

Zpracování signálů

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1 Zadání

Vypočítejte odezvu systému $\mathbf{y}[\mathbf{n}]$ na vstupní diskrétní posloupnost $\mathbf{x}[\mathbf{n}]$, když znáte impulsní odezvu systému $\mathbf{h}[\mathbf{n}]$ (tzv. konvoluční jádro).

Uvažujte sekvenci:

$$x = [0, 1, 2, 3, 2, 1]$$

Uživatel si vybere z těchto impulzních odezev $\mathbf{h}[\mathbf{k}]$:

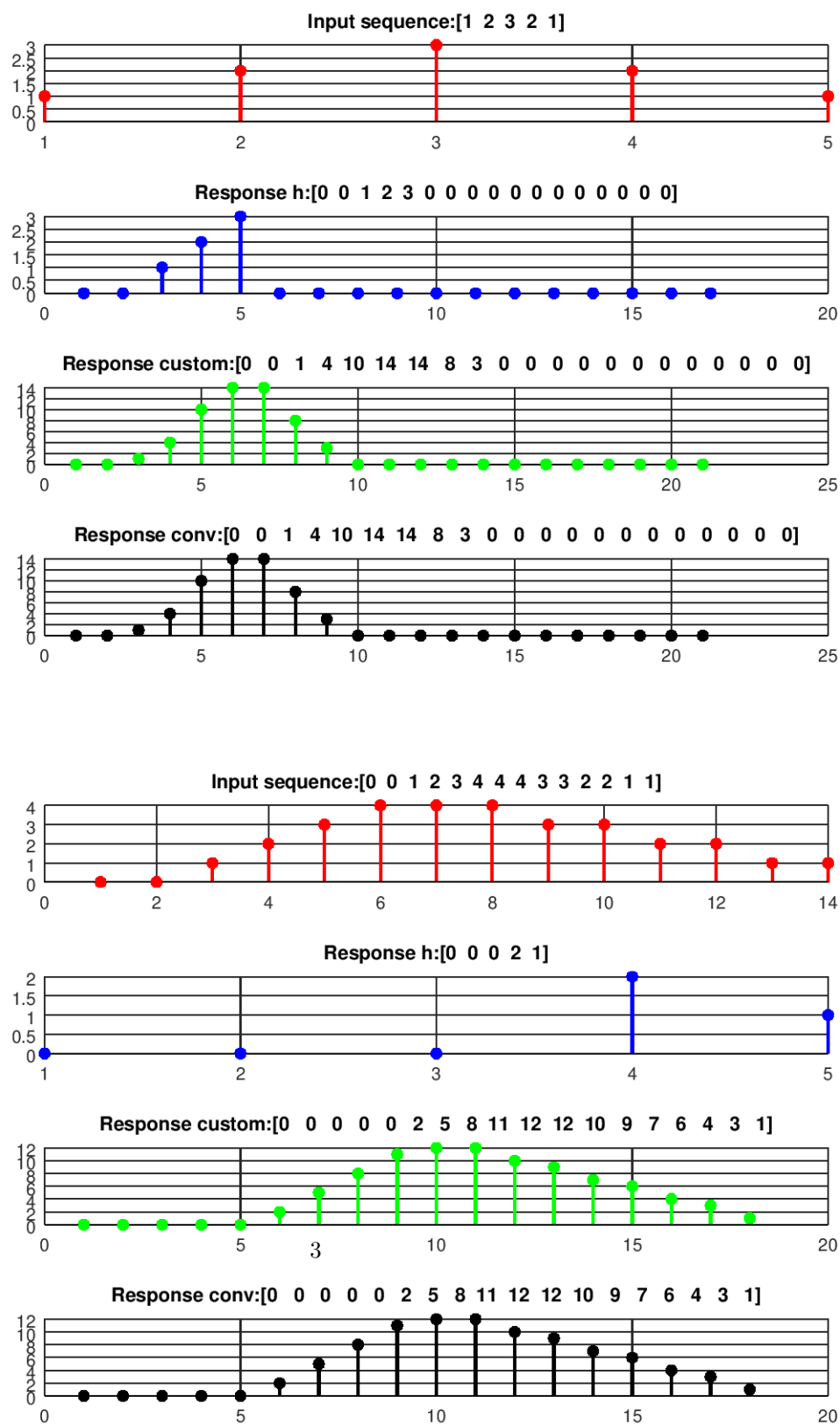
- $\mathbf{h} = [1]$
- $\mathbf{h} = [0, 0, 0, 0, 1]$
- $\mathbf{h} = [-1, 1]$
- $\mathbf{h} = [0, 0, 0, 0, -1, 1]$
- $\mathbf{h} = [3]$
- $\mathbf{h} = [0, 0, 0, 0, 3]$
- $\mathbf{h} = [0, 0, 1, 2, 3]$

Naprogramujte vlastní algoritmus výpočtu diskrétní lineární konvoluce a ověřte s vestavěnou funkcí matlabu „conv“.

