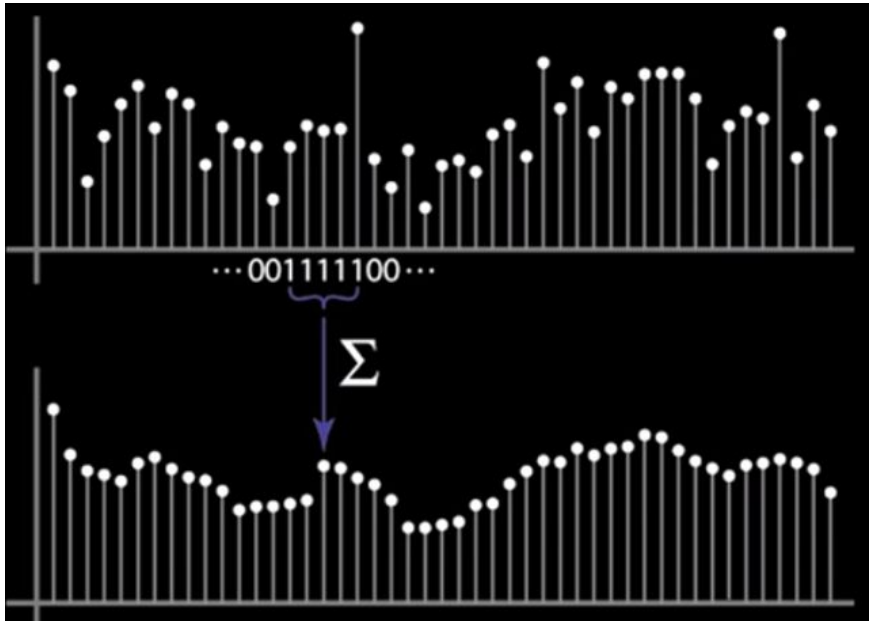
Filtreleme

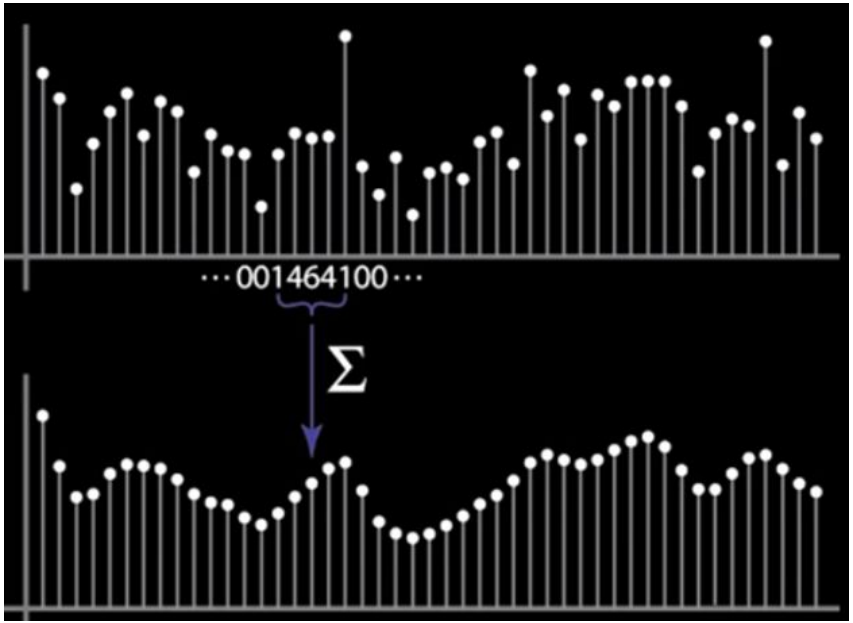
Filtering

1D - Ortalama filtre (uniform/nonuniform)

