Computer Vision I

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4. Juli 2018

1 Gaussian Pyramids

```matlab
boats = im2double(imread('boats.tif'));

G = cell(1,6);
S = cell(1,6);
G{1} = boats;
S{1} = boats;

figure;

subplot(2,6,1);
imshow(G{1});
title({"Subsampled by 1","with Gaussian Blur"});
subplot(2,6,7);
imshow(S{1});
title({"Subsampled by 1","without Gaussian Blur"});


for c=2:6
    blurred = imgaussfilt(G{c-1});
    G{c} = blurred(1:2:end, 1:2:end);
    S{c} = S{c-1}(1:2:end, 1:2:end);
    subplot(2,6,c);
    imshow(G{c});
    title({"Subsampled by " + 2^(c-1),"with Gaussian Blur"});
    subplot(2,6,c+6);
    imshow(S{c});
    title({"Subsampled by " + 2^(c-1),"without Gaussian Blur"});
end
```

```matlab
30    print ( " sh05ex01 . eps " , "−depsc " ) ;
```


Abbildung 1: Output of the matlab script

2 Laplacian Pyramids

2.1

```matlab
1   % Part 1
2   boats = im2double ( imread ( 'boats . tif ' ) ) ;
3   G = cell ( 1 , 6 ) ;
4   G{1} = boats ;
5   for c=2:6
6       blurred = imgaussfilt (G{c−1}) ;
7       G{c} = blurred ( 1:2: end , 1:2: end ) ;
8       S{c} = S{c−1}(1:2: end , 1:2: end ) ;
9   end
10
11  Ge = cell ( 1 , 5 ) ;
12  for c=1:5
13      Ge{c} = imresize (G{c+1}, 2 ) ;
14  end
15
16  L = cell ( 1 , 6 ) ;
17  L{6} = G{6};
18  for c=1:5
19      L{c} = G{c} − Ge{c };
20  end
```

```
21
22  figure;
23  for  c=1:6
24      subplot(6, 3, (c−1)*3+1);
25      imshow(G{7−c});
26      title("G("+ (7−c) + ")");
27      if  c > 1
28          subplot(6, 3, (c−1)*3+2);
29          imshow(Ge{7−c});
30          title("G_e("+ (7−c) + ")");
31      end
32      subplot(6, 3, (c−1)*3+3);
33      imshow(L{7−c});
34      title("L("+ (7−c) + ")");
35  end
36  print("sh05ex02_1.eps", "−depsc");
```
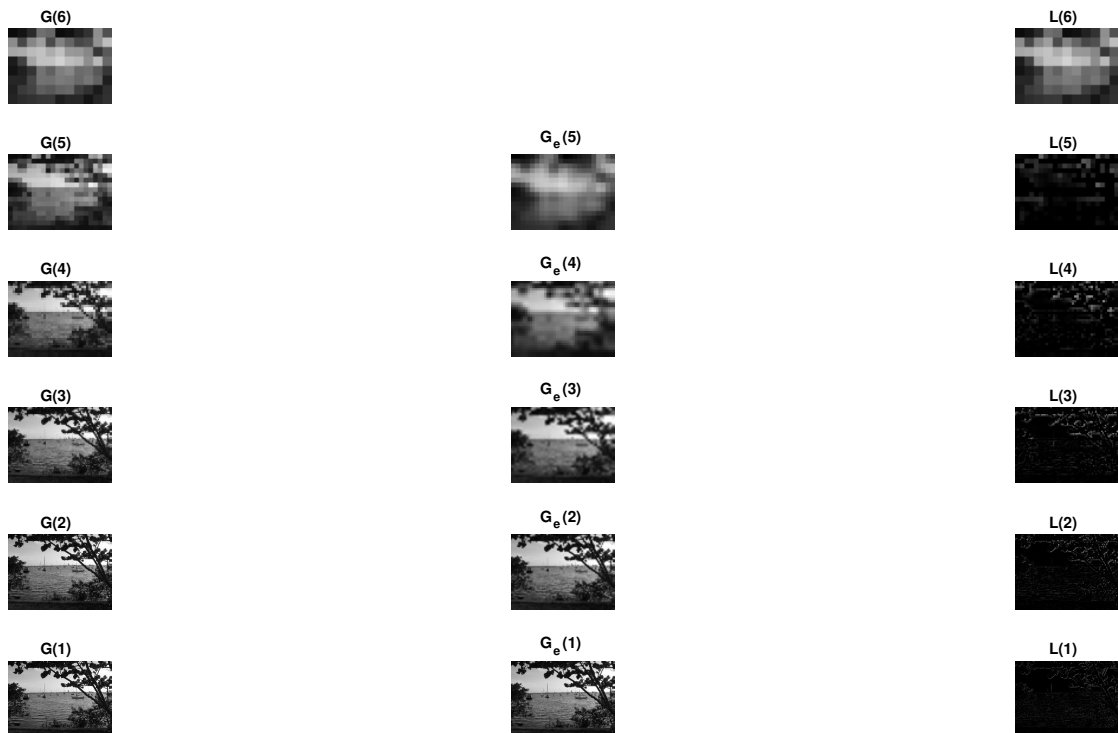

