



**Politechnika  
Śląska**

# Przetwarzanie Obrazów Cyfrowych

**Raport z ćwiczenia nr. 2:  
Przetwarzanie obrazów w dziedzinie  
częstotliwości - transformata Fouriera**

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Data wykonania ćwiczenia: xx.xx.xxxx

## Zadanie 4. Wpływ filtracji przestrzennej na TF

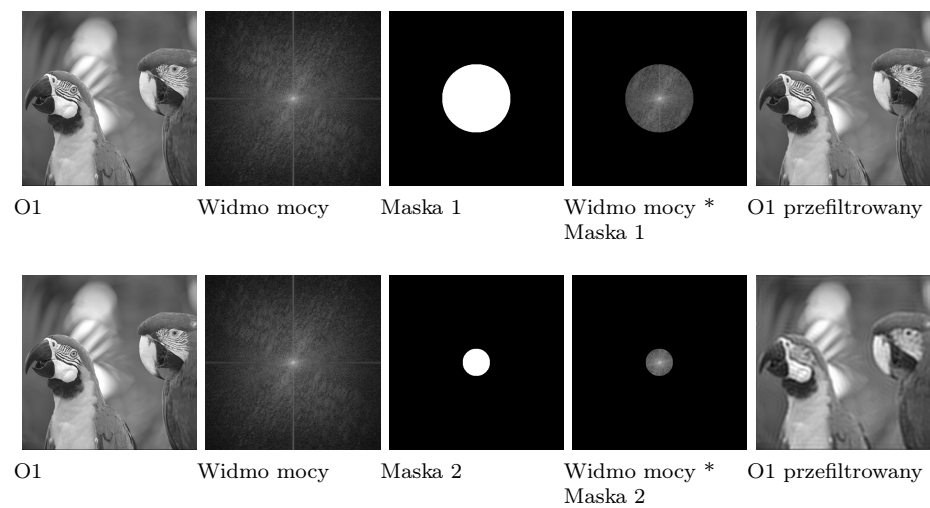


Figure 1: Porównanie

