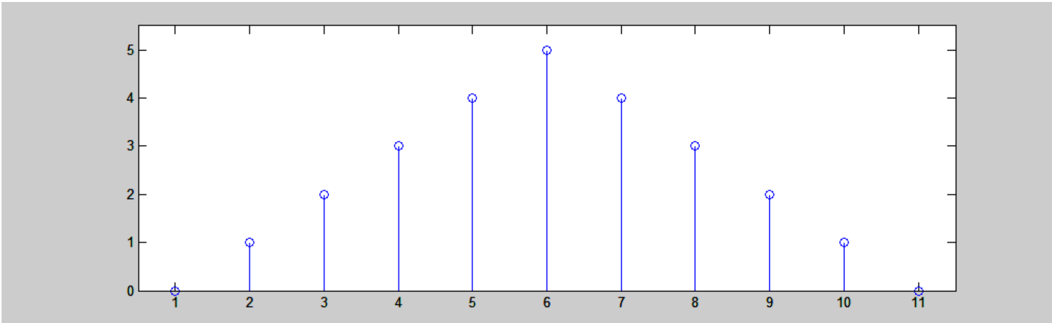
Multimedia Signal Processing 1st Module

11 /2/2013

Ex.1 (Pt.12)

A sinusoidal signal at 400Hz is sampled at 2kHz.

1. We will take a block of 11 samples. Without applying any further filter, what will be the **DTFT** of these 11 samples? Provide its equation.
2. On every block of 11 samples previously acquired is applied the following Bartlett window:



3. What will be the final signal? Represent its DTFT in the range 0-4 π in the pulsation domain.

Ex.2 (Pt.10)

A filter has the following z-transform:

$$H(z) = \frac{1}{1+\frac{1}{4}z^{-2}}$$

1. Draw the zeros-poles diagram.
2. Provide an approximated representation of the filter amplitude.
3. Find the exact amplitude values at normalized pulsations: $0, \pi/2, \pi$.

Ex.3 (Pt. 11 – MATLAB code)

Solve the Exercise 1 using MATLAB.

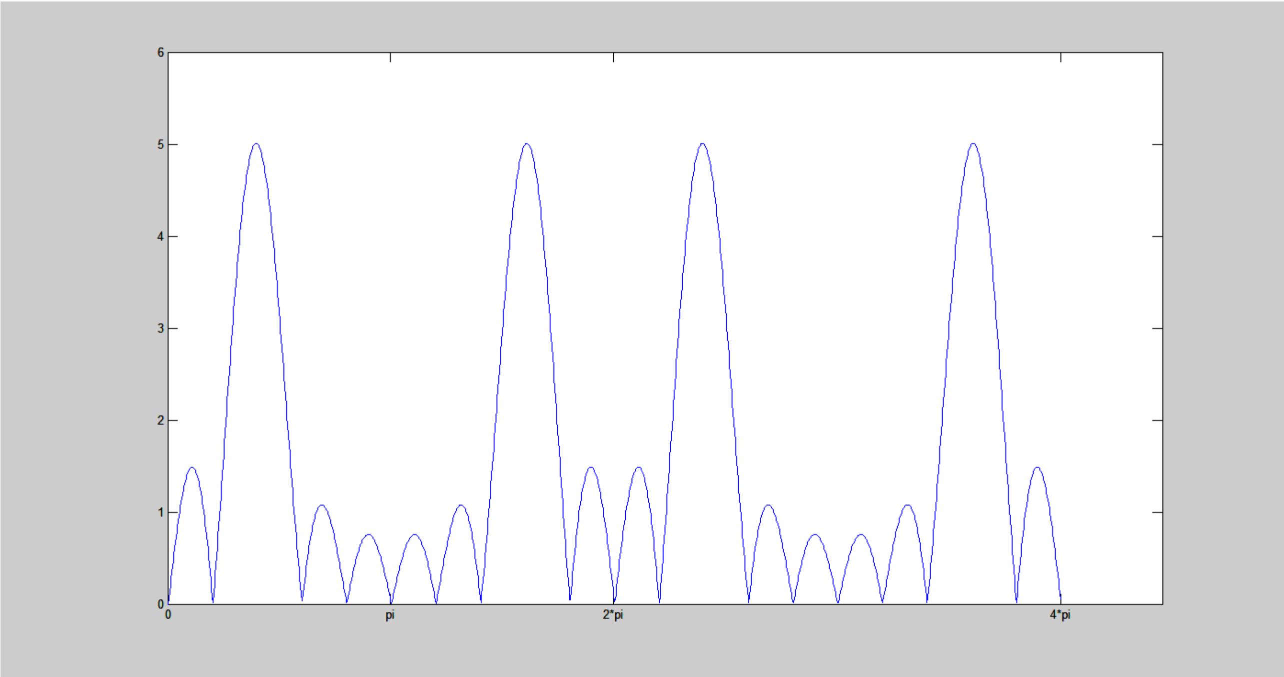
Explain what are the assumptions moving from DTFT to DFT

