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

```
circles = im2double(rgb2gray(imread('circles.png')));

I_x = [1 0 -1; 2 0 -2; 1 0 -1];
I_y = [1 2 1; 0 0 0; -1 -2 -1];

gradX = imfilter(circles, I_x, 'conv');
gradY = imfilter(circles, I_y, 'conv');

absGrad = sqrt(gradX.^2 + gradY.^2);
```

```
angleGrad = atan2(gradY, gradX);

subplot(1,3,1);
imshow(circles);
title('Original Image');

subplot(1,3,2);
xRange = 270:280;
yRange = 270:280;
imshow(absGrad(xRange, yRange));
title('Magnitude and Direction');
hold on;
quiver(gradX(xRange, yRange), gradY(xRange, yRange),1);

subplot(1,3,3);
imshow(gradientColored(absGrad, angleGrad, 0.2));
title('Colored Gradient Image');

print("sh03ex01.eps", "-depsc");
```

1.4

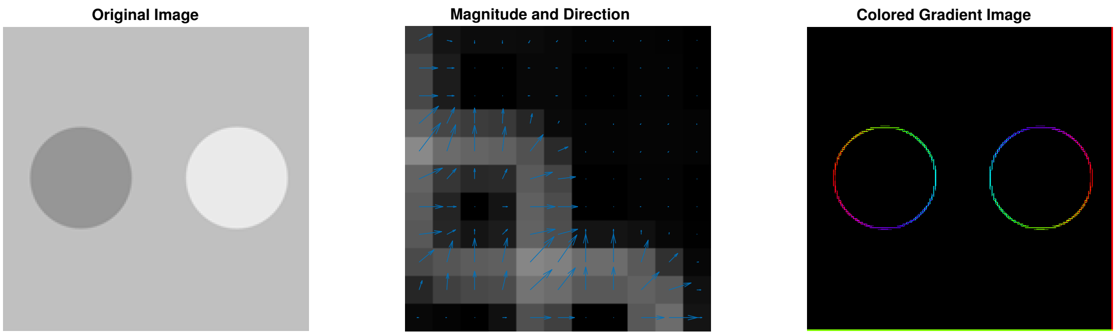

Abbildung 1: Output of the matlab script

2 Deconvolution

2.1

```
% Part 1
load('Hfreq.mat');
load('Hfreq2.mat');

Hspat = ifft2(Hfreq);
```

```
Hspat2 = ifft2(Hfreq2);

Hfreq_display = log(abs(fftshift(Hfreq))*12+1);
Hfreq2_display = log(abs(fftshift(Hfreq2))*12+1);


figure();
subplot(2,2,1);
imshow(Hfreq_display);
title('Filter 1 in the frequency domain');

subplot(2,2,2);
imshow(Hfreq2_display);
title('Filter 2 in the frequency domain');

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

subplot(2,2,3);
imshow(Hspat(spatialXRange, spatialYRange));
title('Filter 1 in the spatial domain');

subplot(2,2,4);
imshow(Hspat2(spatialXRange, spatialYRange));
title('Filter 2 in the spatial domain');

print('sh03ex02_1.eps', '-depsc');
```