Tekdüze (uniform) ağırlıklarla ortalama
[1 1 1 1 1] / 5

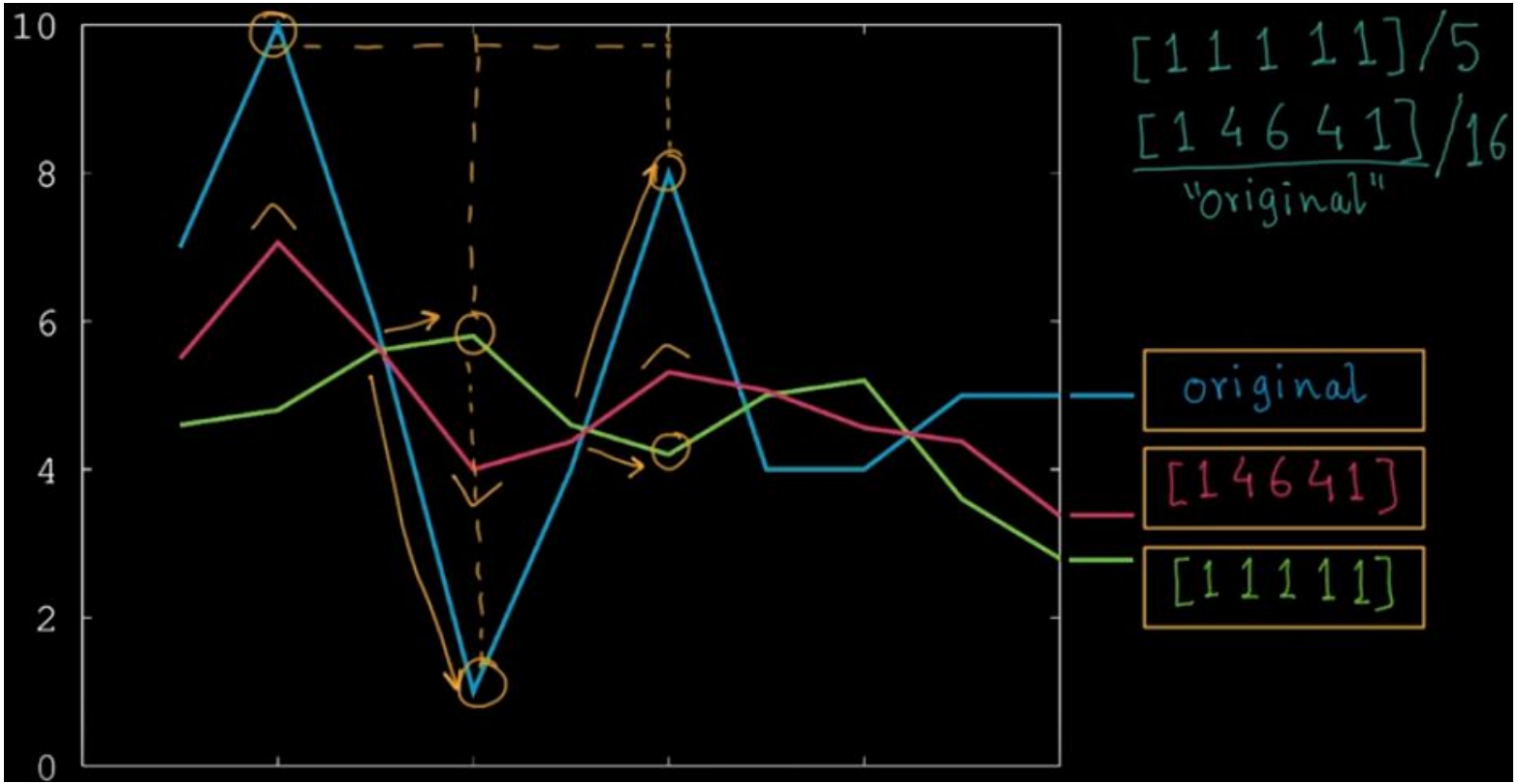


Tekdüze olmayan (non-uniform) ağırlıklarla ortalama
[1 4 6 4 1] / 16



Sonuç: Tekdüze olmayan daha yumuşak geçişlere sahip. Tekdüze sonucunda sert geçişler var.

