

# Przetwarzanie Obrazów Cyfrowych

Raport z ćwiczenia 2

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## zadanie 1: identyfikacja układu matrycy Bayer'a

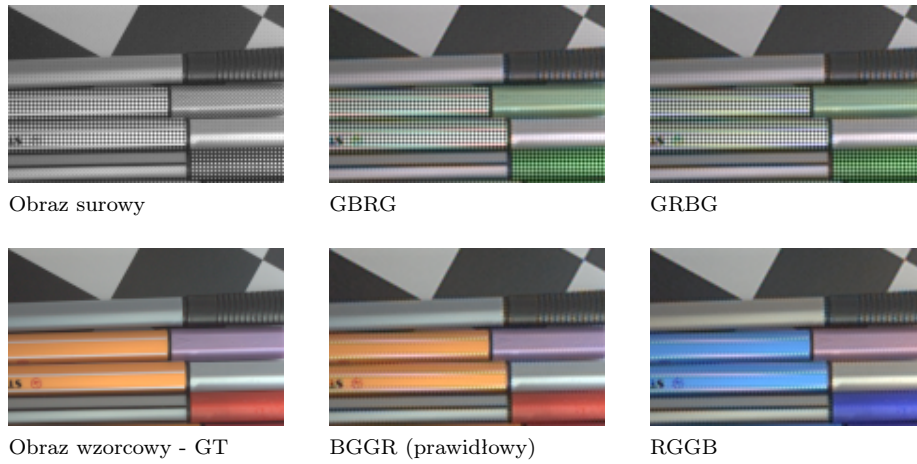


Figure 1: Identyfikacja układu matrycy Bayer'a. w tym przypadku prawidłowy jest układ BGGR

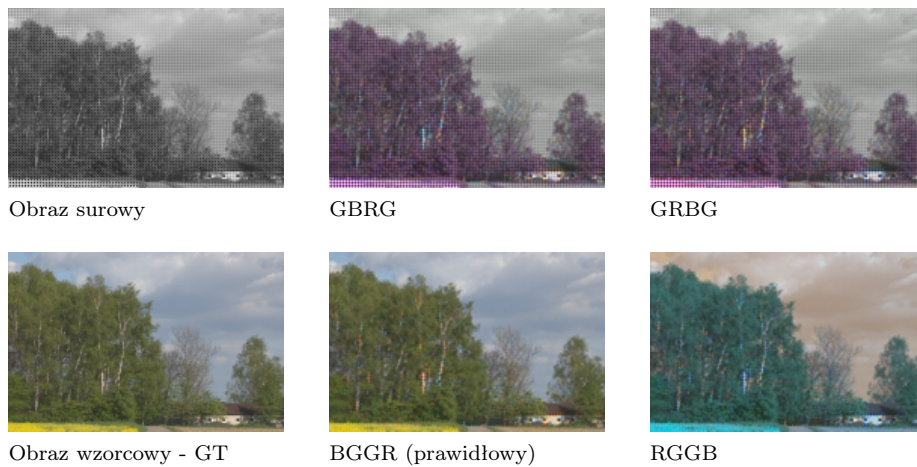


Figure 2: Identyfikacja układu matrycy Bayer'a. w tym przypadku prawidłowy jest układ BGGR

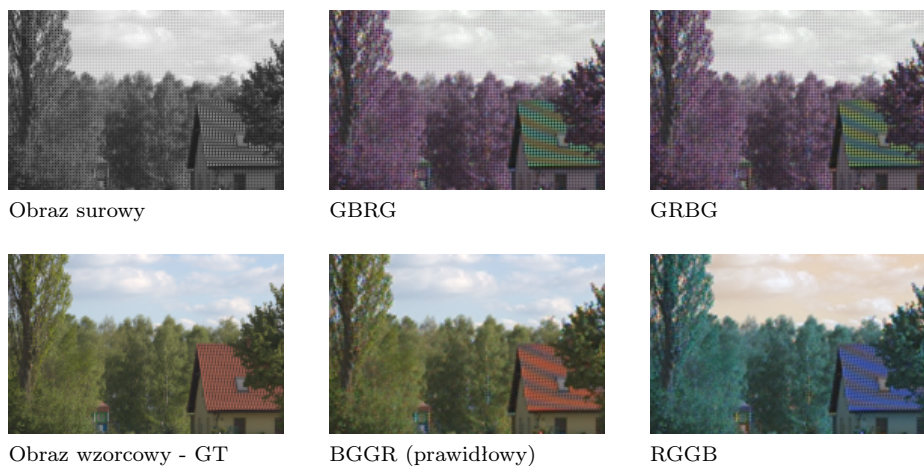


Figure 3: Identyfikacja układu matrycy Bayer'a. w tym przypadku prawidłowy jest układ BGGR

