

CARNEGIE MELLON UNIVERSITY  
APPLIED STOCHASTIC PROCESSES  
(COURSE 18-751)  
HOMEWORK 13

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## 2.b

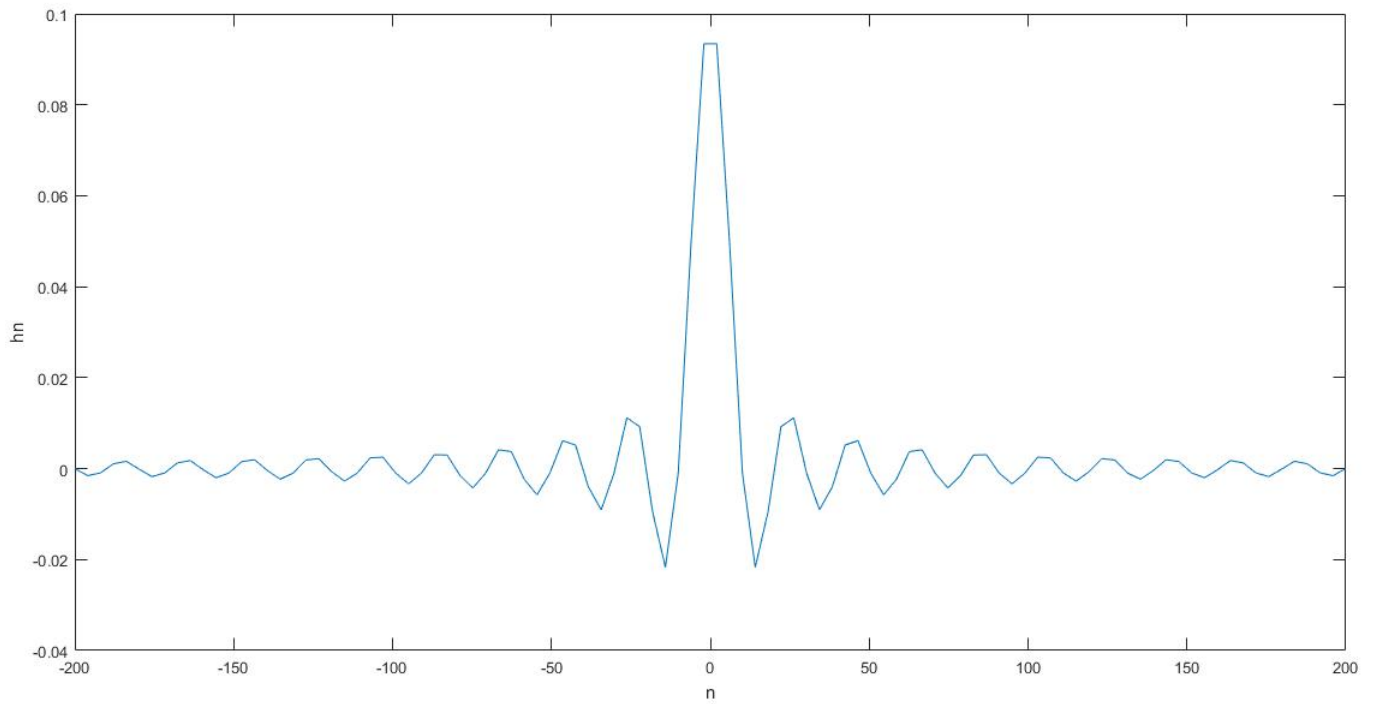


Figure 1:  $h_n$

## 2.c

Comment on the apparent bandwidth of the system in all three cases  
The bandwidth increases as we consider more and more parts of the impulse response(filter) i.e as  $c$  increases.