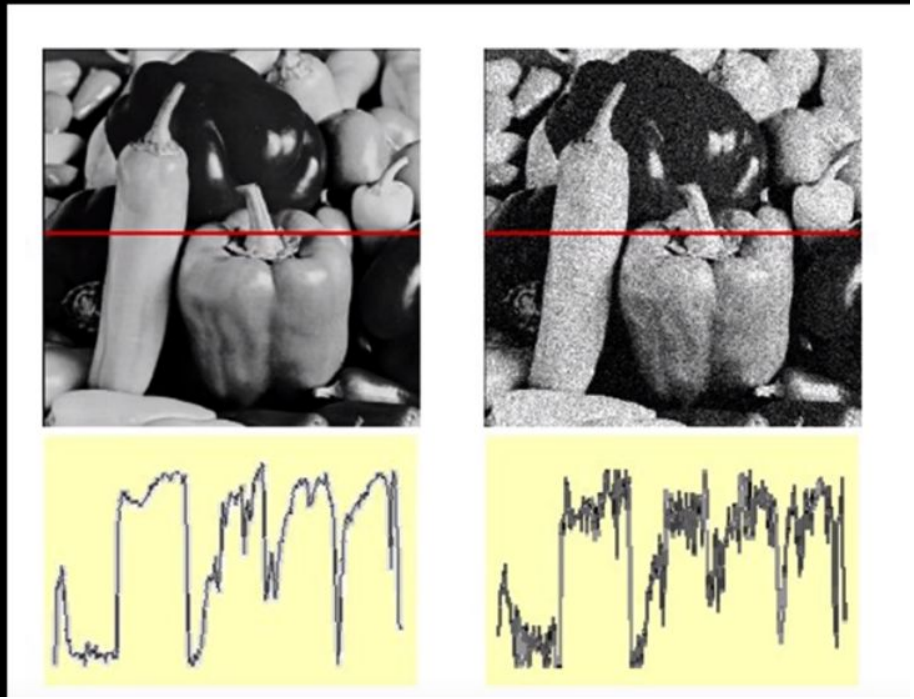
1D - Ortalama filtre



2b gürültülü bir görüntü elde et

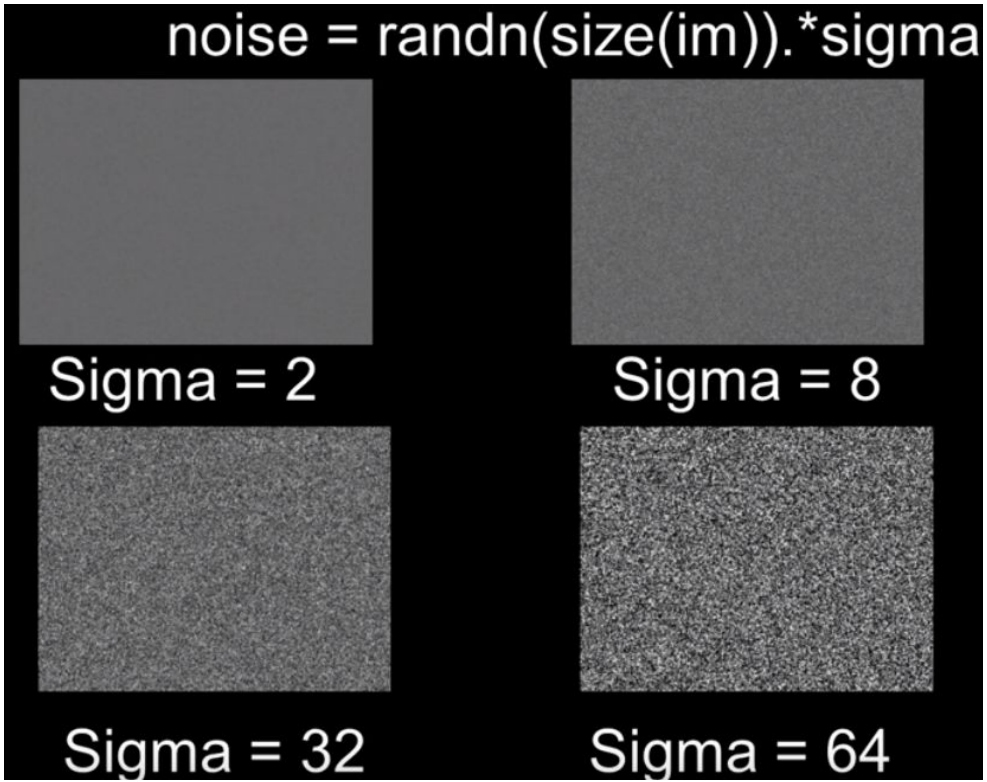
```
>> noise = randn(size(im)).*sigma;

>> output = im + noise;
```