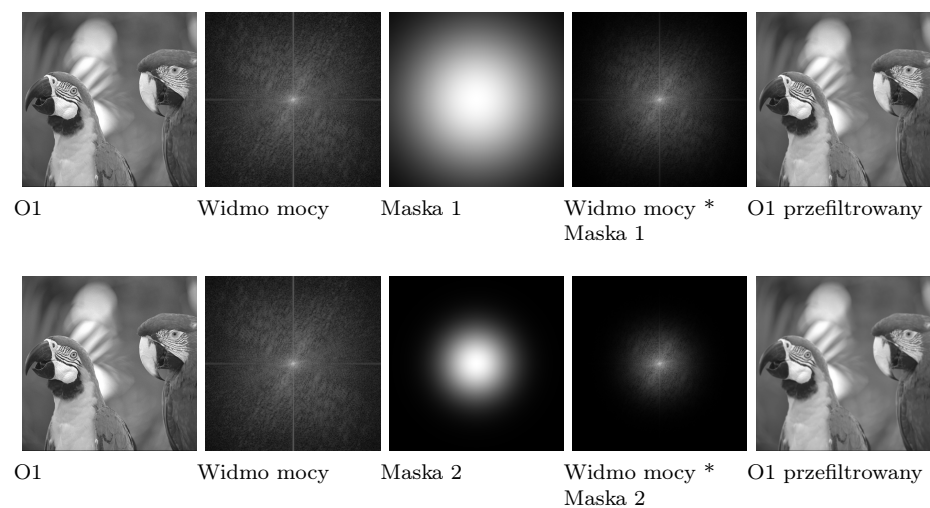


Figure 2: Porównanie

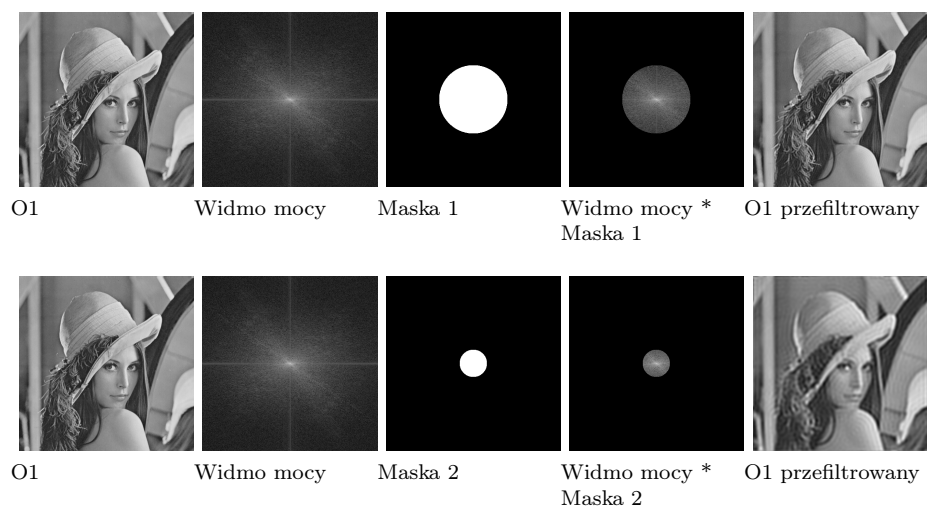


Figure 3: Porownanie

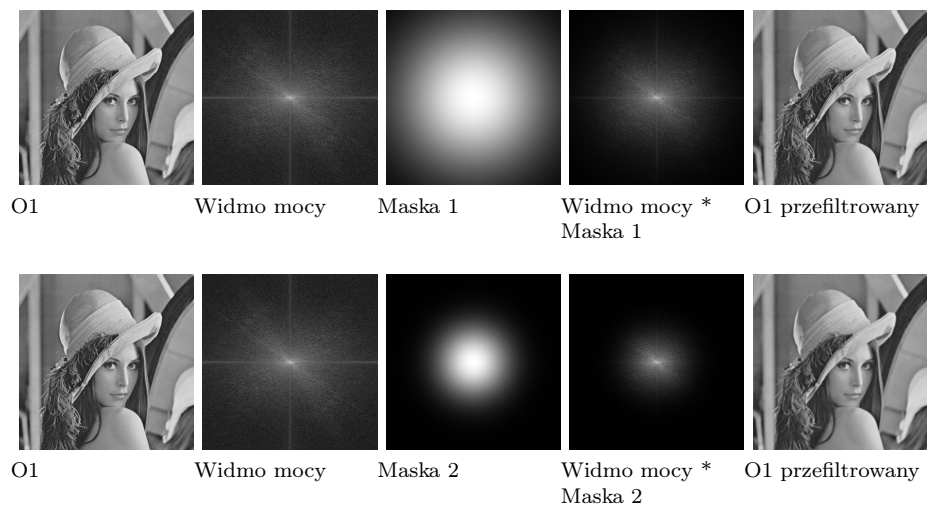


Figure 4: Porownanie

## Kody programów

### image\_fft.m

```
1 function [im_level, im_angle, L1] = image_fft(I1)
2
3     L1 = fftshift(fft2(I1));
4     im_level = log(1+abs(L1));
5     im_angle = angle(L1);
6
7 end
```

