Przetwarzanie Obrazów Cyfrowych

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

Raport opracował:

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Grupa 6 Semestr 7

Data wykonania ćwiczenia: 14.11.2022

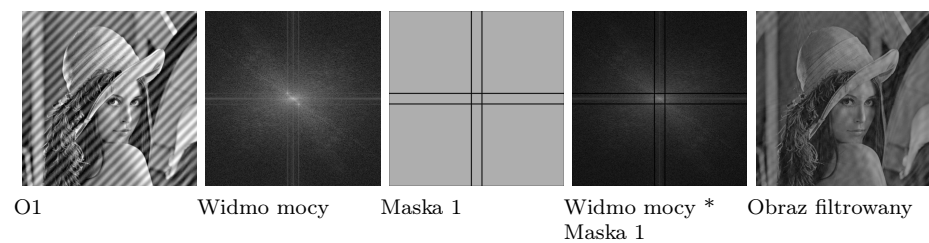# Zadanie 5. Filtracja szumu periodycznego

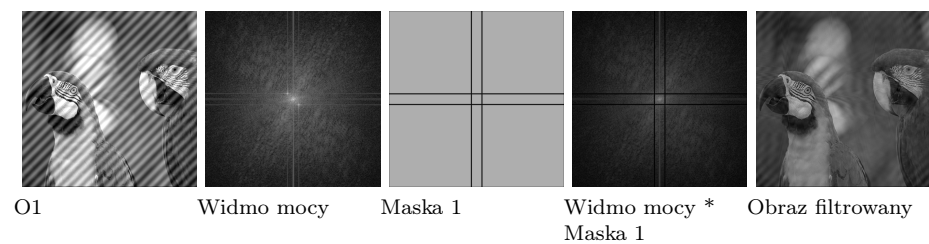O1   Widmo mocy   Maska 1   Widmo mocy * Maska 1   Obraz filtrowany

Figure 1: Porownanie

O1   Widmo mocy   Maska 1   Widmo mocy * Maska 1   Obraz filtrowany

Figure 2: Porownanie

O1   Widmo mocy   Maska 1   Widmo mocy * Maska 1   Obraz filtrowany

Figure 3: Porownanie

O1   Widmo mocy   Maska 1   Widmo mocy *   Obraz filtrowany
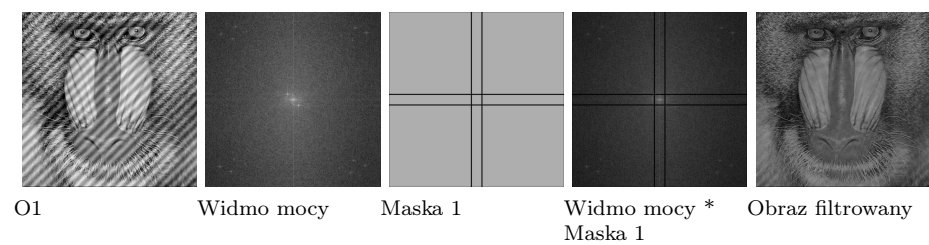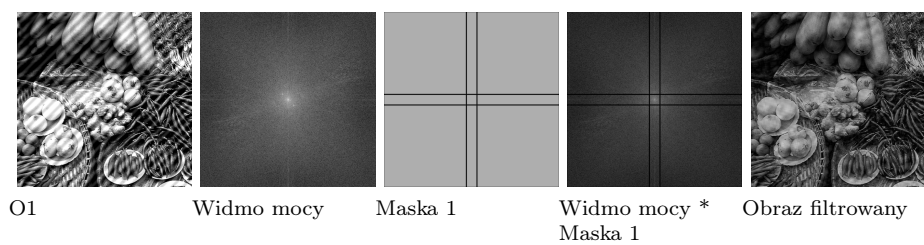   Maska 1

