

تجزیه و تحلیل داده ها در نساجی

پردازش تصویر

دکتر پدرام پیوندی

بخش چهارم

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فیلتر مکانی

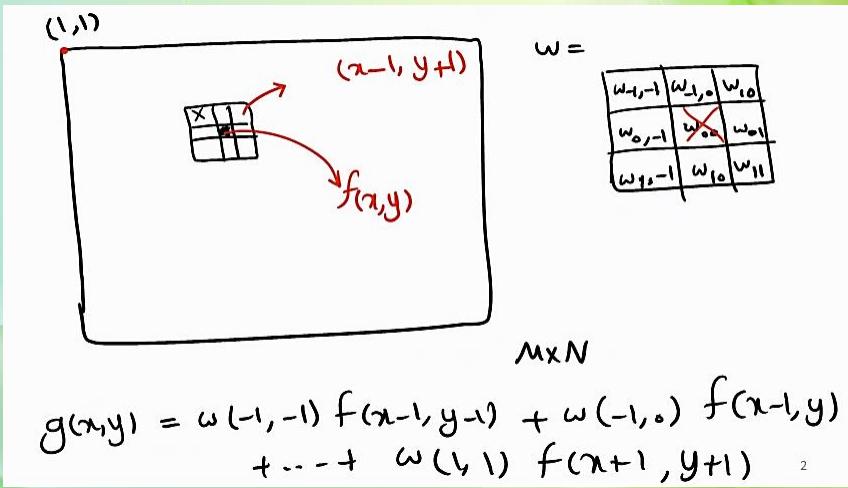
Spatial Filtering

- ۱) یک مبدأ را انتخاب می کنیم (x, y)
- ۲) انجام عملیات مربوط به فیلتر مکانی
- ۳) به عنوان پاسخ فیلتر در نقطه (x, y) در نظر می کنیم
- ۴) مبدأ دلیری را انتخاب می کنیم و از مرحله ۳) مدار می کنیم

