Spatial Filtering

Linear Spatial Filtering

Sum of products between image f & filter kernel w.

$$g(x,y) = w(-1,-1)\, f(x-1, y-1) + w(-1,0)\, f(x-1, y) + \dots$$
$$+\, w(0,0)\, f(x,y) + \dots + w(1,1)\, f(x+1, y+1)$$

$$g(x,y) = \sum_{s=-a}^{a} \sum_{t=-b}^{b} w(s,t) \cdot f(x+s, y+t)$$

Spatial Correlation & Convolution

Correlation: Moving center of a kernel over an image & computing sum of products at each location

Measurement between similarity of two signals

$(x,y) \rightarrow$ any point in the image

w

(-1,-1)	(-1,0)	(-1,1)
(0,-1)	(0,0)	(0,1)
(1,-1)	(1,0)	(1,1)

kernel coefficients

f

(x-1, y-1)	(x-1, y)	(x-1, y+1)
(x, y-1)	(x, y)	(x, y+1)
(x+1, y-1)	x+1, y	(x+1, y+1)

pixel values under kernel when it's centered on (x,y)

Correlation: $(w \cdot f)(x,y) = \sum_{s=-a}^{a} \sum_{t=-b}^{b} w(s,t)\, f(x+s, y+t)$

Convolution: Measurement of effect of one signal on another

$$(w * f)(x,y) = \sum_{s=-a}^{a} \sum_{t=-b}^{b} w(s,t)\, f(x-s, y-t)$$

flip the kernel on both sides

When kernel is symmetrical, correlation = convolution