15EEE337 Digital Image Processing

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Last Lecture

- Spatial filtering
- Linear spatial filtering mechanism
- Spatial correlation & convolution
- Smoothing spatial filter using imfilter in MATLAB

Sharpening Spatial Filters

- Highlights the transitions in intensity
- Electronic printing, medical imaging, industrial inspection etc.
- In blurring applications- pixel averaging in a neighbourhood.
- Averaging is analogous to spatial integration
- Sharpening – spatial differentiation.
- Image differentiation enhances edges and other discontinuities (such as noise) and de-emphasizes areas with slowly varying intensities.
- Sharpening is often referred to as high pass filtering.

Basics

- Derivatives of digital function are defined in terms of differences
- A basic definition of first order derivative of a 1D function f(x)

$$\frac{\partial f}{\partial x} = f(x+1) - f(x)$$

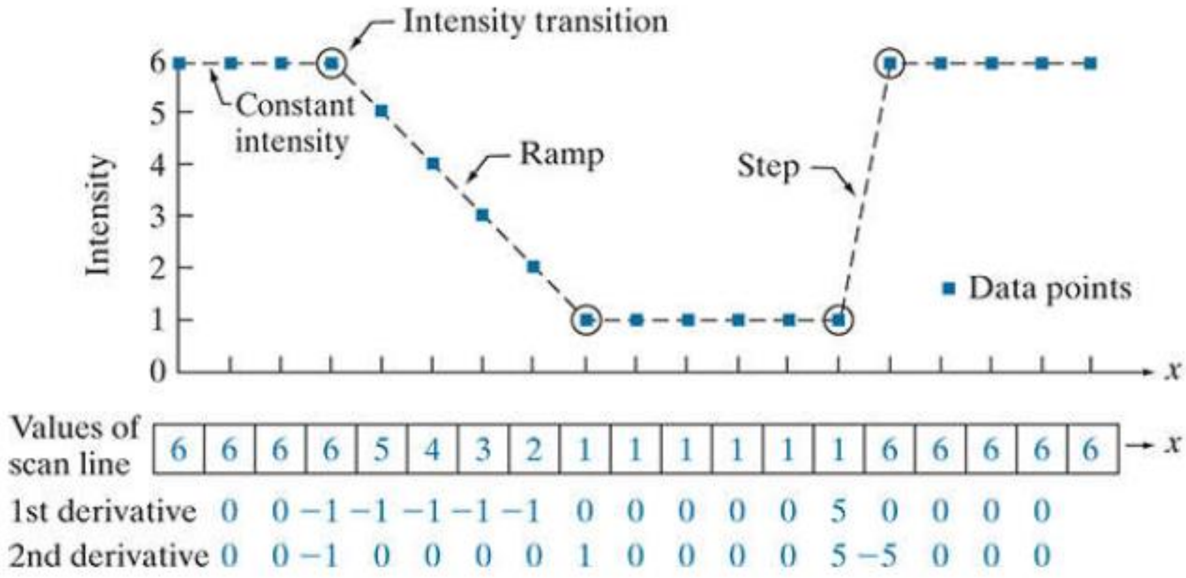
- A basic definition of Second order derivative of a 1D function f(x)

$$\frac{\partial^2 f}{\partial x^2} = f(x+1) + f(x-1) - 2f(x)$$

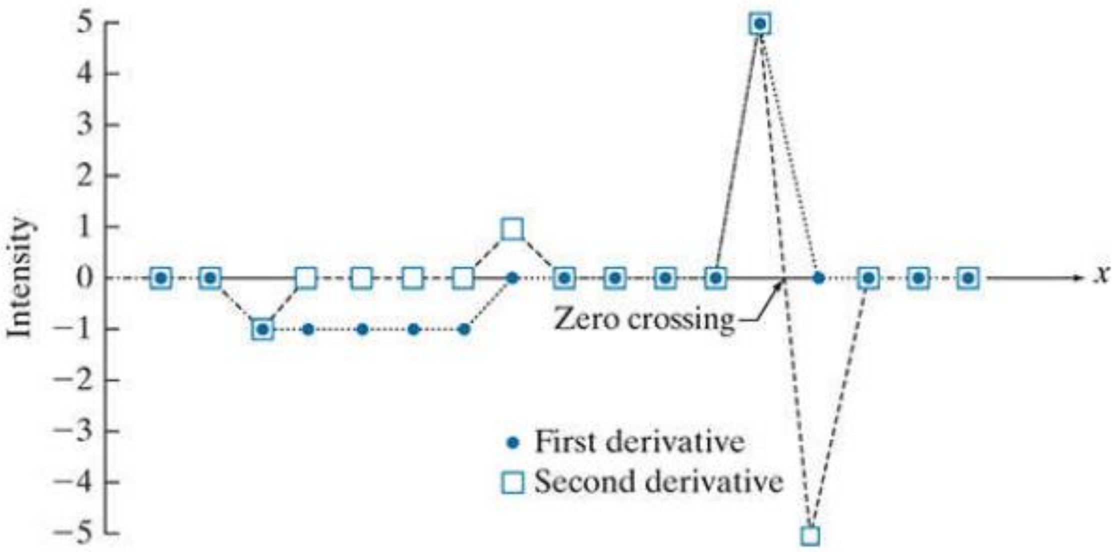
- Must be zero in areas of constant intensity
- Must be nonzero at the onset of an intensity step or ramp
- Must be non zero along intensity ramps