Figure 4: Porownanie

Kody programów

image_fft.m

```matlab
function [im_level, im_angle, L1] = image_fft(I1)

    L1 = fftshift(fft2(I1));
    im_level = log(1+abs(L1));
    im_angle = angle(L1);

end
```

image_ifft.m

```matlab
function I1 = image_ifft(L1)

    I1 = ifft2(ifftshift(L1));
    I1 = abs(I1);

end
```

zad2.m

```matlab
clear all
close all
clc



images_triangle_rot = [
%                       path,   rotation, translation, scale
{"../images/triangle.png",           0,        [0 0],    1 }
{'../images/triangle.png',          15,        [0 0],    1 }
{'../images/triangle.png',          29,        [0 0],    1 }
{'../images/triangle.png',          50,        [0 0],    1 }
]

images_triangle_pos = [
%                       path,   rotation,  translation,  scale
{"../images/triangle.png",           0,          [0 0],    1 }
{'../images/triangle.png',           0,        [30 30],    1 }
{'../images/triangle.png',           0,      [100 100],    1 }
{'../images/triangle.png',           0,     [-100 -20],    1 }
]

images_circle_pos = [
%                      path,   rotation, translation,    scale
{"../images/circle.png",           0,         [0 0],    1 }
{'../images/circle.png',           0,       [30 30],    1 }
{'../images/circle.png',           0,     [100 100],    1 }
{'../images/circle.png',           0,    [-100 -20],    1 }
]


images_circle_scale = [
%                      path, rotation, translation, scale
{"../images/circle.png",           0,       [0 0],    1 }
{'../images/circle.png',           0,       [0 0],   .5 }
{'../images/circle.png',           0,       [0 0],    2 }
{'../images/circle.png',           0,       [0 0],    3 }
]


images_line_rot = [
%                  path,   rotation,   translation, scale
{"../images/lines.png",           0,         [0 0],    1 }
{'../images/lines.png',          15,         [0 0],    1 }
{'../images/lines.png',          29,         [0 0],    1 }
{'../images/lines.png',          50,         [0 0],    1 }
]

images_sine = [
%             path,  rotation,    translation,   scale
{        [.20 .20],         0,          [0 0],       1 }
{       [.05 .005],         0,          [0 0],       1 }
{         [1   .01],        0,          [0 0],       1 }
{          [.01 1],         0,          [0 0],       1 }
```

```matlab
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
128            [im_level, im_angle] = image_fft(I1);
129
130            % scale values
131            im_level = rescale(im_level);
132            im_angle = rescale(im_angle);
133
134            nexttile(tile_index(1))
135            imshow(I1);
136
137            nexttile(tile_index(2))
138            imshow(im_level);
139            xlabel('Widmo mocy');
140
141            nexttile(tile_index(3))
142            imshow(im_angle);
143            xlabel('Faza');
144
145            imwrite(I1, dest_folder + "/I" + tile_index(1) + ".png")
146            imwrite(im_level, dest_folder + "/I" + tile_index(1) + "
     _mag.png")
147            imwrite(im_angle, dest_folder + "/I" + tile_index(1) + "
     _angle.png")
148
149        end
150
151
152        trans2str = @(tran) "(" + tran(1) + ", " + tran(1) + ")"
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[O1 \\ 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[O1 \\ 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     ]

192     Latex = join(Latex,[''],2);
193     Latex = join(Latex,[newline],1);

195     fid = fopen(dest_folder + "/result.tex",'wt');
196     fprintf(fid,"%s", Latex);
197     fclose(fid);


200 end
```

zad3.m

```matlab
1  clear all
2  close all
3  clc
4
5
6
7
8  images = [
9  %              src              ,      iterations,
       filter
10 {"../images/lena_512x512.bmp",      [1 2 5 10], @(I1) imfilter(I1,
       fspecial('average',5)) ,"../zad3/lena_smooth"   }
11 {"../images/lena_512x512.bmp",      [1 2 5 10], @(I1) imsharpen(I1)
                            ,"../zad3/lena_sharp"   }
12 {"../images/kodim23_512x512.png",  [1 2 5 10], @(I1) imfilter(I1,
       fspecial('average',5)) ,"../zad3/kodim_smooth"   }
13 {"../images/kodim23_512x512.png",  [1 2 5 10], @(I1) imsharpen(I1)
                            ,"../zad3/kodim_sharp"   }
14 ]
15
16
17
18
19 for image = images'
20
21     figure
22     show_images(image)
23
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
```

```matlab
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.
    png");
88
89          x = x + 1;
90
91      end
92
93
94      Latex = [
95  "\newcommand{\ww}{0.19} "
96  "\begin{figure}[H] "
97  "   \captionsetup[subfloat]{justification=raggedright,
    singlelinecheck=false, position=bottom,labelformat=empty} % "
98  "   "
99  "    \subfloat[O1]{"
100 "        \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
    I1.png}}  \hfill% "
101 "    \subfloat[O1 - iteracja " + filter_iters(1) + "]{"
102 "        \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
    I1_iter" + filter_iters(1) + ".png}}  \hfill% "
103 "    \subfloat[O1 - iteracja " + filter_iters(2) + "]{"
```

```
104 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
        I1_iter" + filter_iters(2) + ".png}}  \hfill%"
105 "    \subfloat[O1 - iteracja " + filter_iters(3) + "]{"
106 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
        I1_iter" + filter_iters(3) + ".png}}  \hfill"
107 "    \subfloat[O1 - iteracja " + filter_iters(4) + "]{"
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