## Zadanie 2: Interpolacja metodą najbliższego sąsiada

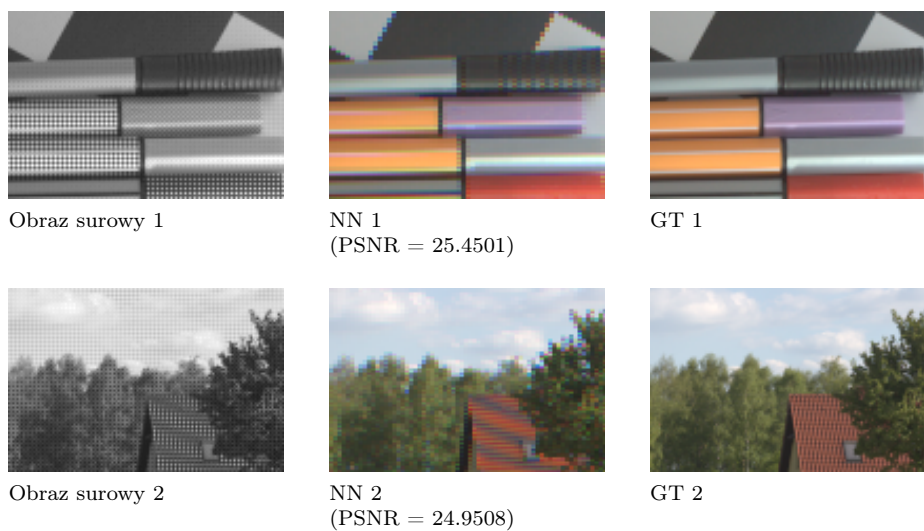


Figure 4: Prezentacja działania interpolacji metodą najbliższego sąsiada

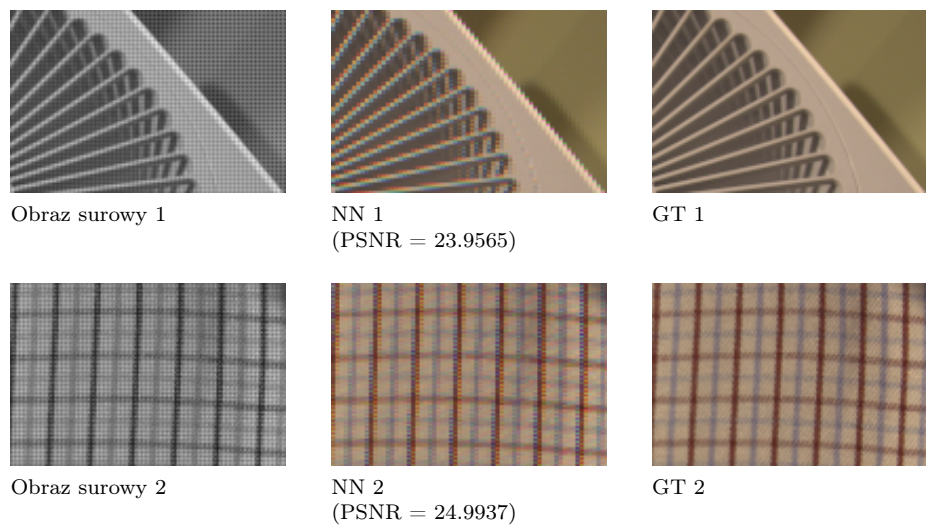


Figure 5: Prezentacja działania interpolacji metodą najbliższego sąsiada

### Zadanie 3: Interpolacja biliniowa

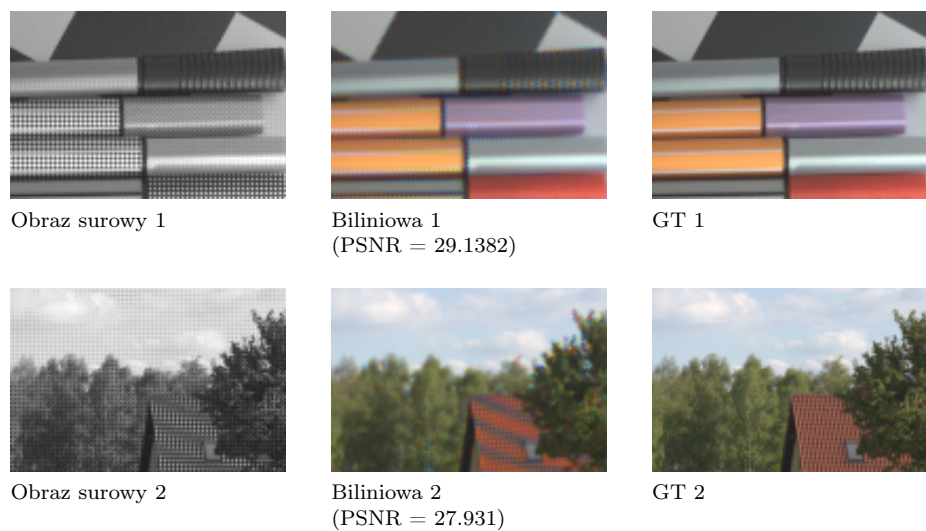
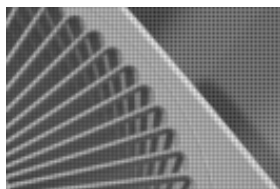