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فیلتر مکانی خطی



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فیلتر مکانی خطی

$$g(x, y) = \sum_{s=-1}^{+1} \sum_{t=-1}^{+1} w(s, t) f(x+s, y+t)$$

$$f(x, y) \xrightarrow{w} g(x, y)$$

Linear Spatial Filter

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فیلتر مکانی خطی

$$w \in \mathbb{R}^{(2a+1) \times (2b+1)}$$

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

$$g = w \circledast f$$

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فیلتر مکانی خطی

$$w \in \mathbb{R}^{(2a+1) \times (2b+1)}$$

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

$$g = w * f$$

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فیلتر مکانی خطی

دعلان ۱۸۰ درجه‌ای حول سکر : R_{180}

$$\underbrace{w \circledast f}_{\text{im filter}} = R_{180}(w) * f$$

$$R_{180}(w) \circledast f = w * f$$

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فیلتر مکانی خطی

$$f(x-1, y-1) \quad f(x-1, y) \quad f(x-1, y+1)$$

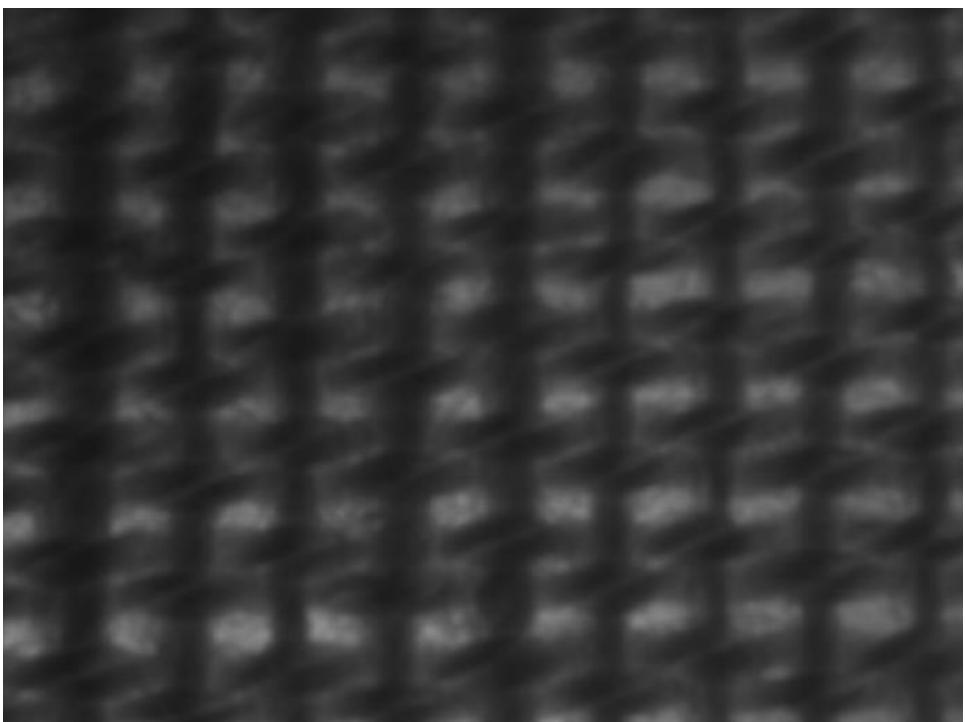
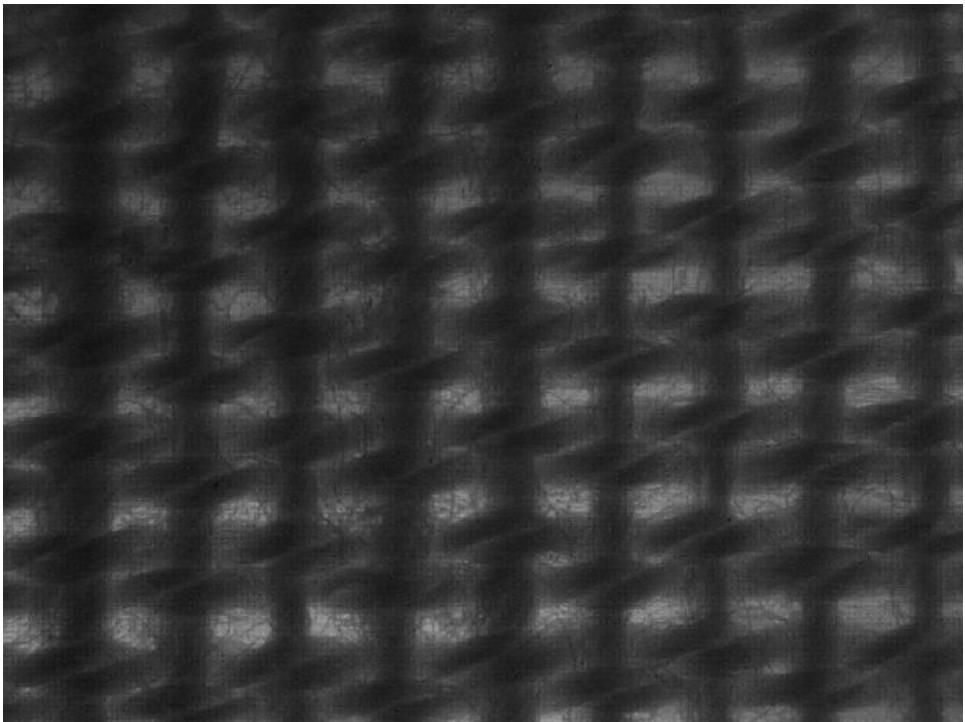
$$f(x, y-1) \quad f(x, y) \quad f(x, y+1)$$

$$f(x+1, y-1) \quad f(x+1, y) \quad f(x+1, y+1)$$

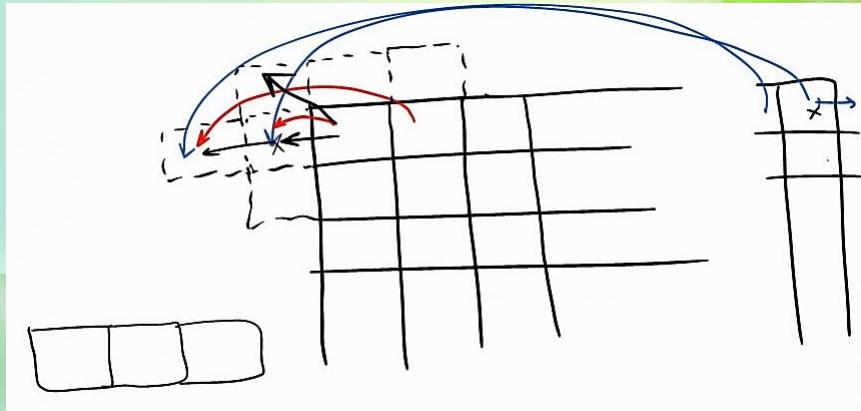
$$g(x, y) = \sum_{s=-1}^{+1} \sum_{t=-1}^{+1} \frac{1}{9} f(x+s, y+t)$$