Abbildung 2: Output of the matlab script

2.2

```
38  % Part 2
```

```matlab
39  E = cell(1, 5);
40  Gr = cell(1,5);
41  E{5} = imresize(L{6}, 2);
42  for c = 1:5
43      Gr{6-c} = E{6-c} + L{6-c};
44      if(c < 5)
45          E{5-c} = imresize(Gr{6-c}, 2);
46      end
47  end
48
49
50  figure;
51  for c=1:6
52      subplot(6, 3, (c-1)*3+1);
53      imshow(L{7-c});
54      title("L("+ (7-c) + ")");
55      if c > 1
56          subplot(6, 3, (c-1)*3+2);
57          imshow(E{7-c});
58          title("E("+ (7-c) + ")");
59          subplot(6, 3, (c-1)*3+3);
60          imshow(Gr{7-c});
61          title("G_r("+ (7-c) + ")");
62      end
63  end
64  print("sh05ex02_2.eps", "-depsc");
```

Abbildung 3: Output of the matlab script

2.3

```matlab
66  % Part 3
67  L_thresh = cell(1,6);
68  L_thresh{6} = L{6};
69  for c = 1:5
70      m = max(max(L{c}));
71      t = m * 0.2;
72      L_thresh{c} = L{c};
73      L_thresh{c}(find(abs(L_thresh{c}) < t)) = 0;
74  end
75
76  E_reduced = cell(1, 5);
77  Gr_reduced = cell(1,5);
78  E_reduced{5} = imresize(L_thresh{6}, 2);
79  for c = 1:5
80      Gr_reduced{6-c} = E_reduced{6-c} + L_thresh{6-c};
81      if(c < 5)
82          E_reduced{5-c} = imresize(Gr_reduced{6-c}, 2);
83      end
```

```
84  end
85
86  figure;
87  for  c=1:6
88      subplot(6, 3, (c-1)*3+1);
89      imshow(L{7-c});
90      title("L("+ (7-c) + ")");
91      if  c > 1
92          subplot(6, 3, (c-1)*3+2);
93          imshow(E_reduced{7-c});
94          title("E("+ (7-c) + ") with Threshold");
95          subplot(6, 3, (c-1)*3+3);
96          imshow(Gr_reduced{7-c});
97          title("G_r("+ (7-c) + ") with Threshold");
98      end
99  end
100 print("sh05ex02_3_1.eps", "-depsc");
101
102 figure();
103 subplot(1,2,1);
104 imshow(Gr{1});
105 subplot(1,2,2);
106 imshow(Gr_reduced{1});
107 print("sh05ex02_3_2.eps", "-depsc");
```
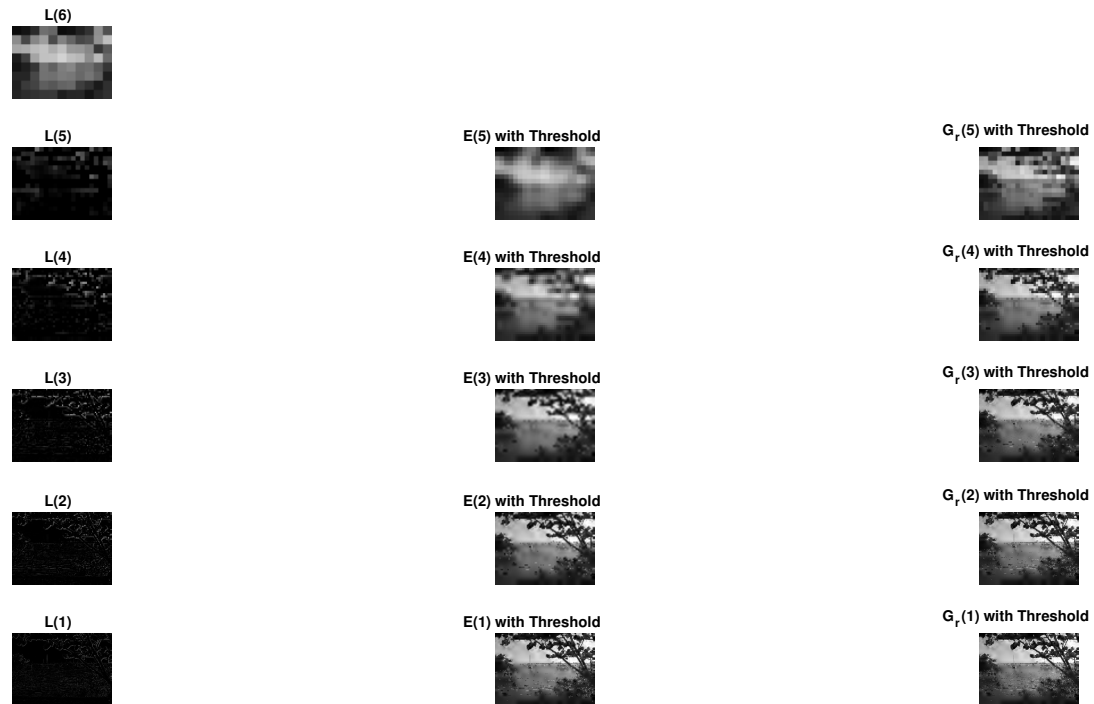
Abbildung 4: Output of the matlab script