Figure 6: Prezentacja działania interpolacji biliniowej



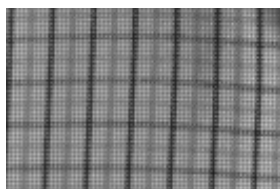
Obraz surowy 1



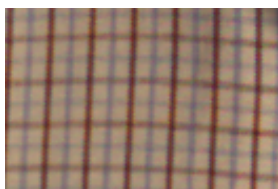
Biliniowa 1  
(PSNR = 29.1615)



GT 1



Obraz surowy 2



Biliniowa 2  
(PSNR = 30.2622)



GT 2

Figure 7: Prezentacja działania interpolacji biliniowej

# Kody Programów

## zad1.m

```
1 clear all
2 close all
3 clc
4
5 imagesList = [...
6 ...%{"sourceCFA",          "sourceRGB",          "folder
7     ", [top, bot, left, right] }; ...
8     { "cienkopisy_srgb_CFA.png" , "cienkopisy_srgb.png" , "img01",
9       [ ] }; ...
10    { "IMG_0016_srgb_CFA.png" , "IMG_0016_srgb.png" , "img02",
11      [ ] }; ...
12    { "IMG_0018_srgb_CFA.png" , "IMG_0018_srgb.png" , "img03",
13      [ ] }; ...
14    { "IMG_0022_srgb_CFA.png" , "IMG_0022_srgb.png" , "img04",
15      [ ] }; ...
16    { "IMG_003_srgb_CFA.png" , "IMG_003_srgb.png" , "img05",
17      [ ] }; ...
18    { "IMG_006_srgb_CFA.png" , "IMG_006_srgb.png" , "img06",
19      [ ] }; ...
20    { "IMG_007_srgb_CFA.png" , "IMG_007_srgb.png" , "img07",
21      [ ] }; ...
22    { "IMG_008_srgb_CFA.png" , "IMG_008_srgb.png" , "img08",
23      [ ] }; ...
24    { "IMG_009_srgb_CFA.png" , "IMG_009_srgb.png" , "img09",
25      [ ] }; ...
26    { "IMG_010_srgb_CFA.png" , "IMG_010_srgb.png" , "img10",
27      [ ] }; ...
28    { "IMG_011_srgb_CFA.png" , "IMG_011_srgb.png" , "img11",
29      [ ] }; ...
30    { "IMG_012_srgb_CFA.png" , "IMG_012_srgb.png" , "img12",
31      [ ] }; ...
32    { "IMG_013_srgb_CFA.png" , "IMG_013_srgb.png" , "img13",
33      [ ] }; ...
34    { "IMG_014_srgb_CFA.png" , "IMG_014_srgb.png" , "img14",
35      [ ] }; ...
36    { "IMG_015_srgb_CFA.png" , "IMG_015_srgb.png" , "img15",
37      [ ] }; ...
38    { "IMG_0440_srgb_CFA.png" , "IMG_0440_srgb.png" , "img16",
39      [ ] }; ...
40    { "IMG_0669_srgb_CFA.png" , "IMG_0669_srgb.png" , "img17",
41      [ ] }; ...
42    { "IMG_0670_srgb_CFA.png" , "IMG_0670_srgb.png" , "img18",
43      [ ] }; ...
44    { "IMG_0674_srgb_CFA.png" , "IMG_0674_srgb.png" , "img19",
45      [ ] }; ...
46    { "IMG_7066_srgb_CFA.png" , "IMG_7066_srgb.png" , "img20",
47      [ ] }; ...
48    { "IMG_7067_srgb_CFA.png" , "IMG_7067_srgb.png" , "img21",
49      [ ] }; ...
50    { "IMG_7068_srgb_CFA.png" , "IMG_7068_srgb.png" , "img22",
51      [ ] }; ...
52    { "IMG_7069_srgb_CFA.png" , "IMG_7069_srgb.png" , "img23",
53      [ ] }; ...
```

```

30     { "IMG_7072_srgb_CFA.png" , "IMG_7072_srgb.png" , "img24" ,
31       [] }; ...
31     { "IMG_7073_srgb_CFA.png" , "IMG_7073_srgb.png" , "img25" ,
32       [] }; ...
32     { "IMG_7074_srgb_CFA.png" , "IMG_7074_srgb.png" , "img26" ,
33       [] }; ...
33     { "IMG_7076_srgb_CFA.png" , "IMG_7076_srgb.png" , "img27" ,
34       [] }; ...
34     { "IMG_7078_srgb_CFA.png" , "IMG_7078_srgb.png" , "img28" ,
35       [] }; ...
35     { "IMG_7084_srgb_CFA.png" , "IMG_7084_srgb.png" , "img29" ,
36       [] }; ...
36     { "IMG_7085_srgb_CFA.png" , "IMG_7085_srgb.png" , "img30" ,
37       [] }; ...
37     { "IMG_7107_srgb_CFA.png" , "IMG_7107_srgb.png" , "img31" ,
38       [] }; ...
38     { "IMG_7109_srgb_CFA.png" , "IMG_7109_srgb.png" , "img32" ,
39       [] }; ...
39     { "IMG_7111_srgb_CFA.png" , "IMG_7111_srgb.png" , "img33" ,
40       [] }; ...
40     { "IMG_7116_srgb_CFA.png" , "IMG_7116_srgb.png" , "img34" ,
41       [] }; ...
41 ]
42
43
44 cropDefault = [.1 .6 .6 .1]
45
46
47
48
49 for imageData = imagesList'
50     disp(imageData)
51
52     inputCFA = append("../Obrazy\Bayer\CFA_sRGB\", imageData{1} )
53     inputRGB = append("../Obrazy\Bayer\GT_sRGB\", imageData{2} )
54     targetFolder = append("../zad1\", imageData{3} )
55
56     crop = imageData{4};
57     if size(crop) == [0 0]
58         crop = cropDefault
59     end
60
61     demosaic_test(inputCFA, inputRGB, targetFolder, crop)
62 break
63 end
64
65
66
67
68
69 function demosaic_test(inputCFA, inputRGB, targetFolder1, crop)
70
71 DISP_ONLY = true
72
73     inputFileNameCFA = inputCFA;
74     inputFileNameRGB = inputRGB;
75     targetFolder = targetFolder1;

