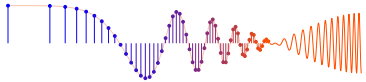


PROBLEM:

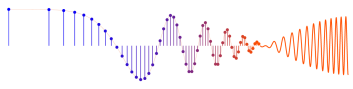
Suppose that an FIR filter is specified by the filter coefficients $\{b_k\} = \{0,\ 0,\ 2,\ 0,\ -1,\ 0,\ 2\}$.

(a) If the input signal to the filter is $x[n] = -7\delta[n-3]$, determine the output, $y[n]$, and make a plot of the output signal.

(b) Write a short MATLAB program (just a few lines) that will solve this problem and make the plot.

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

SOLUTION



$x[n] \longrightarrow$ [filter] $\longrightarrow y[n]$

$\{b_n\} = \{b_0 = 0, b_1 = 0, b_2 = 2, b_3 = 0, b_4 = -1, b_5 = 0, b_6 = 2\}$

a) Note: a) $x[n] = \delta[n] \rightarrow$ [filter] $\rightarrow y[n] = h[n] = b_n$

b) $x[n] = \delta[n-3] \rightarrow$ [filt] $\rightarrow y[n] = h[n-3] = b_{n-3}$

c) $x[n] = A\delta[n-3] \rightarrow$ [filter] $\rightarrow y[n] = Ah[n-3] = A\,b_{n-3}$

So if $x[n] = -7\,\delta[n-3]$ then $y[n] = -7\,h[n-3]$

$= -7\,b_{n-3}$

$\Rightarrow$

$y_0 = 0$
$y_1 = 0$
$y_2 = 0$
$y_3 = 0$
$y_4 = 0$
$y_5 = -7b_{5-3} = -7b_2 = -14$
$y_6 = 0$
$y_7 = -7b_{7-3} = -7b_4 = 7$
$y_8 = -7b_{8-3} = -7b_5 = 0$
$y_9 = -7b_{9-3} = -7b_6 = 14$

b)

```
b=[0 0 2 0 -1 0 2];
x=[0 0 0 -7 0 0 0];
y = conv(x,b)

y = 0  0  0  0  0 -14  0  7  0  -14  0  0  0
```