- Must be zero in areas of constant intensity
- Must be nonzero at the onset and ***end*** of an intensity step or ramp
- Must be ***zero*** along intensity ramps

Properties to be satisfied



- Scan line of an image- ramp, step and constant segments.



- Plot of derivatives
- Zero crossing property
- Edges are having sharp transitions

0	1	0
1	−4	1
0	1	0

1	1	1
1	−8	1
1	1	1

Unsharp Masking & High boost Filtering

- Sharpen an image or perform edge enhancement using a smoothing filter.
- Blur the original image
- Subtract the blurred image from the original
- Add the mask to the original

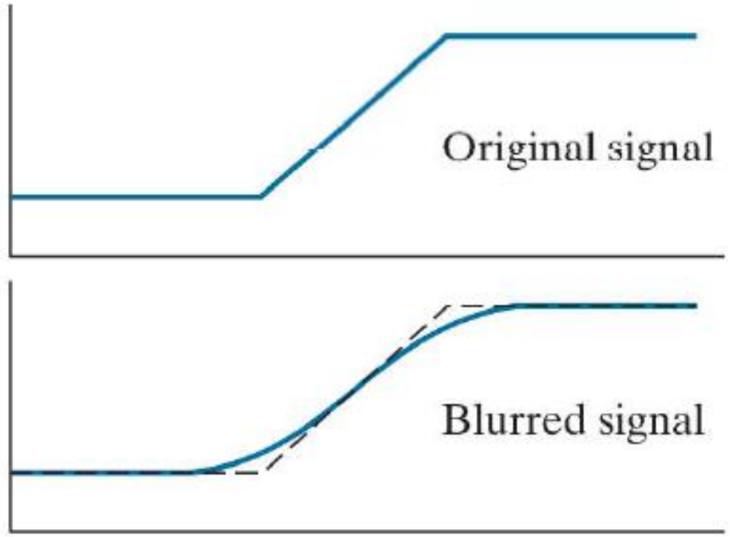
$$\bar{f}(x,y)$$

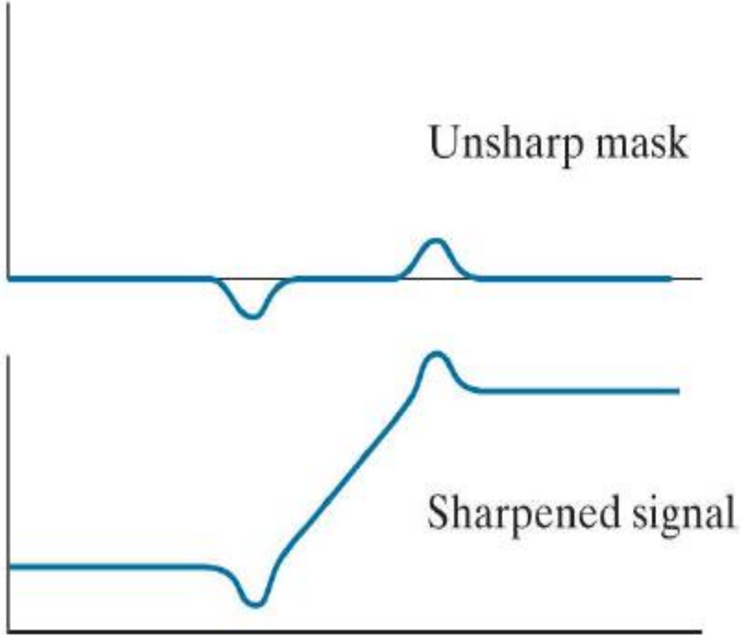
$$g_{\text{mask}}(x,y) = f(x,y) - \bar{f}(x,y)$$

$$g(x, y) = f(x, y) + k g_{\text{mask}}(x, y)$$

- Where k specifies what portion of the mask to be added.
- When k= 1 this is known as Unsharp masking.
- For k>1 we call this as high-boost filtering because we are boosting the high-frequency components by giving more weight to the masked (edge) image.

Mechanics of unsharp masking





a b c
d e f


THANK
YOU