### image\_ifft.m

```
1 function I1 = image_ifft(L1)
2
3     I1 = ifft2(ifftshift(L1));
4     I1 = abs(I1);
5
6 end
```

## zad2.m

```
1 clear all
2 close all
3 clc
4
5
6
7
8 images_triangle_rot = [
9 %           path,   rotation, translation, scale
10 {"../images/triangle.png", 0, [0 0], 1 }
11 {'../images/triangle.png', 15, [0 0], 1 }
12 {'../images/triangle.png', 29, [0 0], 1 }
13 {'../images/triangle.png', 50, [0 0], 1 }
14 ]
15
16 images_triangle_pos = [
17 %           path,   rotation, translation, scale
18 {"../images/triangle.png", 0, [0 0], 1 }
19 {'../images/triangle.png', 0, [30 30], 1 }
20 {'../images/triangle.png', 0, [100 100], 1 }
21 {'../images/triangle.png', 0, [-100 -20], 1 }
22 ]
23
24 images_circle_pos = [
25 %           path,   rotation, translation, scale
26 {"../images/circle.png", 0, [0 0], 1 }
27 {'../images/circle.png', 0, [30 30], 1 }
28 {'../images/circle.png', 0, [100 100], 1 }
29 {'../images/circle.png', 0, [-100 -20], 1 }
30 ]
31
32
33 images_circle_scale = [
34 %           path,   rotation, translation, scale
35 {"../images/circle.png", 0, [0 0], 1 }
36 {'../images/circle.png', 0, [0 0], .5 }
37 {'../images/circle.png', 0, [0 0], 2 }
38 {'../images/circle.png', 0, [0 0], 3 }
39 ]
40
41
42 images_line_rot = [
43 %           path,   rotation, translation, scale
44 {"../images/lines.png", 0, [0 0], 1 }
45 {'../images/lines.png', 15, [0 0], 1 }
46 {'../images/lines.png', 29, [0 0], 1 }
47 {'../images/lines.png', 50, [0 0], 1 }
48 ]
49
50 images_sine = [
51 %           path,   rotation, translation, scale
52 { [0.20 0.20], 0, [0 0], 1 }
53 { [0.05 0.005], 0, [0 0], 1 }
54 { [1 0.01], 0, [0 0], 1 }
55 { [0.01 1], 0, [0 0], 1 }
```

```

56 ]
57
58
59 figure;
60 show_images(images_triangle_rot, "../zad2/triangle_rot");
61
62 figure;
63 show_images(images_triangle_pos, "../zad2/triangle_pos");
64
65 figure;
66 show_images(images_circle_pos, "../zad2/circle_pos");
67
68 figure;
69 show_images(images_circle_scale, "../zad2/circle_scale");
70
71 figure;
72 show_images(images_line_rot, "../zad2/line_rot");
73
74 figure;
75 show_images(images_sine, "../zad2/sine");
76
77
78
79 function show_images(images, dest_folder)
80
81     mkdir(dest_folder);
82
83
84     tiledlayout(3,size(images, 1), 'TileSpacing','none');
85
86     tile_indexes = 1:(3*size(images, 1));
87     tile_indexes = reshape(tile_indexes,[],3)';
88
89
90     for tile_index = tile_indexes
91
92         image = images(tile_index(1),:);
93
94         src    = image{1};
95         rot    = image{2};
96         trans  = image{3};
97         scale  = image{4};
98
99         if isa(src, 'string') || isa(src, 'char')
100             I1 = imread(src);
101             I1 = double(I1)./256;
102             I1 = rgb2gray(I1);
103
104
105             orig_size = size(I1);
106
107             I1 = imrotate(I1, rot);
108             I1 = imtranslate(I1, trans);
109             I1 = imresize(I1, scale);
110
111             if (orig_size - size(I1)) >= 0
112                 w = (orig_size - size(I1)) /2;