```

```

76
77 %inputFileNameCFA = "..\Obrazy\Bayer\CFA_sRGB\
   cienkopisy_srgb_CFA.png"
78 %inputFileNameRGB = "..\Obrazy\Bayer\GT_sRGB\cienkopisy_srgb.
   png"
79
80 %targetFolder = "..\zad1\img1"
81
82 if(DISP_ONLY == false)
83     mkdir(targetFolder)
84 end
85
86 I = imread(inputFileNameCFA);
87 IGT = imread(inputFileNameRGB);
88 I1 = demosaic(I,'gbrg');
89 I2 = demosaic(I,'grbg');
90 I3 = demosaic(I,'bggr');
91 I4 = demosaic(I,'rggb');
92
93
94 %cropImage = @(A) A(20:end-150,200:end-50,:);
95
96 I = cropImage(I, crop);
97 IGT = cropImage(IGT, crop);
98
99 I1 = cropImage(I1, crop);
100 I2 = cropImage(I2, crop);
101 I3 = cropImage(I3, crop);
102 I4 = cropImage(I4, crop);
103
104
105
106 figure()
107 sgtitle(inputCFA)
108 subplot(2,3,1);
109     imshow(I);
110     title("Obraz Surowy")
111 subplot(2,3,4);
112     imshow(IGT);
113     title("Obraz Wzorcowy - GT")
114
115 subplot(2,3,2);
116     imshow(I1);
117     title("gbrg")
118 subplot(2,3,3);
119     imshow(I2);
120     title("grbg")
121 subplot(2,3,5);
122     imshow(I3);
123     title("bggr (prawidlowy)")
124 subplot(2,3,6);
125     imshow(I4);
126     title("rggb")
127
128
129 if(DISP_ONLY == false)
130

```



```
131         imwrite(I, append(targetFolder, "\img1_raw_.png"))
132         imwrite(IGT, append(targetFolder, "\img1_gt_.png"))
133
134         imwrite(I1, append(targetFolder, "\img1_gbrg.png"))
135         imwrite(I2, append(targetFolder, "\img1_grbg.png"))
136         imwrite(I3, append(targetFolder, "\img1_bggr.png"))
137         imwrite(I4, append(targetFolder, "\img1_rggb.png"))
138     end
139 end
```