Abbildung 5: Difference between the reconstructed and the original image

2.4

```
109  % Part 4
110  x = 0:0.05:0.3;
111  y = zeros(size(x));
112
113  for l=1:length(x)
114      L_thresh = cell(1,6);
```

```matlab
115        L_thresh{6} = L{6};
116        for c = 1:5
117            m = max(max(L{c}));
118            t = m * x(l);
119            L_thresh{c} = L{c};
120            L_thresh{c}(find(abs(L_thresh{c}) < t)) = 0;
121        end
122
123        E_reduced = cell(1, 5);
124        Gr_reduced = cell(1,5);
125        E_reduced{5} = imresize(L_thresh{6}, 2);
126        for c = 1:5
127            Gr_reduced{6-c} = E_reduced{6-c} + L_thresh{6-c};
128            if(c < 5)
129                E_reduced{5-c} = imresize(Gr_reduced{6-c}, 2);
130            end
131        end
132        mse = sum(sum((G{1} - Gr_reduced{1}).^2)) / (size(G{1},1) *
               size(G{1},2));
133        y(l) = mse;
134    end
135
136    figure;
137    plot(x, y);
138    xlabel("\lambda");
139    ylabel("MSE");
140    title("Mean square error as a function of the threshold");
141    print("sh05ex02_4.eps", "-depsc");
```
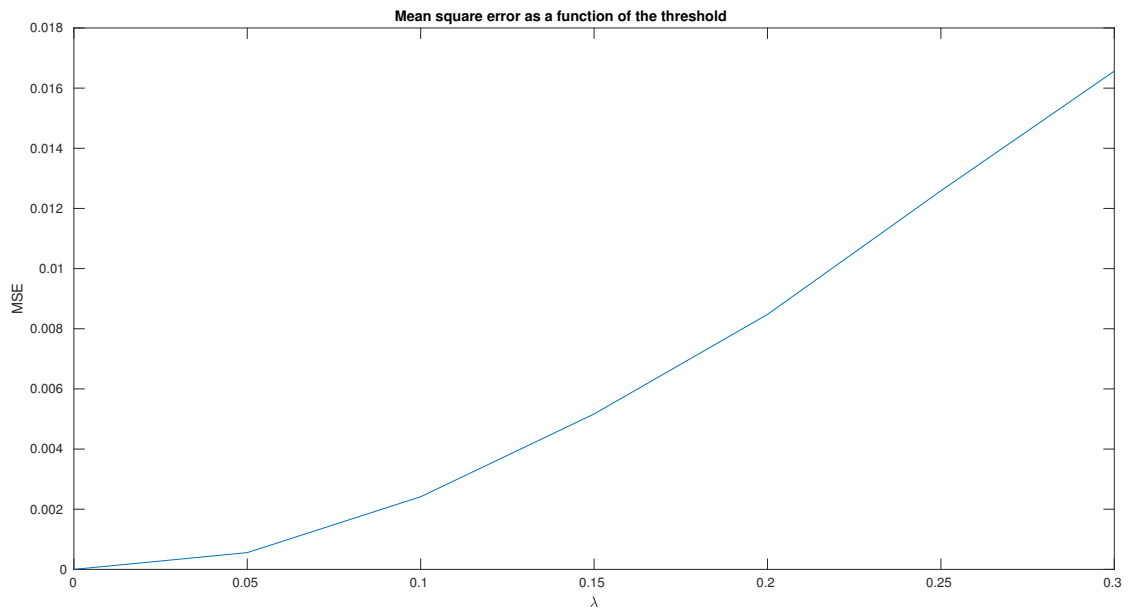
Abbildung 6: Output of the matlab script