```

```

113         w = w + [.1, -.1];
114         w = round(w);
115         I1 = padarray(I1, w, 0);
116     else
117         I1 = imcrop(I1, centerCropWindow2d(size(I1),
orig_size));
118     end
119
120     elseif isa(src, 'double')
121         [X,Y] = meshgrid(1:512, 1:512);
122         I1 = sin(X*src(1) + Y*src(2));
123         I1 = (1 + I1)./2;
124     end
125
126
127     [im_level, im_angle] = image_fft(I1);
128
129     % scale values
130     im_level = rescale(im_level);
131     im_angle = rescale(im_angle);
132
133     nexttile(tile_index(1))
134     imshow(I1);
135
136     nexttile(tile_index(2))
137     imshow(im_level);
138     xlabel('Widmo mocy');
139
140     nexttile(tile_index(3))
141     imshow(im_angle);
142     xlabel('Faza');
143
144     imwrite(I1, dest_folder + "/" + tile_index(1) + ".png")
145     imwrite(im_level, dest_folder + "/" + tile_index(1) + "
_mag.png")
146     imwrite(im_angle, dest_folder + "/" + tile_index(1) + "
_angle.png")
147
148 end
149
150
151 trans2str = @(tran) "(" + tran(1) + ", " + tran(1) + ")"
152
153
154 Latex = [
155 "\newcommand{\ww}{0.24} "
156 "\begin{figure}[H] "
157 " \captionsetup[subfloat]{justification=raggedright,
singlelinecheck=false, position=bottom,labelformat=empty} % "
158 "
159 " \subfloat[01 \\\ rot = " + string(images{1,2}) + " \\\ trans = "
+ trans2str(images{1,3}) + " \\\ scale = " + string(images
{1,4}) + "]{
160 " \includegraphics[width=\ww\linewidth]{" + dest_folder + "/"
I1.png}} \hfill% "
161 " \subfloat[01 \\\ rot = " + string(images{2,2}) + " \\\ trans = "
+ trans2str(images{2,3}) + " \\\ scale = " + string(images

```

```

{2,4}) + "]"
162 " \includegraphics[width=\ww\linewidth]{ " + dest_folder + "/"
I2.png}} \hfill% "
163 " \subfloat[01 \ \ rot = " + string(images{3,2}) + " \ \ trans = "
+ trans2str(images{3,3}) + " \ \ scale = " + string(images
{3,4}) + "]"
164 " \includegraphics[width=\ww\linewidth]{ " + dest_folder + "/"
I3.png}} \hfill%"
165 " \subfloat[01 \ \ rot = " + string(images{4,2}) + " \ \ trans = "
+ trans2str(images{4,3}) + " \ \ scale = " + string(images
{4,4}) + "]"
166 " \includegraphics[width=\ww\linewidth]{ " + dest_folder + "/"
I4.png}} \hfill"
167 ""
168 " \subfloat[Widmo mocy]{ "
169 " \includegraphics[width=\ww\linewidth]{ " + dest_folder + "/"
I1_mag.png}} \hfill% "
170 " \subfloat[Widmo mocy]{ "
171 " \includegraphics[width=\ww\linewidth]{ " + dest_folder + "/"
I2_mag.png}} \hfill% "
172 " \subfloat[Widmo mocy]{ "
173 " \includegraphics[width=\ww\linewidth]{ " + dest_folder + "/"
I3_mag.png}} \hfill%"
174 " \subfloat[Widmo mocy]{ "
175 " \includegraphics[width=\ww\linewidth]{ " + dest_folder + "/"
I4_mag.png}} \hfill"
176 ""
177 " \subfloat[Faza]{ "
178 " \includegraphics[width=\ww\linewidth]{ " + dest_folder + "/"
I1_angle.png}} \hfill% "
179 " \subfloat[Faza]{ "
180 " \includegraphics[width=\ww\linewidth]{ " + dest_folder + "/"
I2_angle.png}} \hfill% "
181 " \subfloat[Faza]{ "
182 " \includegraphics[width=\ww\linewidth]{ " + dest_folder + "/"
I3_angle.png}} \hfill%"
183 " \subfloat[Faza]{ "
184 " \includegraphics[width=\ww\linewidth]{ " + dest_folder + "/"
I4_angle.png}}"
185 ""
186 "\caption{Porownanie} "
187 ""
188 "\end{figure} "
189 "\let\ww\undefined "
190 ]
191
192 Latex = join(Latex,[''],2);
193 Latex = join(Latex,[newline],1);
194
195 fid = fopen(dest_folder + "/result.tex",'wt');
196 fprintf(fid,"%s", Latex);
197 fclose(fid);
198
199
200 end