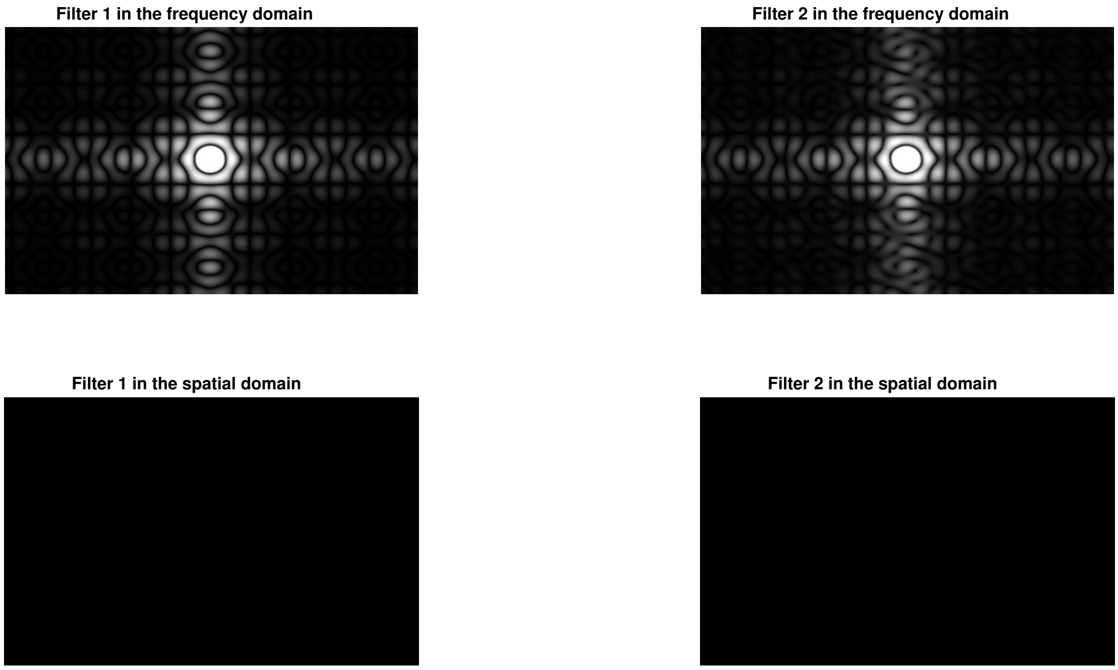

Abbildung 2: Output of the matlab script

2.2

```matlab
% Part 2
bookstore = imread('bookstore.tif');
load('filtered.mat');

filtered_freq = fft2(filtered);
bookstore_freq = fft2(bookstore);

figure();
subplot(2,2,1);
imshow(filtered);
title('Blurred Image');

subplot(2,2,2);
imshow(bookstore);
title('Original Image');

subplot(2,2,3);
imshow(ifft2(filtered_freq./Hfreq));

title('Blurred Image Deconvolved with Filter 1');
```

```

subplot(2,2,4);
imshow(ifft2(filtered_freq./Hfreq2));
title('Blurred Image Deconvolved with Filter 2');

print('sh03ex02_2.eps', '-depsc');
```

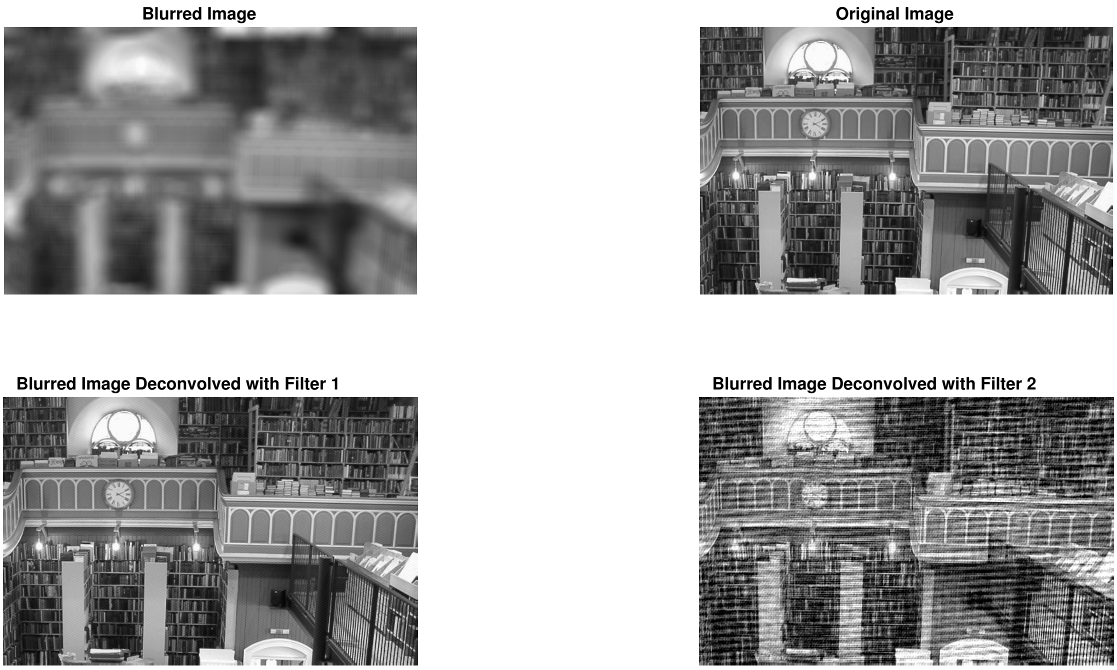

Abbildung 3: Output of the matlab script

2.3

The second filter surpresses high frequencys along the vertical axis more than the first filter. By deconvolving with said filter the corresponding frequencys get amplified in the frequency domain. This results in the horizontal lines in the spatial domain, since these lines have a high frequency.

2.4

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