Gürültü şiddetini sigma ile ayarla

Gri renk = 0




```
% Apply Gaussian noise to an image
img = imread('saturn.png');
imshow(img);

noise = randn(size(img)) .* 100;
output = img + noise;
imshow(output);
```

2D - Ortalama filtre (correlation filter)

F(x,y)

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	90	90	90	90	90	0	0
0	0	0	90	90	90	90	90	0	0
0	0	0	90	90	90	90	90	0	0
0	0	0	90	0	90	90	90	0	0
0	0	0	90	90	90	90	90	0	0
0	0	0	0	0	0	0	0	0	0
0	0	90	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

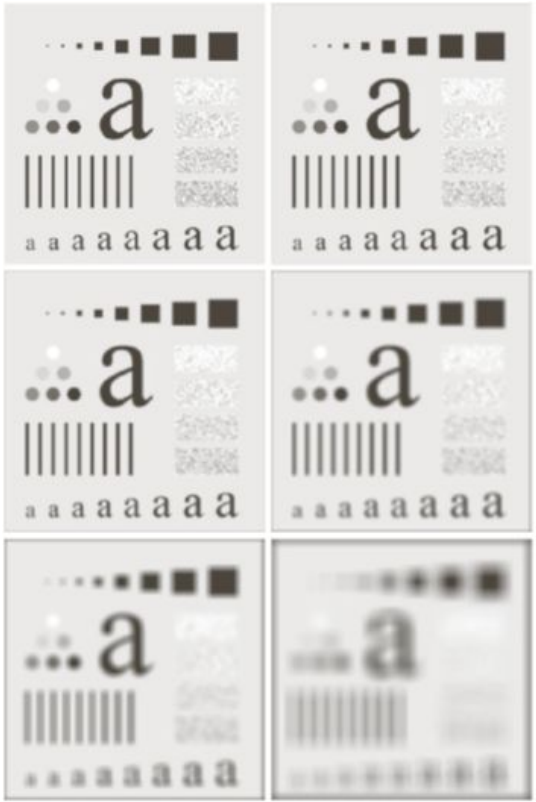
G(x,y)

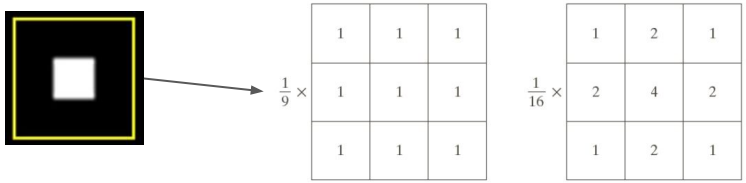
	0	10	20	30	30	30	20	10	
	0	20	40	60	60	60	40	20	
	0	30	60	90	90	90	60	30	
	0	30	50	80	80	90	60	30	
	0	30	50	80	80	90	60	30	
	0	20	30	50	50	60	40	20	
	10	20	30	30	30	30	20	10	
	10	10	10	0	0	0	0	0	

$$G[i,j] = \frac{1}{(2k+1)^2} \sum_{u=-k}^{k} \sum_{v=-k}^{k} F[i+u, j+v]$$

k: kayan pencere boyutu

2D - Ortalama filtre (correlation filter)





a b
c d
e f

FIGURE 3.33 (a) Original image, of size 500 × 500 pixels. (b)–(f) Results of smoothing with square averaging filter masks of sizes $m = 3, 5, 9, 15$, and 35, respectively. The black squares at the top are of sizes 3, 5, 9, 15, 25, 35, 45, and 55 pixels, respectively; their borders are 25 pixels apart. The letters at the bottom range in size from 10 to 24 points, in increments of 2 points; the large letter at the top is 60 points. The vertical bars are 5 pixels wide and 100 pixels high; their separation is 20 pixels. The diameter of the circles is 25 pixels, and their borders are 15 pixels apart; their intensity levels range from 0% to 100% black in increments of 20%. The background of the image is 10% black. The noisy rectangles are of size 50 × 120 pixels.