Solutions

Ex.1

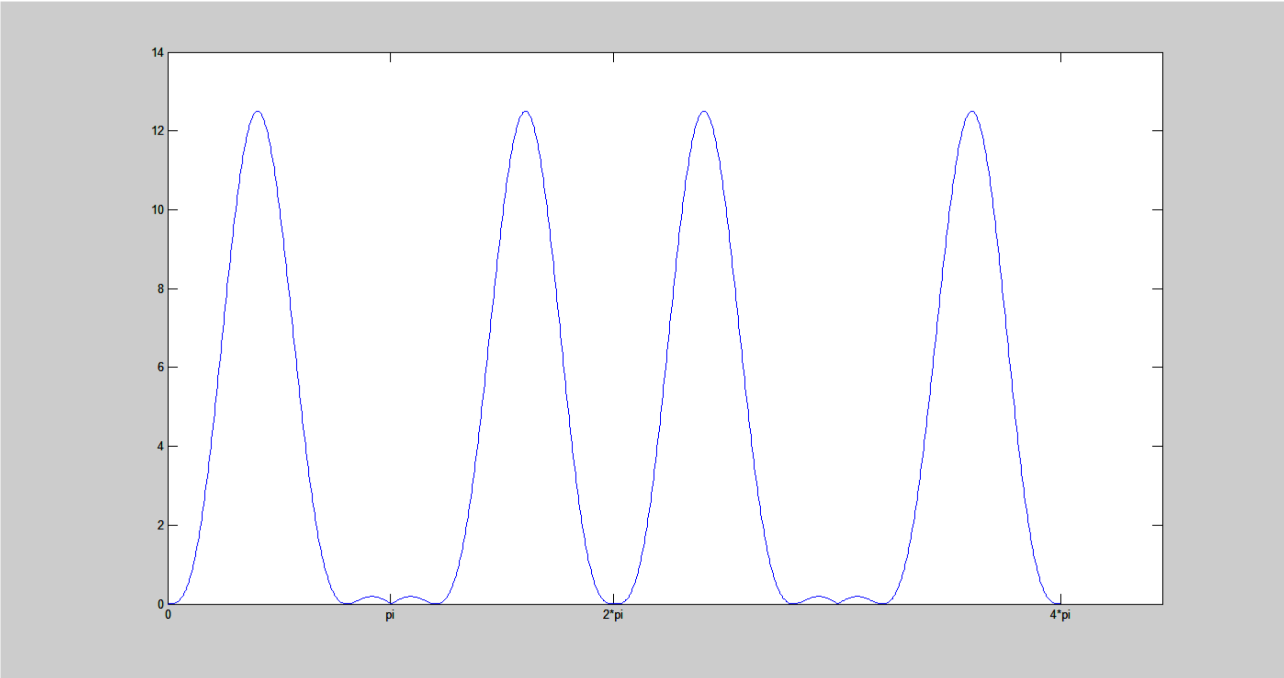
With the rectangular window the signal $y = \sin\left(2\pi \frac{400}{2000} n\right)$ will become: $Y(\omega) = \sum_{n=0}^{10} y(n) e^{-jn\omega}$

In the picture below we show its magnitude from 0 to 4π.