## zad2.m

```
1 clear all
2 close all
3 clc
4
5
6 sourceImage = "..\Obrazy\Bayer\GT_sRGB\cienkopisy_srgb.png"
7 %sourceImage = "C:\Users\dawid\Desktop\testowe.png"
8
9
10 imagesList = [...
11 ...%{"sourceCFA",          "sourceRGB",          "folder
12     ", [top, bot, left, right] }; ...
13     { "cienkopisy_srgb_CFA.png" , "cienkopisy_srgb.png" , "img01" ,
14       [.1, .1, .1, .1] }; ...
15     { "IMG_0016_srgb_CFA.png" , "IMG_0016_srgb.png" , "img02" ,
16       [.1, .1, .1, .1] }; ...
17     { "IMG_0018_srgb_CFA.png" , "IMG_0018_srgb.png" , "img03" ,
18       [.1, .1, .1, .1] }; ...
19     { "IMG_0022_srgb_CFA.png" , "IMG_0022_srgb.png" , "img04" ,
20       [.1, .1, .1, .1] }; ...
21     { "IMG_003_srgb_CFA.png" , "IMG_003_srgb.png" , "img05" ,
22       [.1, .1, .1, .1] }; ...
23     { "IMG_006_srgb_CFA.png" , "IMG_006_srgb.png" , "img06" ,
24       [.1, .1, .1, .1] }; ...
25     { "IMG_007_srgb_CFA.png" , "IMG_007_srgb.png" , "img07" ,
26       [.1, .1, .1, .1] }; ...
27     { "IMG_008_srgb_CFA.png" , "IMG_008_srgb.png" , "img08" ,
28       [.1, .1, .1, .1] }; ...
29     { "IMG_009_srgb_CFA.png" , "IMG_009_srgb.png" , "img09" ,
30       [.1, .1, .1, .1] }; ...
31     { "IMG_010_srgb_CFA.png" , "IMG_010_srgb.png" , "img10" ,
32       [.1, .1, .1, .1] }; ...
33     { "IMG_011_srgb_CFA.png" , "IMG_011_srgb.png" , "img11" ,
34       [.1, .1, .1, .1] }; ...
35     { "IMG_012_srgb_CFA.png" , "IMG_012_srgb.png" , "img12" ,
36       [.1, .1, .1, .1] }; ...
37     { "IMG_013_srgb_CFA.png" , "IMG_013_srgb.png" , "img13" ,
38       [.1, .1, .1, .1] }; ...
39     { "IMG_014_srgb_CFA.png" , "IMG_014_srgb.png" , "img14" ,
40       [.1, .1, .1, .1] }; ...
41     { "IMG_015_srgb_CFA.png" , "IMG_015_srgb.png" , "img15" ,
42       [.1, .1, .1, .1] }; ...
43     { "IMG_0440_srgb_CFA.png" , "IMG_0440_srgb.png" , "img16" ,
44       [.1, .1, .1, .1] }; ...
45     { "IMG_0669_srgb_CFA.png" , "IMG_0669_srgb.png" , "img17" ,
46       [.1, .1, .1, .1] }; ...
47     { "IMG_0670_srgb_CFA.png" , "IMG_0670_srgb.png" , "img18" ,
48       [.1, .1, .1, .1] }; ...
49     { "IMG_0674_srgb_CFA.png" , "IMG_0674_srgb.png" , "img19" ,
50       [.1, .1, .1, .1] }; ...
51     { "IMG_7066_srgb_CFA.png" , "IMG_7066_srgb.png" , "img20" ,
52       [.1, .1, .1, .1] }; ...
53     { "IMG_7067_srgb_CFA.png" , "IMG_7067_srgb.png" , "img21" ,
54       [.1, .1, .1, .1] }; ...
55     { "IMG_7068_srgb_CFA.png" , "IMG_7068_srgb.png" , "img22" ,
```

```

34     [.1, .1, .1, .1] ]; ...
35     { "IMG_7069_srgb_CFA.png" , "IMG_7069_srgb.png" , "img23",
36     [.1, .1, .1, .1] ]; ...
37     { "IMG_7072_srgb_CFA.png" , "IMG_7072_srgb.png" , "img24",
38     [.1, .1, .1, .1] ]; ...
39     { "IMG_7073_srgb_CFA.png" , "IMG_7073_srgb.png" , "img25",
40     [.1, .1, .1, .1] ]; ...
41     { "IMG_7074_srgb_CFA.png" , "IMG_7074_srgb.png" , "img26",
42     [.1, .1, .1, .1] ]; ...
43     { "IMG_7076_srgb_CFA.png" , "IMG_7076_srgb.png" , "img27",
44     [.1, .1, .1, .1] ]; ...
45     { "IMG_7078_srgb_CFA.png" , "IMG_7078_srgb.png" , "img28",
46     [.1, .1, .1, .1] ]; ...
47     { "IMG_7084_srgb_CFA.png" , "IMG_7084_srgb.png" , "img29",
48     [.1, .1, .1, .1] ]; ...
49     { "IMG_7085_srgb_CFA.png" , "IMG_7085_srgb.png" , "img30",
50     [.1, .1, .1, .1] ]; ...
51     { "IMG_7107_srgb_CFA.png" , "IMG_7107_srgb.png" , "img31",
52     [.1, .1, .1, .1] ]; ...
53     { "IMG_7109_srgb_CFA.png" , "IMG_7109_srgb.png" , "img32",
54     [.1, .1, .1, .1] ]; ...
55     { "IMG_7111_srgb_CFA.png" , "IMG_7111_srgb.png" , "img33",
56     [.1, .1, .1, .1] ]; ...
57     { "IMG_7116_srgb_CFA.png" , "IMG_7116_srgb.png" , "img34",
58     [.1, .1, .1, .1] ]; ...
59 ]
60
61 scale = 3.3
62
63 for imageData = imagesList'
64     disp(imageData)
65
66     inputCFA = append("../Obrazy/Bayer/CFA_sRGB\", imageData{1} )
67     inputRGB = append("../Obrazy/Bayer/GT_sRGB\", imageData{2} )
68
69     targetFolder = append("../zad2\", imageData{3} )
70
71     crop = imageData{4}
72     image_resize_test(inputCFA,inputRGB, targetFolder, crop)
73
74     %break
75
76 end
77
78 function image_resize_test(sourceCFA, sourceRGB , targetFolder,
79     crop)
80
81     I = imread(sourceCFA);