Tekdüze olmayan ağırlık kullanılırsa

Cross Correlation olarak bilinir: $G = H \otimes F$ olarak gösterilir

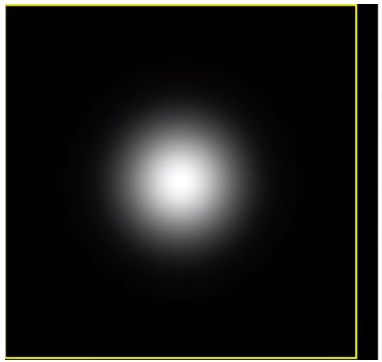
$$G[i,j] = \sum_{u=-k}^{k} \sum_{v=-k}^{k} H[u,v]F[i+u, j+v]$$

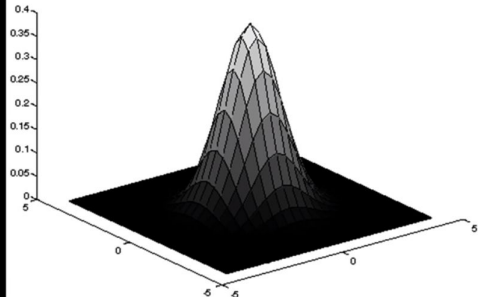
H fonksiyonu Gauss olabilir:

$$h(u,v) = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{x^2+y^2}{2\sigma^2}\right)$$

$\frac{1}{16}$

1	2	1
2	4	2
1	2	1

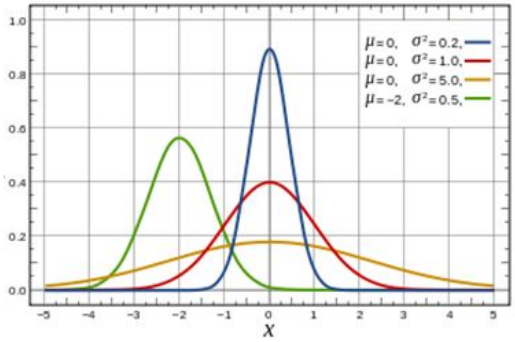




Gauss Fonksiyonu

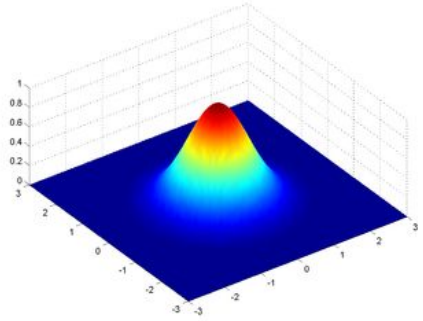
Tek boyutlu Gaussian Fonksiyonu:

$$G(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$



İki boyutlu Gaussian Fonksiyonu:

$$G(x,y) = \frac{1}{2\pi\sigma_x\sigma_y} e^{-\left[\frac{(x-\mu_x)^2}{2\sigma_x^2}+\frac{(y-\mu_y)^2}{2\sigma_y^2}\right]}$$



Özellikleri

- En genel doğal model
- Yumuşatma fonksiyonu
- Sonsuz türeve sahip
- Fourier'i yine bir Gauss
- Convolüsyonu yine bir Gauss
- İnsan gözünde Gauss filter yapan hücreler var

Eğrinin %99.7 hacmi $\mp 3\sigma$ arasında kalmaktadır.

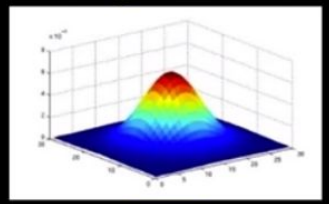
Matlab örneği

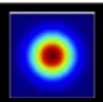
```
hsize = 31;
sigma = 5;
h = fspecial('gaussian', hsize, sigma);

surf(h);

imagesc(h);

outim = imfilter(im, h);
imshow(outim);
```