```



## zad3.m

```
1 clear all
2 close all
3 clc
4
5
6
7
8 images = [
9 %         src           ,      iterations,
10 %         filter
11 {"../images/lena_512x512.bmp", [1 2 5 10], @(I1) imfilter(I1,
12     fspecial('average',5)) , "../zad3/lena_smooth" }
13 {"../images/lena_512x512.bmp", [1 2 5 10], @(I1) imsharpen(I1)
14     , "../zad3/lena_sharp" }
15 {"../images/kodim23_512x512.png", [1 2 5 10], @(I1) imfilter(I1,
16     fspecial('average',5)) , "../zad3/kodim_smooth" }
17 {"../images/kodim23_512x512.png", [1 2 5 10], @(I1) imsharpen(I1)
18     , "../zad3/kodim_sharp" }
19 ]
20
21 for image = images'
22     figure
23     show_images(image)
24 end
25
26
27
28 function show_images(image)
29
30     tiledlayout(2,1 + length(image{2}));
31
32     tile_indexes = 1:(2*length(image{2}) + 2);
33     tile_indexes = reshape(tile_indexes,[],2)';
34
35
36     src = image{1};
37     filter_iters = image{2};
38     %filte_mat = image{3};
39     filter_func = image{3};
40     dest_folder = image{4};
41
42
43     I1 = imread(src);
44     I1 = double(I1)./256;
45     I1 = rgb2gray(I1);
46
47     [im_level, ~] = image_fft(I1);
48     im_level = rescale(im_level);
49
50
```

```

51 nexttile(tile_indexes(1,1))
52 imshow(I1);
53
54 nexttile(tile_indexes(2,1))
55 imshow(im_level,[]);
56 xlabel('Widmo mocy');
57
58
59
60 mkdir(dest_folder)
61 imwrite(I1, dest_folder + "/I1.png");
62 imwrite(im_level, dest_folder + "/I1_mag.png");
63
64
65
66 % filtering
67 x = 1;
68 for iter = filter_iters
69
70     I2 = I1;
71     for i = 1:iter
72         I2 = filter_func(I2);
73     end
74
75     [im_level, ~] = image_fft(I2);
76     im_level = rescale(im_level);
77
78     nexttile(tile_indexes(1,x + 1))
79     imshow(I2);
80
81     nexttile(tile_indexes(2,x + 1))
82     imshow(im_level,[]);
83     xlabel('Widmo mocy');
84
85
86     imwrite(I2, dest_folder + "/I1_iter" + iter + ".png");
87     imwrite(im_level, dest_folder + "/I1_iter" + iter + "_mag.
88 png");
89
90     x = x + 1;
91
92 end
93
94 Latex = [
95 "\newcommand{\ww}{0.19} "
96 "\begin{figure}[H] "
97 " \captionsetup[subfloat]{justification=raggedright,
98 " singlelinecheck=false, position=bottom,labelformat=empty} % "
99 " \subfloat[01]{
100 " \includegraphics[width=\ww\linewidth]{ " + dest_folder + "/"
101 " I1.png}} \hfill% "
102 " \subfloat[01]{
103 " \includegraphics[width=\ww\linewidth]{ " + dest_folder + "/"
104 " I1_iter" + filter_iters(1) + ".png}} \hfill% "
105 " \subfloat[01]{