```matlab
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 {"../images/lena_512x512.bmp",    { "invcircle", 100,  40}, "../
       zad4/lena_invcirc"  }
13 {"../images/kodim23_512x512.png", { "invcircle", 100,  40}, "../
       zad4/kodim_invcirc"  }
14 {"../images/lena_512x512.bmp",    { "invgauss",  150,  70}, "../
       zad4/lena_invgauss"  }
15 {"../images/kodim23_512x512.png", { "invgauss",  150,  70}, "../
       zad4/kodim_invgauss"  }
16 ]
17
18
19
20
21
22 for image = images'
23     show_images(image)
24 end
25
26
27 function show_images(image)
28
29
30     tiledlayout(2, 5, 'TileSpacing','none');
31
32     src = image{1};
33     mask = image{2};
34     dest_folder = image{3};
35
36
37     I1 = imread(src);
38     I1 = double(I1)./256;
39     I1 = rgb2gray(I1);
40
41
42     [im_level, ~, L1] = image_fft(I1);
43     im_level = rescale(im_level);
44
45     if mask{1} == "circle"
46         im_mask1 = MaskCircle(size(I1), mask{2});
47         im_mask2 = MaskCircle(size(I1), mask{3});
```

```matlab
48     elseif mask{1} == "gauss"
49         im_mask1 = MaskGauss(size(I1), mask{2});
50         im_mask2 = MaskGauss(size(I1), mask{3});
51     elseif mask{1} == "invcircle"
52         im_mask1 = MaskCircle(size(I1), mask{2})*-1 + 1;
53         im_mask2 = MaskCircle(size(I1), mask{3})*-1 + 1;
54     elseif mask{1} == "invgauss"
55         im_mask1 = MaskGauss(size(I1), mask{2})*-1 + 1;
56         im_mask2 = MaskGauss(size(I1), mask{3})*-1 + 1;
57     end
58
59
60     % mask 1
61     nexttile
62     imshow(I1);
63
64     nexttile
65     imshow(im_level,[]);
66
67     nexttile
68     imshow(im_mask1);
69
70     nexttile
71     imshow(im_level .* im_mask1 , []);
72
73     nexttile
74     imshow(image_ifft(L1 .* im_mask1));
75
76     % mask 1
77     nexttile
78     imshow(I1);
79
80     nexttile
81     imshow(im_level,[]);
82
83     nexttile
84     imshow(im_mask2);
85
86     nexttile
87     imshow(im_level .* im_mask2  , []);
88
89     nexttile
90     imshow(image_ifft(L1 .* im_mask2));
91
92     mkdir(dest_folder)
93     imwrite(I1,                         dest_folder + "/I1.png");
94     imwrite(im_level,                   dest_folder + "/I1_mag.png"
       );
95     imwrite(im_mask1,                   dest_folder + "/I1_mask1.
       png");
96     imwrite(im_level .* im_mask1,       dest_folder + "/
       I1_mag_mask1.png");
97     imwrite(image_ifft(L1 .* im_mask1), dest_folder + "/I1_1.png");
98
99     % imwrite(I1,                        dest_folder + "/I1.png");
100    % imwrite(im_level,                  dest_folder + "/I1_mag.
       png");
```

