Student name:

ECE 4311[1]S, Digital Signal Processing

Quiz 3
January 17, 2005

Assume that the signal $x[n]$ in fig. 1 measures the displacement of a bridge when a car is passing by (e.g., negative spike)

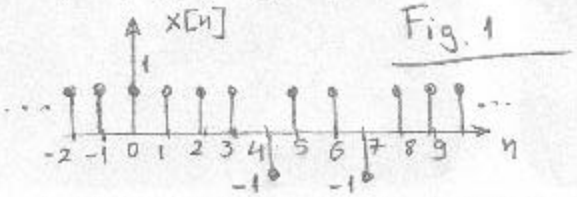


Fig. 1

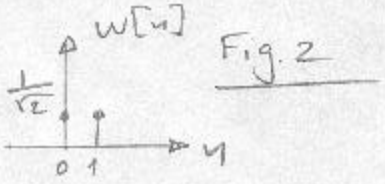


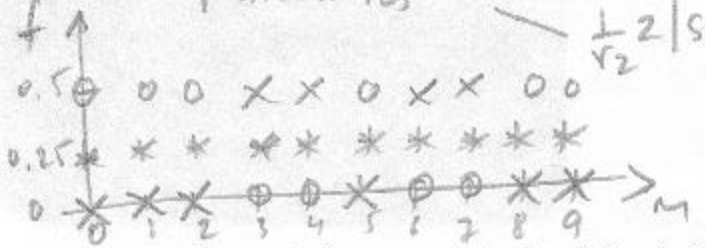
Fig. 2

1. Compute the spectrogram $|X(m,f)|$ for $m = 0,1,...,9$ and $f = -0.5,-0.25,0,0.25,0.5$ by using the window in fig. 2. Place the calculated values in a two dimensional graph.

Hint: [1 1 1 0 1 n DTFT $\leftrightarrow$ $2e^{-j\frac{w}{2}}\cos\frac{w}{2}$, 1 0 -1 n DTFT $\leftrightarrow$ $2je^{-j\frac{w}{2}}\sin\frac{w}{2}$]

$|X(m,f)| = |DTFT(x[n]\cdot w[n-m])|$

here two possibilities $\begin{cases} \frac{1}{\sqrt{2}}\cdot 2|\cos \pi f| & , m = 0,1,2,5,8,9 \\ \frac{1}{\sqrt{2}} 2|\sin \pi f| & , m = 3,4,6,7 \end{cases}$



$X = \frac{2}{\sqrt{2}}$
$O = 0$
$* = 1$

2. What conclusions can we derive from $|X(m, f = 0)|$?

One conclusion is that the signal has variable DC component

3. Can you think how $|X(m,f)|$ can help you design the bridge by properly selecting the "natural" vibrating frequency of the bridge?

at $f = 0.25$ the response of the bridge remains constant over time and thus not affected by the load. This is a good choice