

Lecture 6: Spatial Filtering

Part 1: Smoothing Filters

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Notes:

- Sample images are available in the images folder of the current directory. (You may need to add images folder into your path.)
- Related lecture: Lecture6 - Spatial Filtering
- pdf versions of the .mlx files are also available for those using GNU Octave

```
% clear workspace variables and close windows
clc, clearvars, close all;
```

```
% read input image
I = imread('images/Lena.tif');
```

Standard averaging (box) filter

```
f1 = fspecial('average')
```

```
f1 = 3x3
    0.1111    0.1111    0.1111
    0.1111    0.1111    0.1111
    0.1111    0.1111    0.1111
```

```
f2 = fspecial('average',7)
```

```
f2 = 7x7
    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204
    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204
    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204
    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204
    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204
    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204
    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204    0.0204
```

```
f3 = fspecial('average',15)
```

```
f3 = 15x15
    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044 ...
    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044
    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044
    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044
    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044
    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044
    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044
```

```

0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044
0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044
0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044    0.0044
⋮

```

```

I1 = imfilter(I,f1);
I2 = imfilter(I,f2);
I3 = imfilter(I,f3);

figure, subplot(1,4,1), imshow(I), title('input');
subplot(1,4,2), imshow(I1), title('Box 3x3');
subplot(1,4,3), imshow(I2), title('Box 7x7');
subplot(1,4,4), imshow(I3), title('Box 15x15');

```



Box vs. Gaussian filter

```

f1 = fspecial('average',15);
f2 = fspecial('gaussian',15,3);

I4 = imfilter(I,f1);
I5 = imfilter(I,f2);

figure, subplot(1,3,1), imshow(I4), title('Box 15x15') ;
subplot(1,3,2), imshow(I), title('input');
subplot(1,3,3), imshow(I5), title('Gaussian 15x15');

```



Gaussian filters with different standard deviations

```
I6 = imgaussfilt(I,1);  
I7 = imgaussfilt(I,3);  
I8 = imgaussfilt(I,5);  
  
figure, subplot(1,4,1), imshow(I), title('input');  
subplot(1,4,2), imshow(I6), title('Gaussian s = 1');  
subplot(1,4,3), imshow(I7), title('Gaussian s = 3');  
subplot(1,4,4), imshow(I8), title('Gaussian s = 5');
```



Specifying custom filters

```
mask = [0 0 1 0 0; 0 0 3 0 0; 1 3 5 3 1; 0 0 3 0 0; 0 0 1 0 0];
mask = mask/sum(mask(:))
```

```
mask = 5x5
      0      0  0.0476      0      0
      0      0  0.1429      0      0
0.0476  0.1429  0.2381  0.1429  0.0476
      0      0  0.1429      0      0
      0      0  0.0476      0      0
```

```
out = imfilter(I,mask);
```

```
figure, subplot(1,3,1), imshow(I2), title('Box 5x5') ;
subplot(1,3,2), imshow(I), title('input');
subplot(1,3,3), imshow(out), title('Weighted avg. 5x5');
```

Box 5x5



input



Weighted avg. 5x5