Použijte tyto sekvence:

- $\mathbf{x} = [0 \ 0 \ 1 \ 2 \ 3 \ 4 \ 4 \ 4 \ 3 \ 3 \ 2 \ 2 \ 1 \ 1]$
- $\mathbf{h} = [0 \ 0 \ 0 \ 2 \ 1]$

2 Vypracování



3 Kód

../code/convolution.m

```
1 clear all;
2
3 x = [0,0,1,2,3,4,4,4,3,3,2,2,1,1];%druhy ukol
4 x_xmpl = [1,2,3,2,1] %prvni ukol
5 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
6 h_xmpl = [0,0,1,2,3,0,0,0,0,0,0,0,0,0,0,0]; %prvni ukol
7 h = [0,0,0,2,1] %druhy ukol
8 h1 = [1];
9 h2 = [0, 0, 0, 1];
10 h3 = [-1, 1 ];
11 h4 = [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, -1, 1 ];
12 h5 = [3];
13 h6 = [0, 0, 0, 3];
14 h7 = [0, 0, -2, -1, 0];
15
16
17 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
18 y_xmpl = conv(x_xmpl,h_xmpl); %prvni ukol
19 y = conv(x,h); %druhy ukol
20
21 y1 = conv(x,h1);
22 y2 = conv(x,h2);
23 y3 = conv(x,h3);
24 y4 = conv(x,h4);
25 y5 = conv(x,h5);
26 y6 = conv(x,h6);
27 y7 = conv(x,h7);
28 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
29 function y = con(x_con,h_con)
30     m = length(x_con);
31     n = length(h_con);
32
33     x_con=[x_con,zeros(1,n)];
34     h_con=[h_con,zeros(1,m)];
35
36     y=zeros(1,m+n-1);
37
38     for i=1:m+n-1
39         y(i)=0;
40         for j=1:m+n-1
41             if(j<i+1)
42                 y(i)=y(i)+x_con(j)*h_con(i-j+1);
43             end
44         end
45     end
46 end
```

```

47 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
48 function p = plt(inp_seq,conv_kernel,conv_orig)
49     p = con(inp_seq,conv_kernel);
50     subplot(411);
51     stem(inp_seq,'filled','r','LineWidth',1.5);
52     grid on;
53     title(strcat('Input_sequence: ',
54         ' ',num2str(inp_seq),''));
55
56     subplot(412);
57     stem(conv_kernel,'filled','b','LineWidth',1.5);
58     grid on;
59     title(strcat('Response_h: ',
60         ' ',num2str(conv_kernel),''));
61
62     subplot(413);
63     stem(p,'filled','g','LineWidth',1.5);
64     grid on;
65     title(strcat('Response_custom: ',
66         ' ',num2str(p),''));
67
68     subplot(414);
69     stem(conv_orig,'filled','k','LineWidth',1.5);
70     grid on;
71     title(strcat('Response_conv: ',
72         ' ',num2str(conv_orig),''));
73
74 end
75
76 figure(1);
77 plt(x_xmpl,h_xmpl,y_xmpl);
78 figure(2);
79 plt(x,h,y)
80
81 %Plot s mym algoritmem
82 #{
83     subplot(711);
84     plot(con(x,h1),'-o-');
85     grid on;
86     %
87     subplot(712);
88     plot(con(x,h2),'-o-');
89     grid on;
90     %
91     subplot(713);
92     plot(con(x,h3),'-o-');
93     grid on;
94     %
95     subplot(714);
96     plot(con(x,h4),'-o-');
97     grid on;

```

```

94 %
95 subplot(715);
96 plot(con(x,h5),'-o-');
97 grid on;
98 %
99 subplot(716);
100 plot(con(x,h6),'-o-');
101 grid on;
102 %
103 subplot(717);
104 plot(con(x,h7),'-o-');
105 grid on;
106 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
107 figure(2);
108 %Plot s conv funkci
109 subplot(711);
110 plot(y1,'-o-');
111 grid on;
112 %
113 subplot(712);
114 plot(y2,'-o-');
115 grid on;
116 %
117 subplot(713);
118 plot(y3,'-o-');
119 grid on;
120 %
121 subplot(714);
122 plot(y4,'-o-');
123 grid on;
124 %
125 subplot(715);
126 plot(y5,'-o-');
127 grid on;
128 %
129 subplot(716);
130 plot(y6,'-o-');
131 grid on;
132 %
133 subplot(717);
134 plot(y7,'-o-');
135 grid on;
136 #}

```

[Odkaz na kompetní repozitář se cvičeními](#)