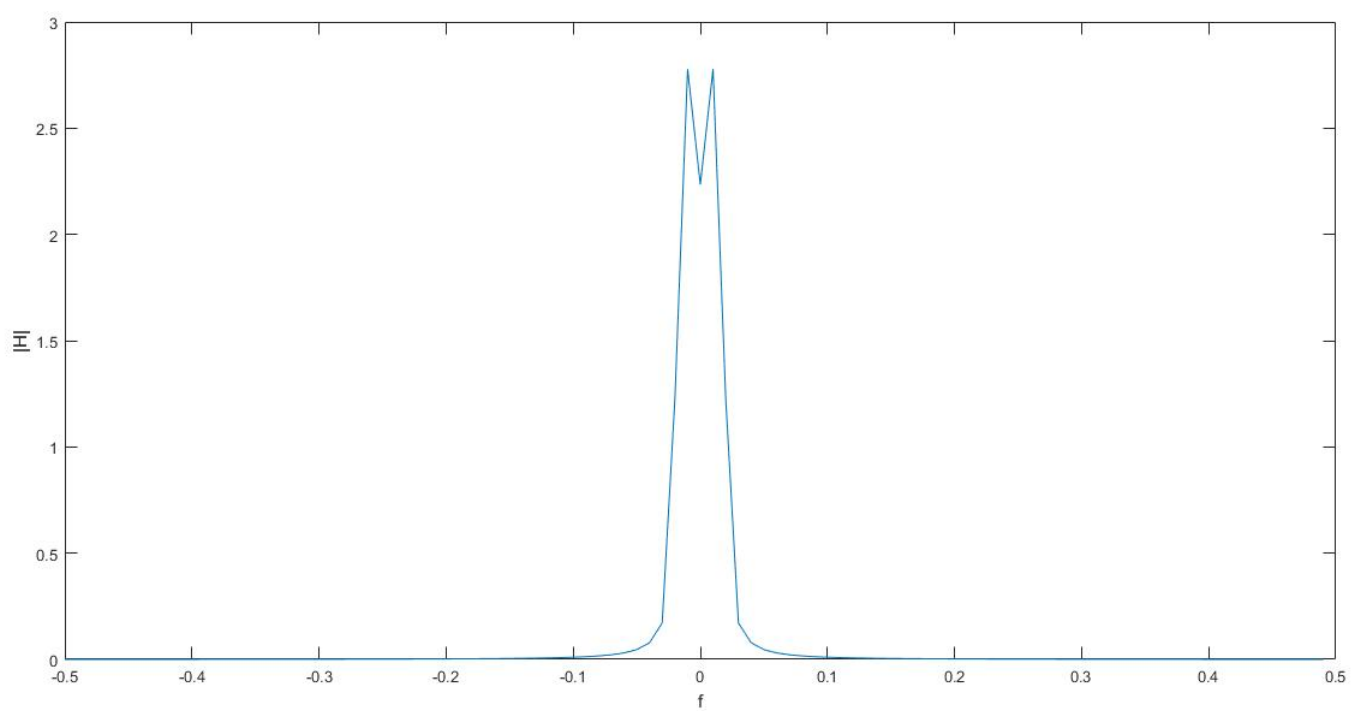


Figure 2: random sequence of impulses

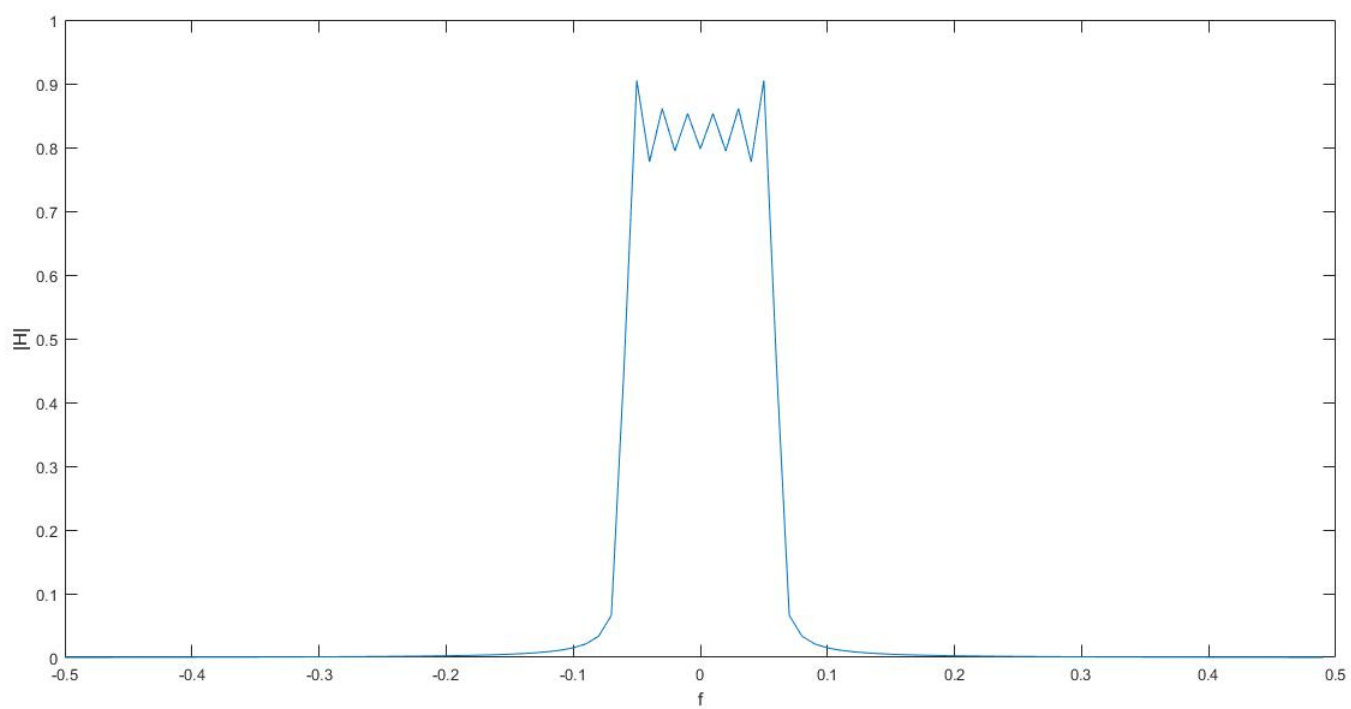


Figure 3: random sequence of impulses

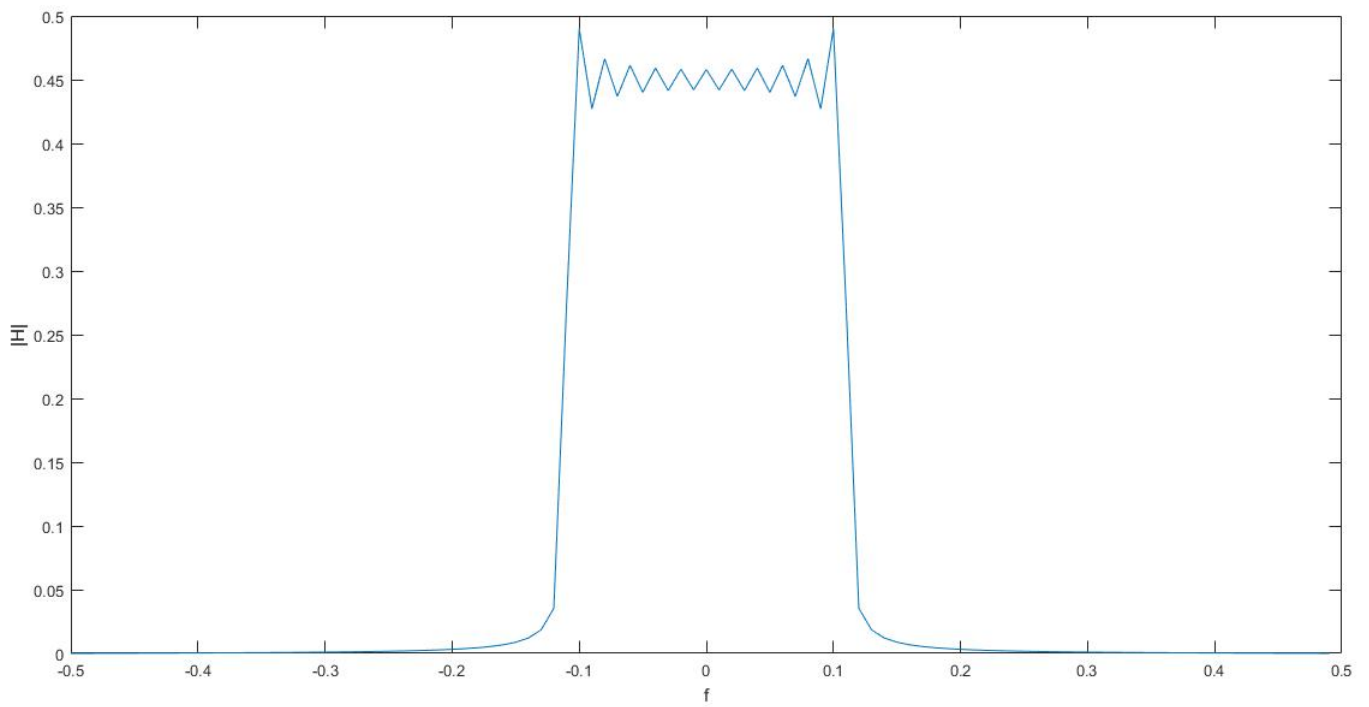


Figure 4: random sequence of impulses

2.d

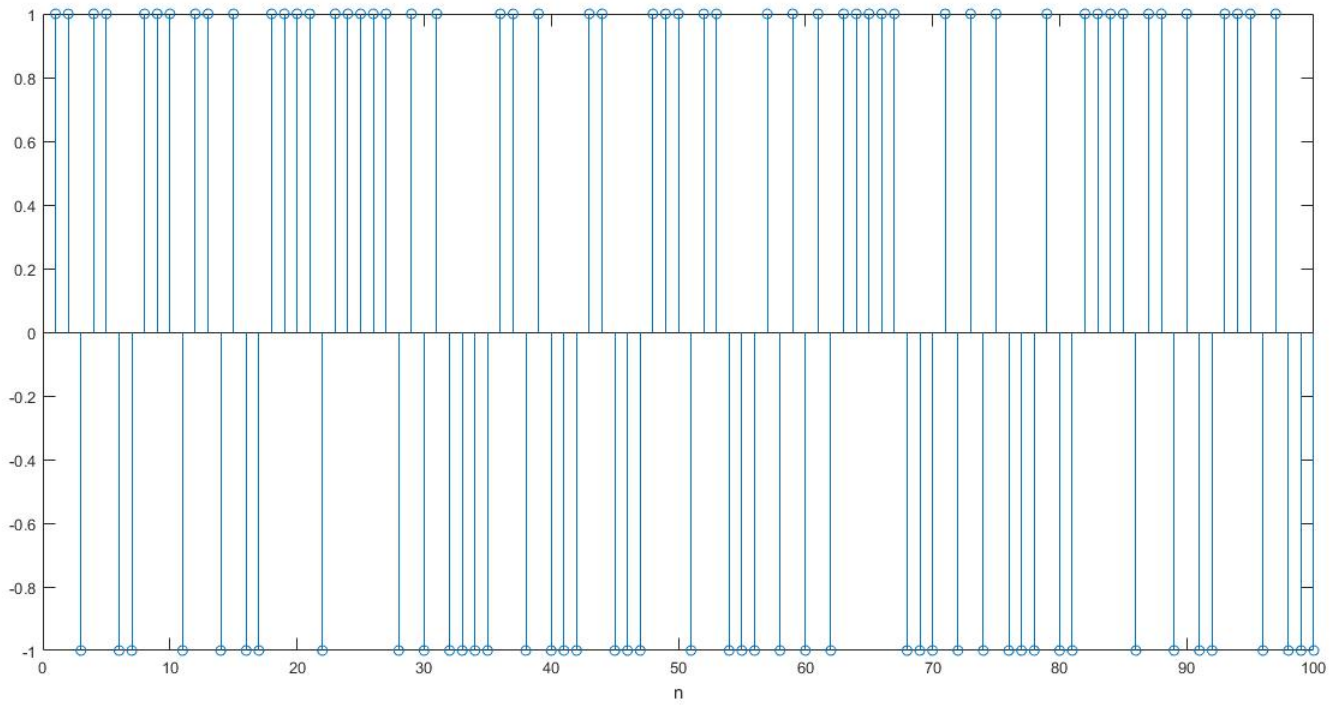


Figure 5: random sequence of impulses

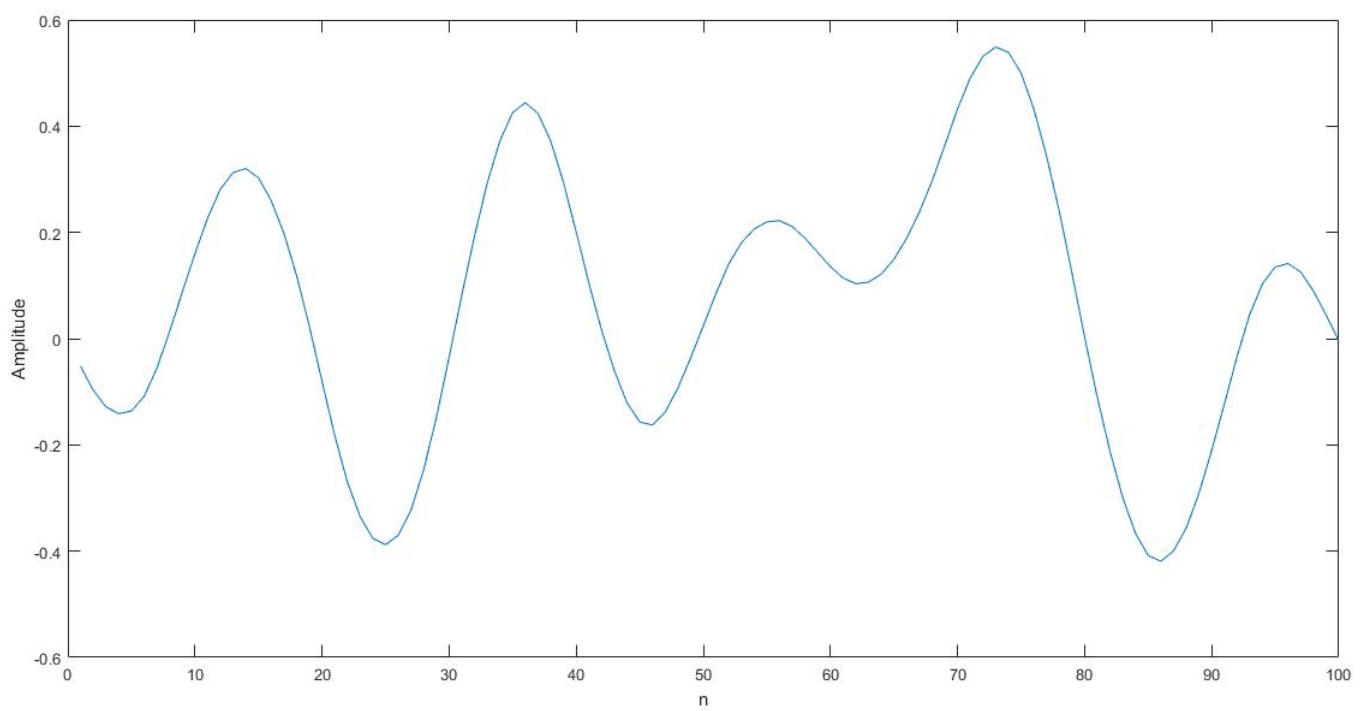


Figure 6: random sequence of pulses



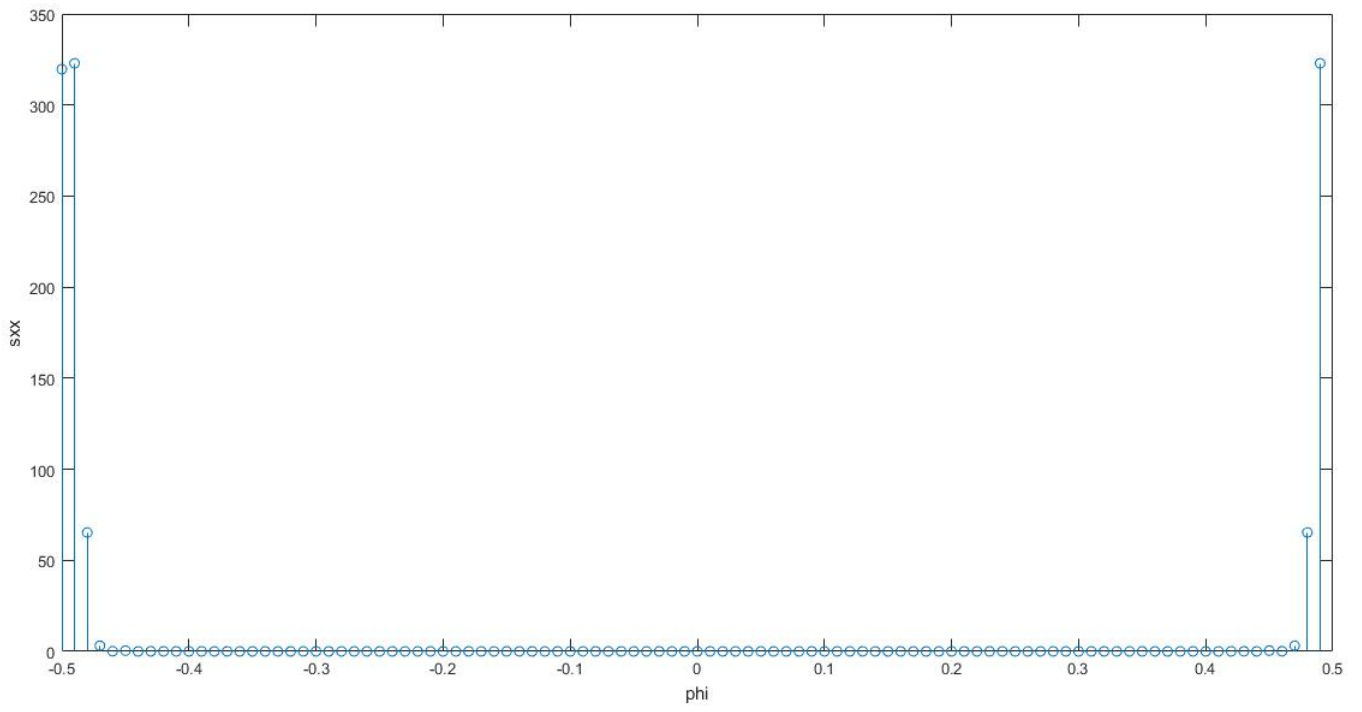