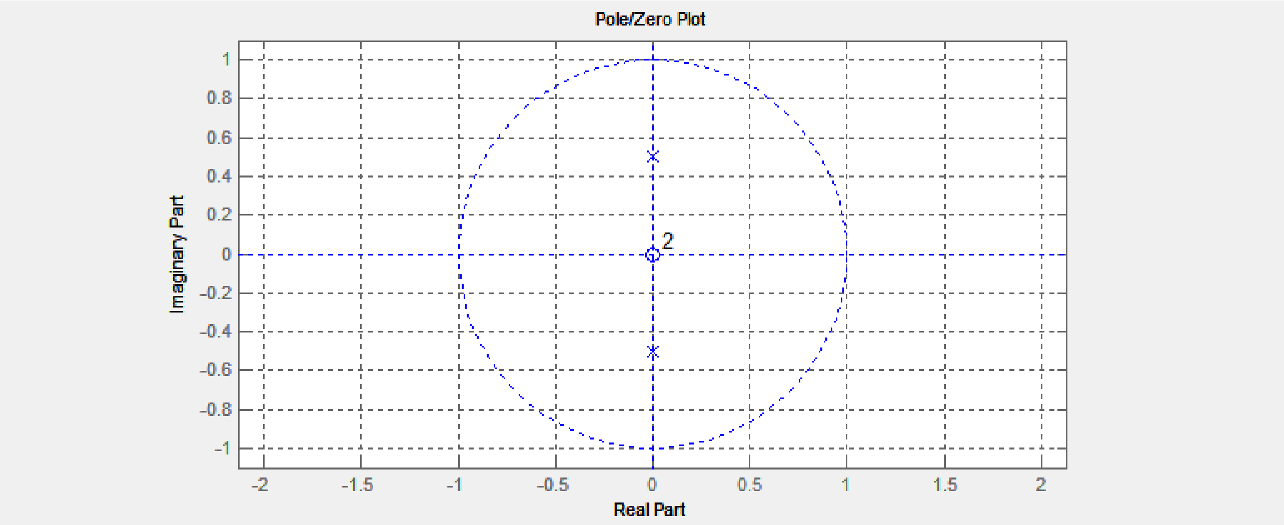


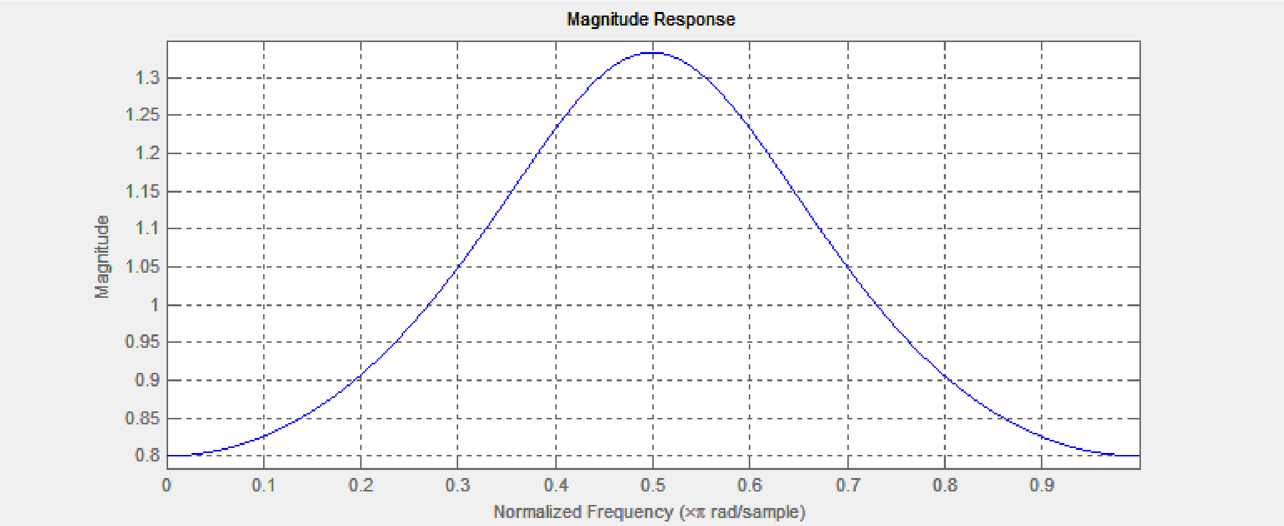
With the Bartlett window *B*(*n*) described in the text we would get: $Y(\omega) = \sum_{n=0}^{10} y(n) B(n+1) e^{-jn\omega}$

[where n+1 is just due to the fact that the window is starting from sample 1 and not 0] we would get:



Ex.2





$$\omega = 0 \quad H\left(z = e^{-j\omega} = 1\right) = \frac{1}{1 + \frac{1}{4}} = \frac{4}{5}$$

$$\omega = \frac{\pi}{2} \quad H\left(z = e^{-j\omega} = j\right) = \frac{1}{1 - \frac{1}{4}} = \frac{4}{3}$$

$$\omega = \pi \quad H\left(z = e^{-j\omega} = -1\right) = \frac{1}{1 + \frac{1}{4}} = \frac{4}{5}$$

Ex.3

```
n=[0:10];
y=sin(2*pi*400/2000*n);
omega=[0:0.01:4*pi];

%%% with the rectangular window

dtft=zeros(size(omega))

for c=1:11
dtft=dtft+y(c)*exp(j*omega*(c-1))
end

plot(abs(dtft));



%%% with Bartlett window

dtft=zeros(size(omega))
for c=1:6
dtft=dtft+y(c)*(c-1)*exp(j*omega*(c-1))
end

for c=7:11
dtft=dtft+y(c)*(11-c)*exp(j*omega*(c-1))
end

plot(abs(dtft))
```