```

```

104 "      \includegraphics[width=\ww\linewidth]{\" + dest_folder + "/"
      I1_iter" + filter_iters(2) + ".png}} \hfill%"
105 "      \subfloat[01]{\"
106 "      \includegraphics[width=\ww\linewidth]{\" + dest_folder + "/"
      I1_iter" + filter_iters(3) + ".png}} \hfill%"
107 "      \subfloat[01]{\"
108 "      \includegraphics[width=\ww\linewidth]{\" + dest_folder + "/"
      I1_iter" + filter_iters(4) + ".png}} \hfill%"
109 ""
110 "      \subfloat[Widmo mocy]{\"
111 "      \includegraphics[width=\ww\linewidth]{\" + dest_folder + "/"
      I1_mag.png}} \hfill% \"
112 "      \subfloat[Widmo mocy]{\"
113 "      \includegraphics[width=\ww\linewidth]{\" + dest_folder + "/"
      I1_iter" + filter_iters(1) + "_mag.png}} \hfill% \"
114 "      \subfloat[Widmo mocy]{\"
115 "      \includegraphics[width=\ww\linewidth]{\" + dest_folder + "/"
      I1_iter" + filter_iters(2) + "_mag.png}} \hfill%"
116 "      \subfloat[Widmo mocy]{\"
117 "      \includegraphics[width=\ww\linewidth]{\" + dest_folder + "/"
      I1_iter" + filter_iters(3) + "_mag.png}} \hfill%"
118 "      \subfloat[Widmo mocy]{\"
119 "      \includegraphics[width=\ww\linewidth]{\" + dest_folder + "/"
      I1_iter" + filter_iters(4) + "_mag.png}} \hfill%"
120 ""
121 "\caption{Porownanie} \"
122 \" \"
123 "\end{figure} \"
124 "\let\ww\undefined \"
125 ]
126
127 Latex = join(Latex,[''],2);
128 Latex = join(Latex,[newline],1);
129
130 fid = fopen(dest_folder + "/result.tex",'wt');
131 fprintf(fid,"%s", Latex);
132 fclose(fid);
133
134
135
136 end

```

## zad4.m

```
1 clear all
2 close all
3 clc
4
5
6 images = [
7 %           src           ,   mask
8 {"../images/lena_512x512.bmp", { "circle", 100, 40}, "../zad4/
   lena_circ" }
9 {"../images/kodim23_512x512.png", { "circle", 100, 40}, "../zad4/
   kodim_circ" }
10 {"../images/lena_512x512.bmp", { "gauss", 150, 70}, "../zad4/
   lena_gauss" }
11 {"../images/kodim23_512x512.png", { "gauss", 150, 70}, "../zad4/
   kodim_gauss" }
12 ]
13
14
15
16
17
18 for image = images'
19     show_images(image)
20 end
21
22
23 function show_images(image)
24
25
26     tiledlayout(2, 5, 'TileSpacing','none');
27
28     src = image{1};
29     mask = image{2};
30     dest_folder = image{3};
31
32
33     I1 = imread(src);
34     I1 = double(I1)./256;
35     I1 = rgb2gray(I1);
36
37
38     [im_level, ~, L1] = image_fft(I1);
39     im_level = rescale(im_level);
40
41     if mask{1} == "circle"
42         im_mask1 = MaskCircle(size(I1), mask{2});
43         im_mask2 = MaskCircle(size(I1), mask{3});
44     elseif mask{1} == "gauss"
45         im_mask1 = MaskGauss(size(I1), mask{2});
46         im_mask2 = MaskGauss(size(I1), mask{3});
47     end
48
49     % mask 1
50     nexttile
51     imshow(I1);
```

```

52
53     nexttile
54     imshow(im_level, []);
55
56     nexttile
57     imshow(im_mask1);
58
59     nexttile
60     imshow(im_level .* im_mask1 , []);
61
62     nexttile
63     imshow(image_ifft(L1 .* im_mask1));
64
65     % mask 1
66     nexttile
67     imshow(I1);
68
69     nexttile
70     imshow(im_level, []);
71
72     nexttile
73     imshow(im_mask2);
74
75     nexttile
76     imshow(im_level .* im_mask2 , []);
77
78     nexttile
79     imshow(image_ifft(L1 .* im_mask2));
80
81     mkdir(dest_folder)
82     imwrite(I1, dest_folder + "/I1.png");
83     imwrite(im_level, dest_folder + "/I1_mag.png"
84     );
85     imwrite(im_mask1, dest_folder + "/I1_mask1.
86     png");
87     imwrite(im_level .* im_mask1, dest_folder + "/"
88     I1_mag_mask1.png");
89     imwrite(image_ifft(L1 .* im_mask1), dest_folder + "/I1_1.png");
90
91     % imwrite(I1, dest_folder + "/I1.png");
92     % imwrite(im_level, dest_folder + "/I1_mag.
93     png");
94     imwrite(im_mask2, dest_folder + "/I1_mask2.
95     png");
96     imwrite(im_level .* im_mask2, dest_folder + "/"
97     I1_mag_mask2.png");
98     imwrite(image_ifft(L1 .* im_mask2), dest_folder + "/I1_2.png");
99
100
101     Latex = [
102     "\newcommand{\ww}{0.19} "
103     "\begin{figure}[H] "
104     "\captionsetup[subfloat]{justification=raggedright,
105     singlelinecheck=false, position=bottom, labelformat=empty} % "
106     "