Figure 7:  $SXX(\phi)$   $c = 2$

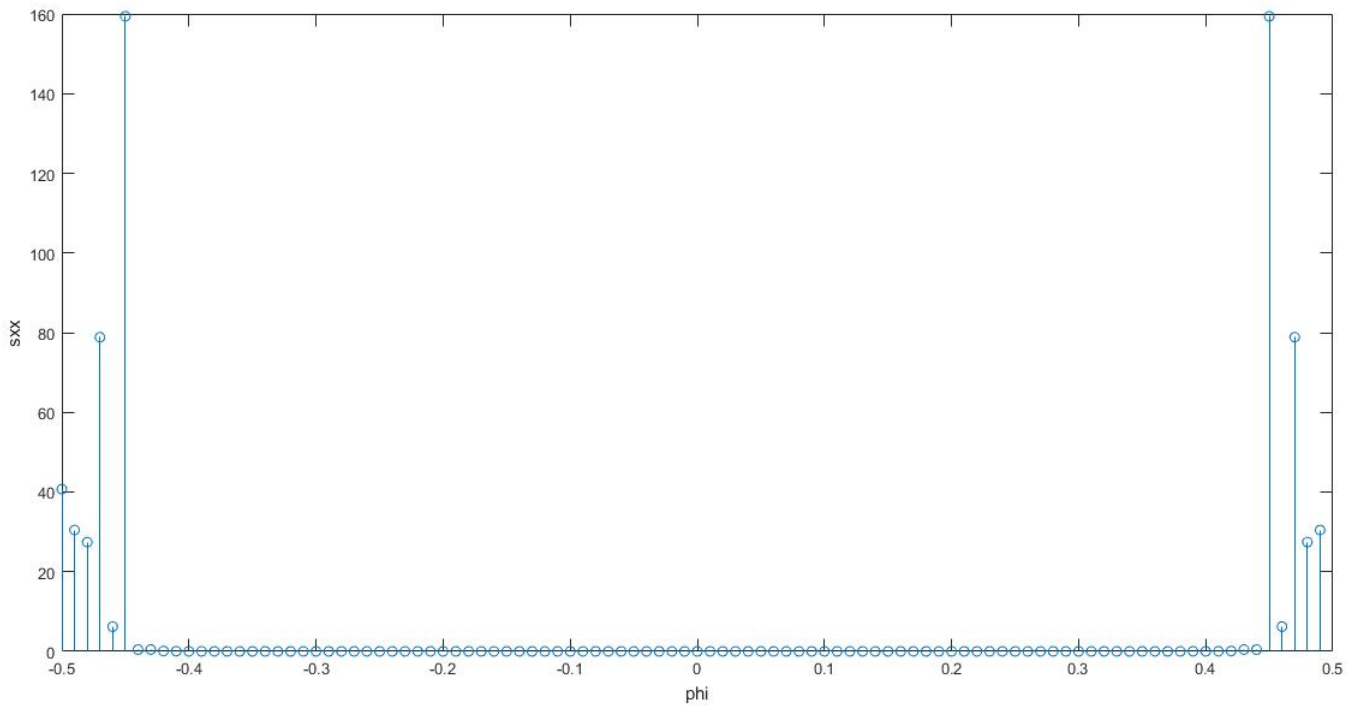


Figure 8:  $SXX(\phi)$   $c = 5$

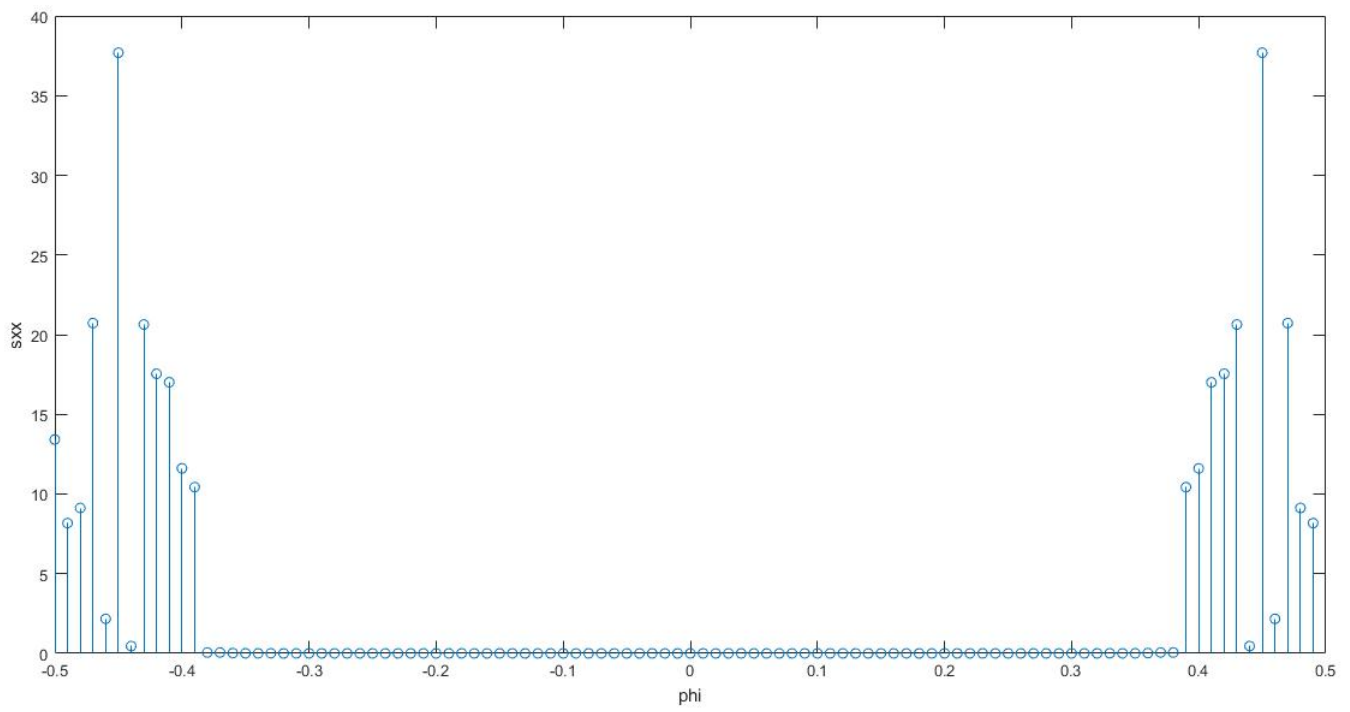


Figure 9:  $SXX(\phi)$   $c = 10$

## Code Appendix

```
1 clear;
2 clc;
3 close all;
4
5 fe = 0.05;
6 n = linspace(-200,200);
7 h = 2*fe*sinc(2*fe*n);
8 figure;
9 plot(n,h);
10 xlabel('n')
11 ylabel('hn')
12 %c=2
13 n = linspace(-20,20);
14 h = 2*fe*sinc(2*fe*n);
15 figure;
16 plot(n,h);
17 xlabel('n')
