1

Compare Built-in and User Defined Convolution Function

1.1 Theory

In a linear time-invariant (LTI) system, convolution sum is a mathematical operation used to express the relation between input and output of the system[1]. It is expressed as

$$y(n) = x(n) * h(n) = \Sigma_{k=-\infty}^{\infty} x(k)h(n-k)$$

Equation 1.1: Convolution Sum equation

the input $x(n)$ is convolved with the impulse response $h(n)$ to yield the output $y(n)$[2].

1.2 Matlab Code

```
n1 = 0 : 1 : 3;
y1 = [ 1 2 3 4 ];
h1 = [ 4 4 3 2 ];
n2 = 0 : 1 : 6;
X = conv (h1, y1);
h_new = flip(h1);
answ = 1:1:4+3;
answ = answ * 0.0;
for i = 1:1:4
        for j=1:1:i
                answ(i) = answ(i) + y1(j)*h_new(j+4-i);
        end
end

for i = 2:1:4
        for j=i:1:4
                answ(i+4-1) = answ(i+4-1) + y1(j)*h_new(j-i+1);
        end
end
subplot(4,1,1)
stem(n1, y1,'filled')
xlim([-1 7])
title('input (y(n))')
subplot(4,1,2)
stem(n1, h1,'filled')
xlim([-1 7])
title('impulse response (h(n))');
subplot(4,1,3)
stem(n2, X,'filled')
```

```
30 xlim([-1 7])
31 title('Conv Function (x(n))');
32 subplot(4,1,4)
33 stem(n2, answ,'filled')
34 xlim([-1 7])
35 title('Manual Function (x(n))');
```

1.3 Output

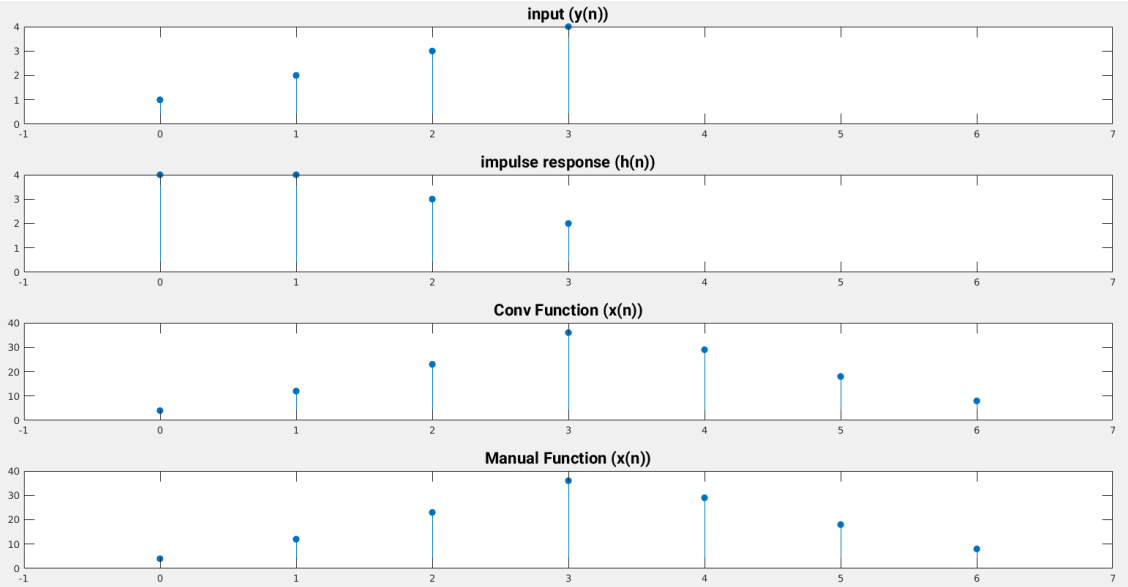

Figure 1.1: Built-In vs User defined Convolution

1.4 Conclusion

From the output figure 1.1, we can see that our code gives same output as Matlab's built-in code. So we have successfully implemented the code of convolution.

Bibliography

[1] "Convolution and Correlation". (), [Online]. Available: https://www.tutorialspoint.com/signals_and_systems/convolution_and_correlation.htm (visited on 03/24/2023).

[2] J. Proakis and D. Manolakis, *Digital Signal Processing*, 4th edition. Upper Saddle River, N.J: Pearson, Mar. 28, 2006, 1104 pp., ISBN: 978-0-13-187374-2.