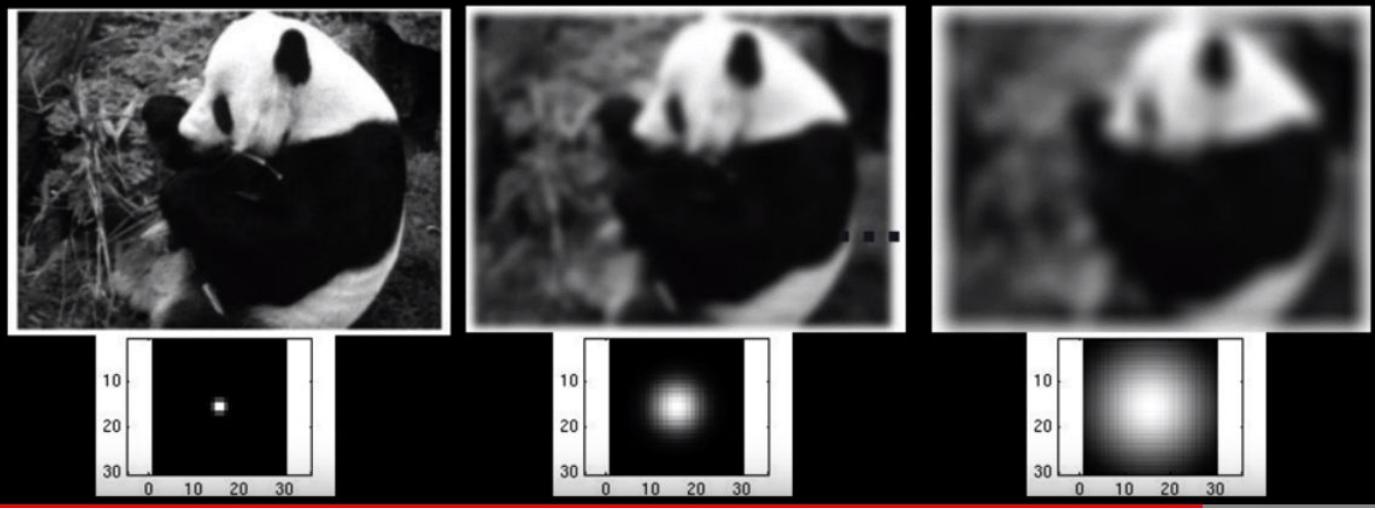


im

outim

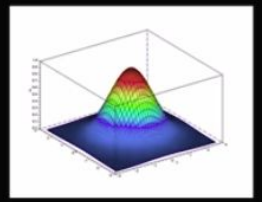
Matlab örneği - sigma etkisi

```
for sigma=1:3:10
 h = fspecial('gaussian',
 fsize, sigma);
 out = imfilter(im, h);
 imshow(out);
 pause;
end
```