18 ylabel('hn')
19 dtft = fft(h);
20 dtft = fftshift(abs(dtft));
21 fc = (-numel(dtft)/2:numel(dtft)/2-1)./numel(dtft);
22 figure;
23 plot(fc,dtft);
24 xlabel('f');
25 ylabel('|H|');
26 %c=5
27 n = linspace(-60,60);
28 h = 2*fe*sinc(2*fe*n);
29 figure;
30 plot(n,h);
31 xlabel('n')
32 ylabel('hn')
33 dtft = fft(h);
34 dtft = fftshift(abs(dtft));
35 fc = (-numel(dtft)/2:numel(dtft)/2-1)./numel(dtft);
36 figure;
37 plot(fc,dtft);
38 xlabel('f');
39 ylabel('|H|');
40 %c=10
41 n = linspace(-110,110);
42 h = 2*fe*sinc(2*fe*n);
43 figure;
44 plot(n,h);
45 xlabel('n')
46 ylabel('hn')
47 dtft = fft(h);
48 dtft = fftshift(abs(dtft));
49 fc = (-numel(dtft)/2:numel(dtft)/2-1)./numel(dtft);
50 figure;
51 plot(fc,dtft);
```

```

52 xlabel('f');
53 ylabel('|H|');
54 %last part
55 iidp = zeros(1,100);
56 for i=1:100
57 flip = discrete([1,1]);
58 if(flip==2)
59 iidp(i) = 1;
60 else
61 iidp(i) = -1;
62 end
63 end
