

## Filtering Images

### Median Filter:

Returns the median value of the pixels in a neighbourhood.

### Sharpening Filter:

$$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 4 & -1 \\ -1 & -1 & -1 \end{bmatrix} = \text{basic sharpening filter}$$

Highlights edges and removes blurred parts of images. This is based on spatial differentiation, suppressing neighbouring pixels and increasing the weight of the current pixel.

Original Image - Smoothed Image = Detail

Original Image + Weight \* Detail = Sharpened Image

The 2nd derivative is more useful for image sharpening or enhancement than the first derivative as it has a stronger response to fine detail.

### Laplacian Filter:

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix} = \text{Laplacian sharpening filter}$$

$$\nabla^2 f = [f(x+1, y) + f(x-1, y) + f(x, y+1) + f(x, y-1)] - 4f(x, y)$$

### Filtering is used to achieve:

- Enhancement
- Smoothing
- Template matching
- Feature Extraction
- Analysis