$$w = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

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فیلتر در لبه تصویر



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Option	Description
Boundary Options	
'x'	Input array values outside the bounds of the array are implicitly assumed to have the value x. When no boundary option is specified, the default is 0.
'symmetric'	Input array values outside the bounds of the array are computed by mirror-reflecting the array across the array border.
'replicate'	Input array values outside the bounds of the array are assumed to equal the nearest array border value.
'circular'	Input array values outside the bounds of the array are computed by implicitly assuming the input array is periodic.
Output Size	
'same'	The output array is the same size as the input array. This is the default behavior when no output size options are specified.
'full'	The output array is the full filtered result, and so is larger than the input array.
Correlation and Convolution Options	
'corr'	imfilter performs multidimensional filtering using correlation, which is the same way that filter2 performs filtering. When no correlation or convolution option is specified, imfilter uses correlation.
'conv'	imfilter performs multidimensional filtering using convolution.

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فیلترهای خطی

fspecial

Create predefined 2-D filter

Syntax

$h = \text{fspecial}(\text{type})$

$h = \text{fspecial}(\text{type}, \text{parameters})$

Value	Description
average	Averaging filter
disk	Circular averaging filter (pillbox)
gaussian	Gaussian lowpass filter
laplacian	Approximates the two-dimensional Laplacian operator
log	Laplacian of Gaussian filter
motion	Approximates the linear motion of a camera
prewitt	Prewitt horizontal edge-emphasizing filter
sobel	Sobel horizontal edge-emphasizing filter

%% In The Name Of GOD

%This Program is written by Pedram Payvandy

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clc

clear all

close all

IM=imread('Fabric.bmp');

IM_gray=rgb2gray(IM);

$h = \text{fspecial}(\text{'average'}, [11 11])$;

IM1=imfilter(IM_gray,h);

imshow(IM_gray);

figure

imshow(IM1);

h = fspecial('disk', radius) returns a circular averaging filter (pillbox) within the square matrix of side $2 * \text{radius} + 1$. The default radius is 5.

```
>> fspecial('disk')

ans =

    0     0     0    0.0012   0.0050   0.0063   0.0050   0.0012     0     0     0
    0    0.0000   0.0062   0.0124   0.0127   0.0127   0.0127   0.0124   0.0062   0.0000     0
    0    0.0062   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0062     0
    0.0012   0.0124   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0124   0.0012
    0.0050   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0050
    0.0063   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0063
    0.0050   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0050
    0.0012   0.0124   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0124   0.0012
    0    0.0062   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0127   0.0062     0
    0    0.0000   0.0062   0.0124   0.0127   0.0127   0.0127   0.0124   0.0062   0.0000     0
    0     0     0    0.0012   0.0050   0.0063   0.0050   0.0012     0     0     0
```

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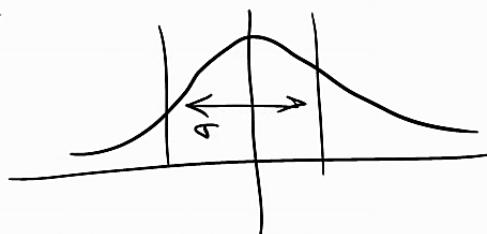
h = fspecial('gaussian', hsize,sigma)

```
>> fspecial('gaussian')

ans =

    0.0113   0.0838   0.0113
    0.0838   0.6193   0.0838
    0.0113   0.0838   0.0113
```

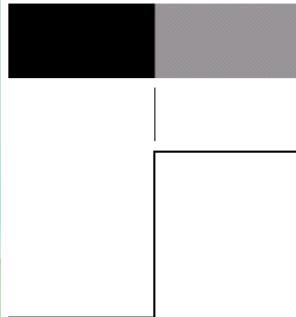
$$e^{-\frac{1}{2} \left(\frac{x}{\sigma}\right)^2}$$



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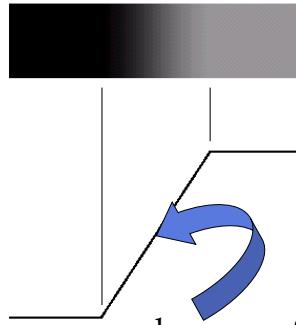
تعريف لبه