64
65 %c=5
66 n = linspace(-60,60);
67 h = 2*fe*sinc(2*fe*n);
68 figure;
69 stem(iidp)
70 xlabel('n');
71 iidpft = fft(iidp);
72 filterdFt = iidpft.*fft(h);
73 filteredDt = ifft(filterdFt);
74 figure;
75 plot(filteredDt);
76 xlabel('n');
77 ylabel('Amplitude')
78
79 %c=2
80 n = linspace(-20,20);
81 h = 2*fe*sinc(2*fe*n);
82 figure;
83 stem(iidp)
84 xlabel('n');
85 iidpft = fft(iidp);
86 filterdFt = iidpft.*fft(h);
87 filteredDt = ifft(filterdFt);
88 figure;
89 plot(filteredDt);
90 sxx = (abs(iidpft).^2).*(abs(fft(h))).^2;
91 x = -0.5:0.01:0.49;
92 figure;
93 stem(x,sxx);
94 xlabel('phi');
95 ylabel('sxx');
96
97 %c=5
98 n = linspace(-60,60);
99 h = 2*fe*sinc(2*fe*n);
100 figure;
101 stem(iidp)
102 xlabel('n');
103 iidpft = fft(iidp);
104 filterdFt = iidpft.*fft(h);
105 filteredDt = ifft(filterdFt);

```

```

106 figure;
107 plot(filteredDt);
108 sxx = (abs(iidpft).^2).*(abs(fft(h))).^2;
109 x = -0.5:0.01:0.49;
110 figure;
111 stem(x,sxx);
112 xlabel('phi');
113 ylabel('sxx');
114 %c=10
115 n = linspace(-110,110);
116 h = 2*fe*sinc(2*fe*n);
117 figure;
118 stem(iidp)
119 xlabel('n');
120 iidpft = fft(iidp);
121 filterdFt = iidpft.*fft(h);
122 filteredDt = ifft(filterdFt);
123 figure;
124 plot(filteredDt);
125 sxx = (abs(iidpft).^2).*(abs(fft(h))).^2;
126 x = -0.5:0.01:0.49;
127 figure;
128 stem(x,sxx);
129 xlabel('phi');
130 ylabel('sxx');

```