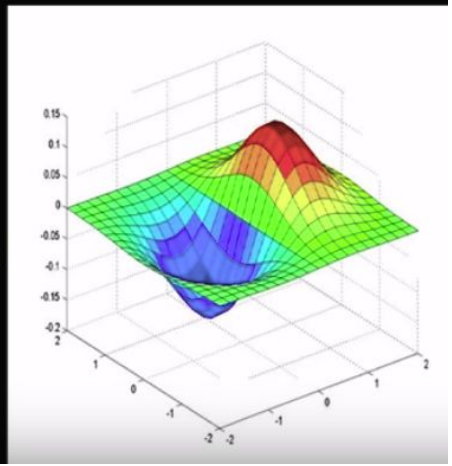


Yumuşatılmış kenar

$$(I \otimes g) \otimes h = I \otimes (g \otimes h)$$

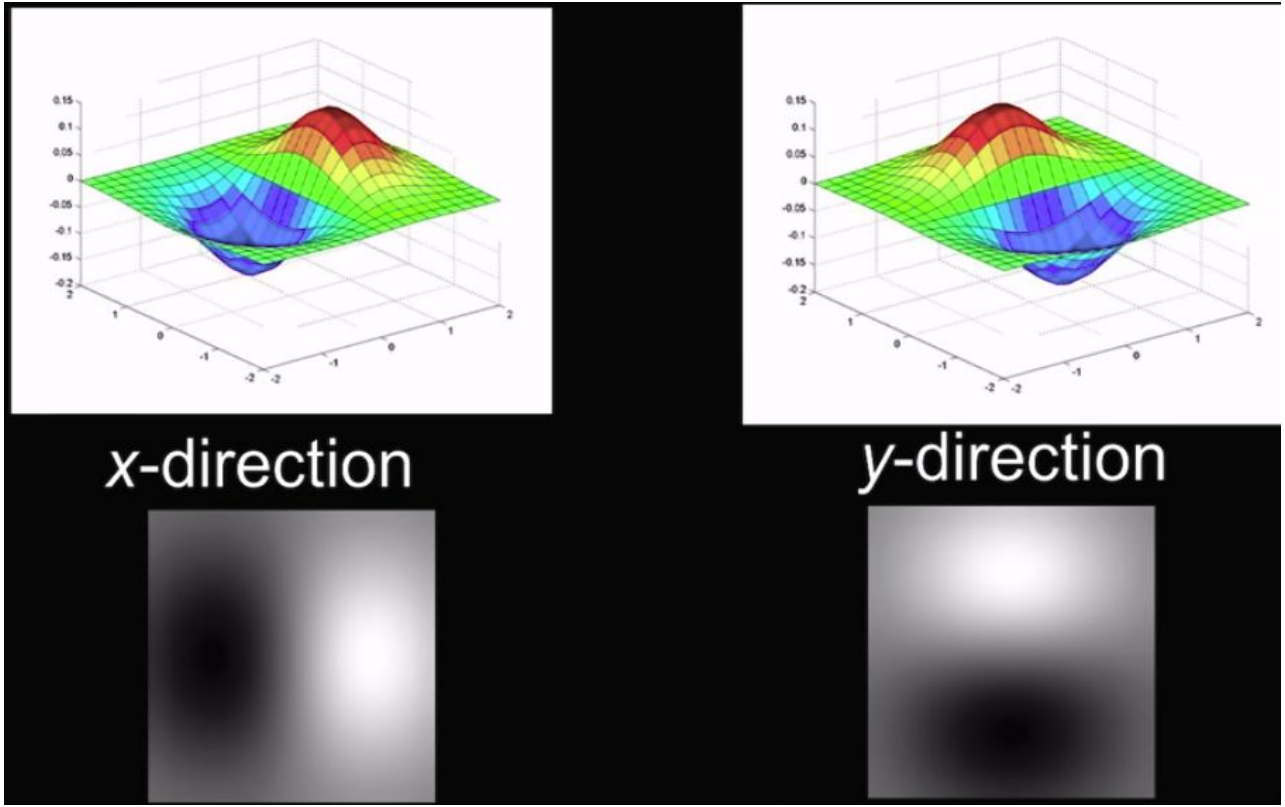


$$\begin{bmatrix} 0.0030 & 0.0133 & 0.0219 & 0.0133 & 0.0030 \\ 0.0133 & 0.0596 & 0.0983 & 0.0596 & 0.0133 \\ 0.0219 & 0.0983 & 0.1621 & 0.0983 & 0.0219 \\ 0.0133 & 0.0596 & 0.0983 & 0.0596 & 0.0133 \\ 0.0030 & 0.0133 & 0.0219 & 0.0133 & 0.0030 \end{bmatrix} \otimes \begin{bmatrix} -1 & 1 \end{bmatrix} =$$

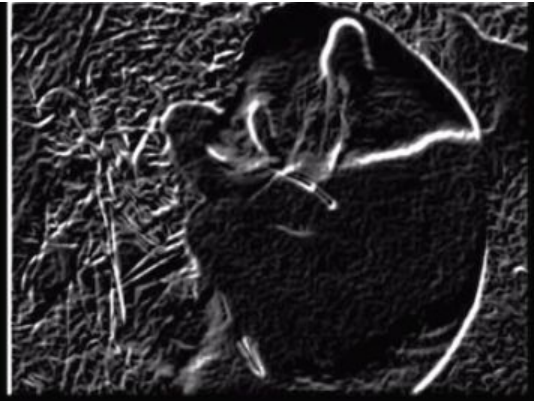


Is this preferable?

Yumuşatılmış kenar



Yumuşatılmış kenarda sigma nın etkisi



σ = 1 pixel

σ = 3 pixels

Smaller values: finer features detected

Larger values: larger scale edges detected