Model of an ideal digital edge



Gray-level profile
of a horizontal line
through the image

Model of a ramp digital edge



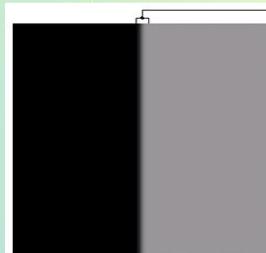
Gray-level profile
of a horizontal line
through the image

because of optics,
sampling, image
acquisition
imperfection

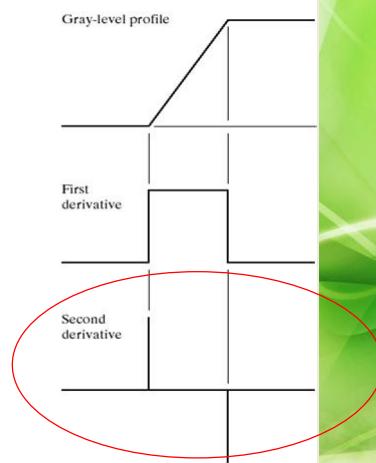
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تعريف لبه



Gray-level profile



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Sobel masks

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

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

Prewitt masks

$$\begin{bmatrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{bmatrix}$$

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

x filter

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

y filter

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0	1	1
-1	0	1
-1	-1	0

-1	-1	0
-1	0	1
0	1	1

Prewitt

0	1	2
-1	0	1
-2	-1	0

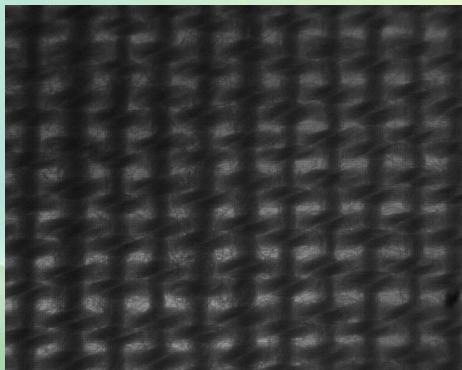
-2	-1	0
-1	0	1
0	1	2

Sobel

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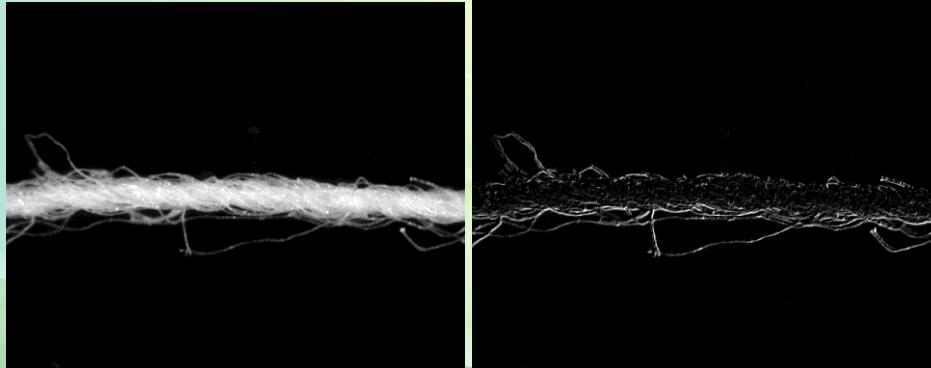
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فیلتر تشخیص لبه



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فیلتر تشخیص لبه



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`h = fspecial('laplacian', alpha)` returns a 3-by-3 filter approximating the shape of the two-dimensional Laplacian operator. The parameter alpha controls the shape of the Laplacian and must be in the range 0.0 to 1.0. The default value for alpha is 0.2.

$$\nabla^2 f(x,y) = \frac{\partial^2 f(x,y)}{\partial x^2} + \frac{\partial^2 f(x,y)}{\partial y^2}$$

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

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

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$$\nabla^2 f(x,y) \approx f(x,y+1) + f(x,y-1) + f(x+1,y) + f(x-1,y)$$

$$w = \begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

-4 $f(x,y)$

$$w = \begin{bmatrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

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```
>> fspecial('laplacian')
```

```
ans =
```

$$\begin{matrix} 0.1667 & 0.6667 & 0.1667 \\ 0.6667 & -3.3333 & 0.6667 \\ 0.1667 & 0.6667 & 0.1667 \end{matrix}$$

$$w_\alpha = \frac{1}{1+\alpha} \begin{bmatrix} \alpha & 1-\alpha & \alpha \\ 1-\alpha & -4 & 1-\alpha \\ \alpha & 1-\alpha & \alpha \end{bmatrix}$$

$$\alpha = 0 \longrightarrow w_\alpha = \begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

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