Computer Vision I

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1 Image Gradients

1.1

The sign of the sobel operator corresponds to the sign of the calculated gradient (linearity). By changing the sign the absolute value remains the same, the direction if the gradients gets rotated by 180°.

1.2

| Position v_i	(I_x, I_y)	$\|\nabla I(v_i)\|$	σ_i
v_1	$(255, -255)$	361	$-45°$
v_2	$(765, -255)$	806	$-108°$
v_3	$(255, 255)$	361	$45°$
v_4	$(255, 765)$	806	$72°$
v_5	$(1275, 0)$	1275	$0°$
v_6	$(-765, 765)$	1082	$135°$

1.3

```
1  circles = im2double(rgb2gray(imread('circles.png')));
2
3  I_x = [1 0 -1; 2 0 -2; 1 0 -1];
4  I_y = [1 2 1; 0 0 0; -1 -2 -1];
5
6  gradX = imfilter(circles, I_x, 'conv');
7  gradY = imfilter(circles, I_y, 'conv');
8
9  absGrad = sqrt(gradX.^2 + gradY.^2);
```

```
10  angleGrad = atan2(gradY, gradX);
11
12  subplot(1,3,1);
13  imshow(circles);
14  title('Original Image');
15
16  subplot(1,3,2);
17  xRange = 270:280;
18  yRange = 270:280;
19  imshow(absGrad(xRange, yRange));
20  title('Magnitude and Direction');
21  hold on;
22  quiver(gradX(xRange, yRange), gradY(xRange, yRange),1);
23
24  subplot(1,3,3);
25  imshow(gradientColored(absGrad, angleGrad, 0.2));
26  title('Colored Gradient Image');
27
28  print("sh03ex01.eps", "-depsc");
```

1.4
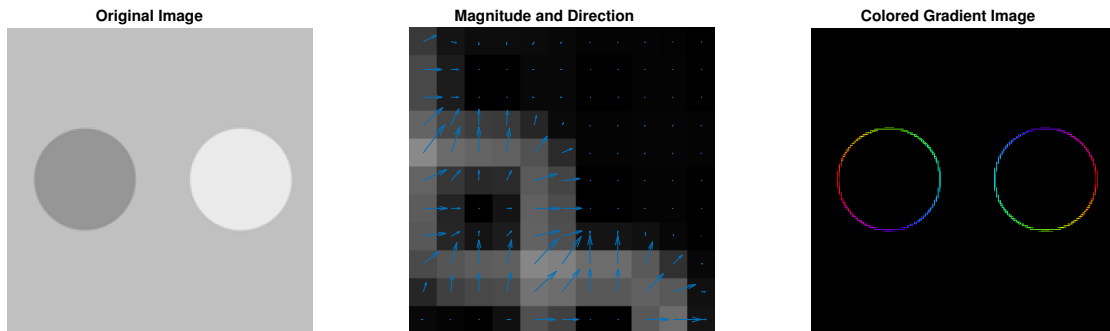
2 Deconvolution

2.1

```
1  load('filtered.mat');
2  load('Hfreq.mat');
3  load('Hfreq2.mat');
4  bookstore = imread('bookstore.tif');
5
6  filtered_freq = fft2(filtered);
```

```matlab
7   bookstore_freq = fft2(bookstore);

8

9   Hspat = ifft2(Hfreq);
10  Hspat2 = ifft2(Hfreq2);

11

12  subplot(5,2,1);
13  imshow(filtered);
14  title('Blurred Image');

15

16  subplot(5,2,2);
17  imshow(bookstore);
18  title('Original Image');

19

20  subplot(5,2,3);
21  imshow(fftshift(filtered_freq));
22  title('Fourier Transform of the Blurred Image');

23

24  subplot(5,2,4);
25  imshow(fftshift(bookstore_freq));
26  title('Fourier Transform of the Original Image');

27

28  subplot(5,2,5);
29  imshow(abs(fftshift(Hfreq)));
30  title('Filter in the frequency domain');

31

32  subplot(5,2,6);
33  imshow(abs(fftshift(Hfreq2)));
34  title('Filter 2 in the frequency domain');

35

36  spatialXRange = 1:30;
37  spatialYRange = 1:50;

38

39  subplot(5,2,7);
40  imshow(Hspat(spatialXRange, spatialYRange));
41  title('Filter 1 in the spatial domain');

42

43  subplot(5,2,8);
44  imshow(Hspat2(spatialXRange, spatialYRange));
45  title('Filter 2 in the spatial domain');

46

47  subplot(5,2,9);
48  imshow(ifft2(filtered_freq./Hfreq));
49  title('Deconvolved blurred image');
```

2.2

If the original filter contains zeros in the frequency domain, the corresponding frequencies get surpressed and cannot be reconstructed.