```

```

77     IGT = imread(sourceRGB);
78
79     I = double(I)./255;
80     IGT = double(IGT)./255;
81
82     %I1 = imresize(I,scale,"nearest");
83     %I2 = resize_nearest(I,scale);
84
85
86
87
88
89     %cropImage = @(A) A(20:end-150,200:end-50,:);
90     %crop = [.3 .3 .3 .3]
91     %I = cropImage(I, crop);
92     %I1 = cropImage(I1, crop);
93     %I2 = cropImage(I2, crop);
94
95     I1 = demosaic_nearest(I, "bggr");
96     %I1 = demosaic_bilinear(I, "bggr");
97     psnr_val = psnr(I1, IGT)
98
99     crop = [.1 .6 .6 .1]
100     I = cropImage(I, crop);
101     IGT = cropImage(IGT, crop);
102     I1 = cropImage(I1, crop);
103
104
105
106     figure()
107     sgtitle(sourceCFA)
108     subplot(1,3,1);
109         imshow(I);
110         title("Obraz Surowy")
111     subplot(1,3,2);
112         imshow(I1);
113         title("NN psnr = " + string(psnr_val))
114     subplot(1,3,3);
115         imshow(IGT);
116         title("GT")
117
118
119     max(I1 - IGT,[], 'all')
120
121     mkdir(targetFolder)
122     imwrite(I, append(targetFolder, "\img1_orig.png"))
123     imwrite(I1, append(targetFolder, "\img1_NN_.png"))
124     imwrite(IGT, append(targetFolder, "\img1_reff.png"))
125
126     fid = fopen(append(targetFolder, "\psnr.tex"),'w');
127     fprintf(fid, string(psnr_val));
128     fclose(fid);
129
130 end

```

### zad3.m

```
1 clear all
2 close all
3 clc
4
5
6 sourceImage = "..\Obrazy\Bayer\GT_sRGB\cienkopisy_srgb.png"
7 %sourceImage = "C:\Users\dawid\Desktop\testowe.png"
8
9
10 imagesList = [...
11 ...%{"sourceCFA",          "sourceRGB",          "folder
12     ", [top, bot, left, right] }; ...
13     { "cienkopisy_srgb_CFA.png" , "cienkopisy_srgb.png" , "img01" ,
14       [.1, .1, .1, .1] }; ...
15     { "IMG_0016_srgb_CFA.png" , "IMG_0016_srgb.png" , "img02" ,
16       [.1, .1, .1, .1] }; ...
17     { "IMG_0018_srgb_CFA.png" , "IMG_0018_srgb.png" , "img03" ,
18       [.1, .1, .1, .1] }; ...
19     { "IMG_0022_srgb_CFA.png" , "IMG_0022_srgb.png" , "img04" ,
20       [.1, .1, .1, .1] }; ...
21     { "IMG_003_srgb_CFA.png" , "IMG_003_srgb.png" , "img05" ,
22       [.1, .1, .1, .1] }; ...
23     { "IMG_006_srgb_CFA.png" , "IMG_006_srgb.png" , "img06" ,
24       [.1, .1, .1, .1] }; ...
25     { "IMG_007_srgb_CFA.png" , "IMG_007_srgb.png" , "img07" ,
26       [.1, .1, .1, .1] }; ...
27     { "IMG_008_srgb_CFA.png" , "IMG_008_srgb.png" , "img08" ,
28       [.1, .1, .1, .1] }; ...
29     { "IMG_009_srgb_CFA.png" , "IMG_009_srgb.png" , "img09" ,
30       [.1, .1, .1, .1] }; ...
31     { "IMG_010_srgb_CFA.png" , "IMG_010_srgb.png" , "img10" ,
32       [.1, .1, .1, .1] }; ...
33     { "IMG_011_srgb_CFA.png" , "IMG_011_srgb.png" , "img11" ,
34       [.1, .1, .1, .1] }; ...
35     { "IMG_012_srgb_CFA.png" , "IMG_012_srgb.png" , "img12" ,
36       [.1, .1, .1, .1] }; ...
37     { "IMG_013_srgb_CFA.png" , "IMG_013_srgb.png" , "img13" ,
38       [.1, .1, .1, .1] }; ...
39     { "IMG_014_srgb_CFA.png" , "IMG_014_srgb.png" , "img14" ,
40       [.1, .1, .1, .1] }; ...
41     { "IMG_015_srgb_CFA.png" , "IMG_015_srgb.png" , "img15" ,
42       [.1, .1, .1, .1] }; ...
43     { "IMG_0440_srgb_CFA.png" , "IMG_0440_srgb.png" , "img16" ,
44       [.1, .1, .1, .1] }; ...
45     { "IMG_0669_srgb_CFA.png" , "IMG_0669_srgb.png" , "img17" ,
46       [.1, .1, .1, .1] }; ...
47     { "IMG_0670_srgb_CFA.png" , "IMG_0670_srgb.png" , "img18" ,
48       [.1, .1, .1, .1] }; ...
49     { "IMG_0674_srgb_CFA.png" , "IMG_0674_srgb.png" , "img19" ,
50       [.1, .1, .1, .1] }; ...
51     { "IMG_7066_srgb_CFA.png" , "IMG_7066_srgb.png" , "img20" ,
52       [.1, .1, .1, .1] }; ...
53     { "IMG_7067_srgb_CFA.png" , "IMG_7067_srgb.png" , "img21" ,
54       [.1, .1, .1, .1] }; ...
55     { "IMG_7068_srgb_CFA.png" , "IMG_7068_srgb.png" , "img22" ,
```

```

34     [.1, .1, .1, .1] ]; ...
35     { "IMG_7069_srgb_CFA.png" , "IMG_7069_srgb.png" , "img23",
36     [.1, .1, .1, .1] ]; ...
37     { "IMG_7072_srgb_CFA.png" , "IMG_7072_srgb.png" , "img24",
38     [.1, .1, .1, .1] ]; ...
39     { "IMG_7073_srgb_CFA.png" , "IMG_7073_srgb.png" , "img25",
40     [.1, .1, .1, .1] ]; ...
41     { "IMG_7074_srgb_CFA.png" , "IMG_7074_srgb.png" , "img26",
42     [.1, .1, .1, .1] ]; ...
43     { "IMG_7076_srgb_CFA.png" , "IMG_7076_srgb.png" , "img27",
44     [.1, .1, .1, .1] ]; ...
45     { "IMG_7078_srgb_CFA.png" , "IMG_7078_srgb.png" , "img28",
46     [.1, .1, .1, .1] ]; ...
47     { "IMG_7084_srgb_CFA.png" , "IMG_7084_srgb.png" , "img29",
48     [.1, .1, .1, .1] ]; ...
49     { "IMG_7085_srgb_CFA.png" , "IMG_7085_srgb.png" , "img30",
50     [.1, .1, .1, .1] ]; ...
51     { "IMG_7107_srgb_CFA.png" , "IMG_7107_srgb.png" , "img31",
52     [.1, .1, .1, .1] ]; ...
53     { "IMG_7109_srgb_CFA.png" , "IMG_7109_srgb.png" , "img32",
54     [.1, .1, .1, .1] ]; ...
55     { "IMG_7111_srgb_CFA.png" , "IMG_7111_srgb.png" , "img33",
56     [.1, .1, .1, .1] ]; ...
57     { "IMG_7116_srgb_CFA.png" , "IMG_7116_srgb.png" , "img34",
58     [.1, .1, .1, .1] ]; ...
59 ]
60
61 scale = 3.3
62
63 for imageData = imagesList'
64     disp(imageData)
65
66     inputCFA = append("../Obrazy/Bayer/CFA_sRGB\", imageData{1} )
67     inputRGB = append("../Obrazy/Bayer/GT_sRGB\", imageData{2} )
68
69     targetFolder = append("../zad3\", imageData{3} )
70
71     crop = imageData{4}
72     image_resize_test(inputCFA,inputRGB, targetFolder, crop)
73
74     %break
75
76 end
77
78 function image_resize_test(sourceCFA, sourceRGB , targetFolder,
79     crop)
80
81     I = imread(sourceCFA);

