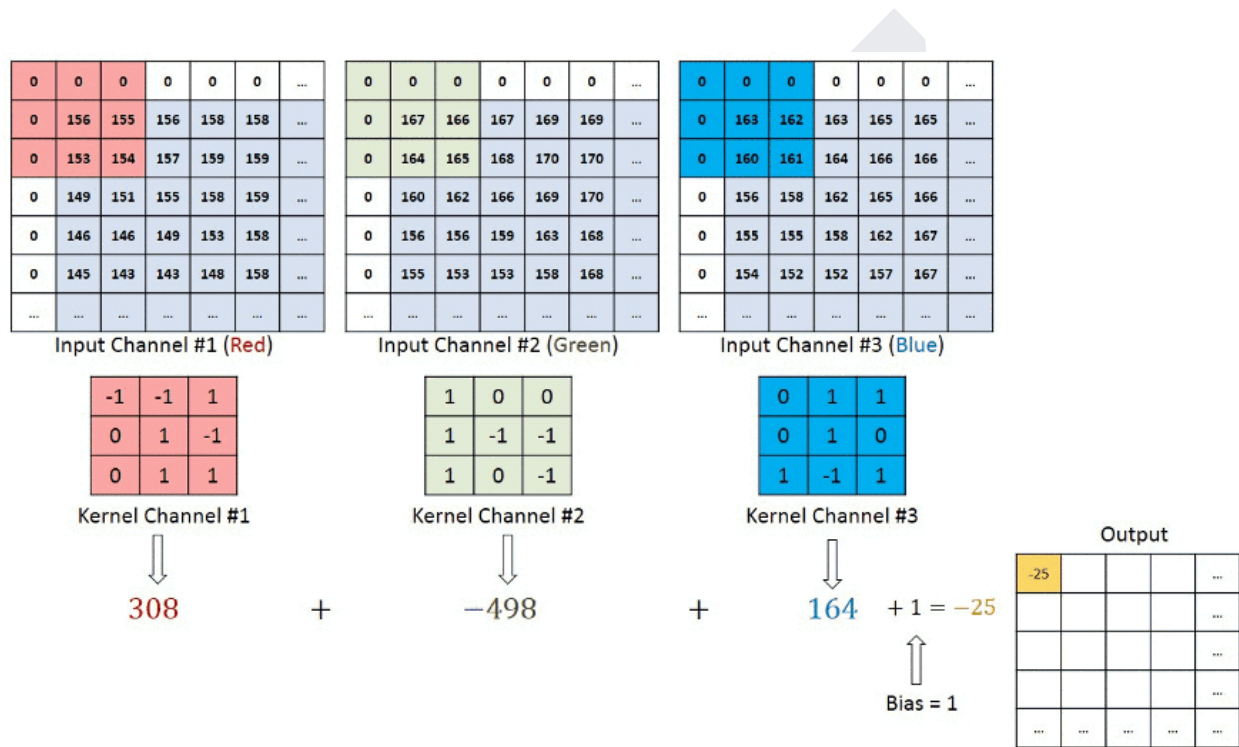


Image Processing for Computer Vision  
Session 10

# 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](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

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

`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

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix} \quad \begin{bmatrix} 1 & -2 & 1 \\ 1 & -2 & 1 \\ 1 & -2 & 1 \end{bmatrix}$$

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.