```
101      imwrite(im_mask2,                      dest_folder + "/I1_mask2.
         png");
102      imwrite(im_level .* im_mask2,          dest_folder + "/
         I1_mag_mask2.png");
103      imwrite(image_ifft(L1 .* im_mask2), dest_folder + "/I1_2.png");
104
105
106
107
108      Latex = [
109 "\newcommand{\ww}{0.19} "
110 "\begin{figure}[H] "
111 "     \captionsetup[subfloat]{justification=raggedright,
         singlelinecheck=false, position=bottom,labelformat=empty} % "
112 "     "
113 "     \subfloat[O1]{"
114 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
         I1.png}}  \hfill% "
115 "     \subfloat[Widmo mocy]{"
116 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
         I1_mag.png}}  \hfill% "
117 "     \subfloat[Maska 1]{"
118 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
         I1_mask1.png}}  \hfill%"
119 "     \subfloat[Widmo mocy * Maska 1]{"
120 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
         I1_mag_mask1.png}}  \hfill"
121 "     \subfloat[O1 przefiltrowany]{"
122 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
         I1_1.png}}  \hfill"
123 ""
124 "     \subfloat[O1]{"
125 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
         I1.png}}  \hfill% "
126 "     \subfloat[Widmo mocy]{"
127 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
         I1_mag.png}}  \hfill% "
128 "     \subfloat[Maska 2]{"
129 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
         I1_mask2.png}}  \hfill%"
130 "     \subfloat[Widmo mocy * Maska 2]{"
131 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
         I1_mag_mask2.png}} \hfill"
132 "     \subfloat[O1 przefiltrowany]{"
133 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
         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');
```

```matlab
145     fprintf(fid,"%s", Latex);
146     fclose(fid);
147
148
149
150 end
151
152
153
154
155
156
157 function M = MaskCircle(dim, r)
158
159     x = (1:dim(1)) - dim(1)/2;
160     y = (1:dim(2)) - dim(2)/2;
161     [X, Y] = meshgrid(x, y);
162
163     R2 = X.*X + Y.*Y;
164     r2 = r.*r;
165
166     M = R2 < r2;
167     M = double(M);
168
169 end
170
171
172
173 function M = MaskGauss(dim, sigma)
174
175     x = (1:dim(1)) - dim(1)/2;
176     y = (1:dim(2)) - dim(2)/2;
177     [X, Y] = meshgrid(x, y);
178
179     R = sqrt(X.*X + Y.*Y);
180
181     M = normpdf(R, 1,sigma);
182     M = M ./ max(M, [], "all");
183
184 end
```

zad5.m

```matlab
clear all
close all
clc


images = [
%               src                 ,   mask
{"../images/lena_512x512.bmp",    { "circle", 100,  40}, "../zad4/
    lena_circ"  }
{"../images/kodim23_512x512.png", { "circle", 100,  40}, "../zad4/
    kodim_circ"  }
{"../images/lena_512x512.bmp",    { "gauss",  150,  70}, "../zad4/
    lena_gauss"  }
{"../images/kodim23_512x512.png", { "gauss",  150,  70}, "../zad4/
    kodim_gauss"  }
{"../images/lena_512x512.bmp",    { "invcircle", 100,  40}, "../
    zad4/lena_invcirc"  }
{"../images/kodim23_512x512.png", { "invcircle", 100,  40}, "../
    zad4/kodim_invcirc"  }
{"../images/lena_512x512.bmp",    { "invgauss",  150,  70}, "../
    zad4/lena_invgauss"  }
{"../images/kodim23_512x512.png", { "invgauss",  150,  70}, "../
    zad4/kodim_invgauss"  }
]




 


for image = images'
    show_images(image)
end


function show_images(image)


    tiledlayout(2, 5, 'TileSpacing','none');

    src = image{1};
    mask = image{2};
    dest_folder = image{3};


    I1 = imread(src);
    I1 = double(I1)./256;
    I1 = rgb2gray(I1);


    [im_level, ~, L1] = image_fft(I1);
    im_level = rescale(im_level);

    if mask{1} == "circle"
        im_mask1 = MaskCircle(size(I1), mask{2});
        im_mask2 = MaskCircle(size(I1), mask{3});
```

```matlab
48    elseif mask{1} == "gauss"
49        im_mask1 = MaskGauss(size(I1), mask{2});
50        im_mask2 = MaskGauss(size(I1), mask{3});
51    elseif mask{1} == "invcircle"
52        im_mask1 = MaskCircle(size(I1), mask{2})*-1 + 1;
53        im_mask2 = MaskCircle(size(I1), mask{3})*-1 + 1;
54    elseif mask{1} == "invgauss"
55        im_mask1 = MaskGauss(size(I1), mask{2})*-1 + 1;
56        im_mask2 = MaskGauss(size(I1), mask{3})*-1 + 1;
57    end