```

```

77     IGT = imread(sourceRGB);
78
79     I = double(I)./255;
80     IGT = double(IGT)./255;
81
82     %I1 = demosaic_nearest(I, "bggr");
83     I1 = demosaic_bilinear(I, "bggr");
84     psnr_val = psnr(I1, IGT)
85
86     crop = [.1 .6 .6 .1]
87     I = cropImage(I, crop);
88     IGT = cropImage(IGT, crop);
89     I1 = cropImage(I1, crop);
90
91
92
93     figure()
94     sgttitle(sourceCFA)
95     subplot(1,3,1);
96         imshow(I);
97         title("Obraz Surowy")
98     subplot(1,3,2);
99         imshow(I1);
100        title("Bi psnr = " + string(psnr_val))
101    subplot(1,3,3);
102        imshow(IGT);
103        title("GT")
104
105
106    max(I1 - IGT,[], 'all')
107
108    mkdir(targetFolder)
109    imwrite(I, append(targetFolder, "\img1_orig.png"))
110    imwrite(I1, append(targetFolder, "\img1_NN_.png"))
111    imwrite(IGT, append(targetFolder, "\img1_reff.png"))
112
113    fid = fopen(append(targetFolder, "\psnr.tex"),'w');
114    fprintf(fid, string(psnr_val));
115    fclose(fid);
116
117 end