```

```

102 "      \subfloat[01]{\"
103 "          \includegraphics[width=\ww\linewidth]{\" + dest_folder + \"/
104 "      I1.png}} \hfill\"
105 "      \subfloat[Widmo mocy]{\"
106 "          \includegraphics[width=\ww\linewidth]{\" + dest_folder + \"/
107 "      I1_mag.png}} \hfill\"
108 "      \subfloat[Maska 1]{\"
109 "          \includegraphics[width=\ww\linewidth]{\" + dest_folder + \"/
110 "      I1_mask1.png}} \hfill\"
111 "      \subfloat[Widmo mocy * Maska 1]{\"
112 "          \includegraphics[width=\ww\linewidth]{\" + dest_folder + \"/
113 "      I1_mag_mask1.png}} \hfill\"
114 "      \subfloat[01 przefiltrowany]{\"
115 "          \includegraphics[width=\ww\linewidth]{\" + dest_folder + \"/
116 "      I1_1.png}} \hfill\"
117 \"
118 \"
119 \"      \subfloat[01]{\"
120 \"          \includegraphics[width=\ww\linewidth]{\" + dest_folder + \"/
121 \"      I1.png}} \hfill\"
122 \"      \subfloat[Widmo mocy]{\"
123 \"          \includegraphics[width=\ww\linewidth]{\" + dest_folder + \"/
124 \"      I1_mag.png}} \hfill\"
125 \"      \subfloat[Maska 2]{\"
126 \"          \includegraphics[width=\ww\linewidth]{\" + dest_folder + \"/
127 \"      I1_mask2.png}} \hfill\"
128 \"      \subfloat[Widmo mocy * Maska 2]{\"
129 \"          \includegraphics[width=\ww\linewidth]{\" + dest_folder + \"/
130 \"      I1_mag_mask2.png}} \hfill\"
131 \"      \subfloat[01 przefiltrowany]{\"
132 \"          \includegraphics[width=\ww\linewidth]{\" + dest_folder + \"/
133 \"      I1_2.png}} \hfill\"
134 \"
135 \"\caption{Porownanie} \"
136 \" \"
137 \"\end{figure} \"
138 \"\let\ww\undefined \"
139 ]
140
141 Latex = join(Latex,[''],2);
142 Latex = join(Latex,[newline],1);
143
144 fid = fopen(dest_folder + \"/result.tex','wt');
145 fprintf(fid,"%s", Latex);
146 fclose(fid);
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149     y = (1:dim(2)) - dim(2)/2;
150     [X, Y] = meshgrid(x, y);
151
152     R2 = X.*X + Y.*Y;
153     r2 = r.*r;
154
155     M = R2 < r2;
156     M = double(M);
157
158 end
159
160
161
162 function M = MaskGauss(dim, sigma)
163
164     x = (1:dim(1)) - dim(1)/2;
165     y = (1:dim(2)) - dim(2)/2;
166     [X, Y] = meshgrid(x, y);
167
168     R = sqrt(X.*X + Y.*Y);
169
170     M = normpdf(R, 1, sigma);
171     M = M ./ max(M, [], "all");
172
173 end

```