60    % mask 1
61    nexttile
62    imshow(I1);
63
64    nexttile
65    imshow(im_level,[]);
66
67    nexttile
68    imshow(im_mask1);
69
70    nexttile
71    imshow(im_level .* im_mask1 , []);
72
73    nexttile
74    imshow(image_ifft(L1 .* im_mask1));
75
76    % mask 1
77    nexttile
78    imshow(I1);
79
80    nexttile
81    imshow(im_level,[]);
82
83    nexttile
84    imshow(im_mask2);
85
86    nexttile
87    imshow(im_level .* im_mask2  , []);
88
89    nexttile
90    imshow(image_ifft(L1 .* im_mask2));
91
92    mkdir(dest_folder)
93    imwrite(I1,                      dest_folder + "/I1.png");
94    imwrite(im_level,                dest_folder + "/I1_mag.png"
    );
95    imwrite(im_mask1,                dest_folder + "/I1_mask1.
    png");
96    imwrite(im_level .* im_mask1,    dest_folder + "/
    I1_mag_mask1.png");
97    imwrite(image_ifft(L1 .* im_mask1), dest_folder + "/I1_1.png");
98
99    % imwrite(I1,                      dest_folder + "/I1.png");
100   % imwrite(im_level,                dest_folder + "/I1_mag.
    png");
```

16

```
101     imwrite(im_mask2,                     dest_folder + "/I1_mask2.
        png");
102     imwrite(im_level .* im_mask2,        dest_folder + "/
        I1_mag_mask2.png");
103     imwrite(image_ifft(L1 .* im_mask2), dest_folder + "/I1_2.png");
104
105
106
107
108     Latex = [
109 "\newcommand{\ww}{0.19} "
110 "\begin{figure}[H] "
111 "   \captionsetup[subfloat]{justification=raggedright,
        singlelinecheck=false, position=bottom,labelformat=empty} % "
112 "     "
113 "     \subfloat[O1]{"
114 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
        I1.png}}   \hfill% "
115 "     \subfloat[Widmo mocy]{"
116 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
        I1_mag.png}}   \hfill% "
117 "     \subfloat[Maska 1]{"
118 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
        I1_mask1.png}}   \hfill%"
119 "     \subfloat[Widmo mocy * Maska 1]{"
120 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
        I1_mag_mask1.png}}   \hfill"
121 "     \subfloat[O1 przefiltrowany]{"
122 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
        I1_1.png}}   \hfill"
123 ""
124 "     \subfloat[O1]{"
125 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
        I1.png}}   \hfill% "
126 "     \subfloat[Widmo mocy]{"
127 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
        I1_mag.png}}   \hfill% "
128 "     \subfloat[Maska 2]{"
129 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
        I1_mask2.png}}   \hfill%"
130 "     \subfloat[Widmo mocy * Maska 2]{"
131 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
        I1_mag_mask2.png}} \hfill"
132 "     \subfloat[O1 przefiltrowany]{"
133 "         \includegraphics[width=\ww\linewidth]{" + dest_folder + "/
        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');
```

```matlab
145     fprintf(fid,"%s", Latex);
146     fclose(fid);
147
148
149
150 end
151
152
153
154
155
156
157 function M = MaskCircle(dim, r)
158
159     x = (1:dim(1)) - dim(1)/2;
160     y = (1:dim(2)) - dim(2)/2;
161     [X, Y] = meshgrid(x, y);
162
163     R2 = X.*X + Y.*Y;
164     r2 = r.*r;
165
166     M = R2 < r2;
167     M = double(M);
168
169 end
170
171
172
173 function M = MaskGauss(dim, sigma)
174
175     x = (1:dim(1)) - dim(1)/2;
176     y = (1:dim(2)) - dim(2)/2;
177     [X, Y] = meshgrid(x, y);
178
179     R = sqrt(X.*X + Y.*Y);
180
181     M = normpdf(R, 1,sigma);
182     M = M ./ max(M, [], "all");
183
184 end
```