```

## demosaic\_nearest.m

```
1 function A1 = demosaic_nearest(A, color)
2
3     color = convertStringsToChars(color)
4     colorGrid = [ color(1), color(2); color(3), color(4) ]
5
6     colorGrid_r = colorGrid == 'r' | colorGrid == 'R';
7     colorGrid_g = colorGrid == 'g' | colorGrid == 'G';
8     colorGrid_b = colorGrid == 'b' | colorGrid == 'B';
9
10    A1 = []
11    A1(:, :, 1) = demosaic_nearest_color(A, colorGrid_r);
12    A1(:, :, 2) = demosaic_nearest_color(A, colorGrid_g);
13    A1(:, :, 3) = demosaic_nearest_color(A, colorGrid_b);
14
15
16 end
17
18
19 function A1 = demosaic_nearest_color(A, colorGrid)
20
21     A1 = zeros(size(A));
22
23     for pos_x = 1:2:size(A,1)
24         for pos_y = 1:2:size(A,2)
25
26             if sum(colorGrid, 'all') == 1
27                 val = colorGrid .* A(pos_x:pos_x+1, pos_y:pos_y+1);
28                 A1(pos_x:pos_x+1, pos_y:pos_y+1) = [1 1; 1 1] * max
29                 (val, [], 'all');
30             end
31             if sum(colorGrid, 'all') == 2
32                 val = colorGrid .* A(pos_x:pos_x+1, pos_y:pos_y+1);
33                 A1(pos_x:pos_x+1, pos_y:pos_y+1) = val + flip(val
34                 ,2);
35             end
36         end
37     end
38 end
```



## demosaic\_bilinear.m

```
1 function A1 = demosaic_bilinear(A, color)
2
3     color = "bggr";
4
5     s = size(A);
6
7     A = [ A(1:2 ,:); A; A(end-1:end ,:) ];
8     A = [ A(:,1:2), A, A(:,end-1:end) ];
9
10    A_r = zeros(s);
11    A_g = zeros(s);
12    A_b = zeros(s);
13
14
15    % red
16    indexOffset = 2;
17    for x = 1:2:s(1)
18        for y = 1:2:s(2)
19
20            % a1 | a2
21            % ----|----
22            % a3 | a4
23
24            a1 = A( x-1 + indexOffset, y-1 + indexOffset );
25            a2 = A( x+1 + indexOffset, y-1 + indexOffset );
26            a3 = A( x-1 + indexOffset, y+1 + indexOffset );
27            a4 = A( x+1 + indexOffset, y+1 + indexOffset );
28
29            A_r(x ,y ) = 1/4 * (a1 + a2 + a3 + a4);
30            A_r(x+1,y ) = 1/2 * (a2 + a4);
31            A_r(x ,y+1) = 1/2 * (a3 + a4);
32            A_r(x+1,y+1) = 1 * (a4);
33
34        end
35    end
36
37
38    % blue
39    indexOffset = 3;
40    for x = 1:2:s(1)
41        for y = 1:2:s(2)
42
43            % a1 | a2
44            % ----|----
45            % a3 | a4
46
47            a1 = A( x-1 + indexOffset, y-1 + indexOffset );
48            a2 = A( x+1 + indexOffset, y-1 + indexOffset );
49            a3 = A( x-1 + indexOffset, y+1 + indexOffset );
50            a4 = A( x+1 + indexOffset, y+1 + indexOffset );
51
52            A_b(x ,y ) = 1 * (a1);
53            A_b(x+1,y ) = 1/2 * (a1 + a2);
54            A_b(x ,y+1) = 1/2 * (a1 + a3);
55            A_b(x+1,y+1) = 1/4 * (a1 + a2 + a3 + a4);
```

```

56
57     end
58 end
59
60 % green
61 indexOffset = 2;
62 indexOffset2 = 2;
63 for x = 1:2:s(1)
64     for y = 1:2:s(2)
65
66         %      | a1 |
67         % a2 | XX | a3
68         %      | a4 | YY | a5
69         %      |      | a6
70
71         a1 = A( x      + indexOffset, y-1 + indexOffset );
72         a2 = A( x-1 + indexOffset, y      + indexOffset );
73         a3 = A( x+1 + indexOffset, y      + indexOffset );
74         a4 = A( x      + indexOffset, y+1 + indexOffset );
75
76         a5 = A( x+2 + indexOffset, y+1 + indexOffset );
77         a6 = A( x+1 + indexOffset, y+2 + indexOffset );
78
79         A_g(x      ,y      ) = 1/4 * (a1 + a2 + a3 + a4);
80         A_g(x+1,y      ) = 1      * (a3);
81         A_g(x      ,y+1) = 1      * (a4);
82         A_g(x+1,y+1) = 1/4 * (a3 + a4 + a5 + a6);
83
84     end
85 end
86
87
88 A1 = zeros([s , 3]);
89 A1(:,:,1) = A_r;
90 A1(:,:,3) = A_b;
91 A1(:,:,2) = A_g;
92
93 end

```

## cropImage.m

```
1 function img = cropImage(image, crop)
2
3     w = size(image,2);
4     h = size(image,1);
5
6     top    = round(crop(1) * h);
7     bot    = round(crop(2) * h);
8     left   = round(crop(3) * w);
9     right  = round(crop(4) * w);
10
11     if top <= 0
12         top = 1;
13     end
14
15     if left <= 0
16         left = 1;
17     end
18
19     if bot < 0
20         bot = 0;
21     end
22
23     if right < 0
24         right = 0;
25     end
26
27
28
29     img = image( top:end-bot, left:end-right, : );
30
31 end
```