Name : Wenxuan Wang

Q1 : 2h

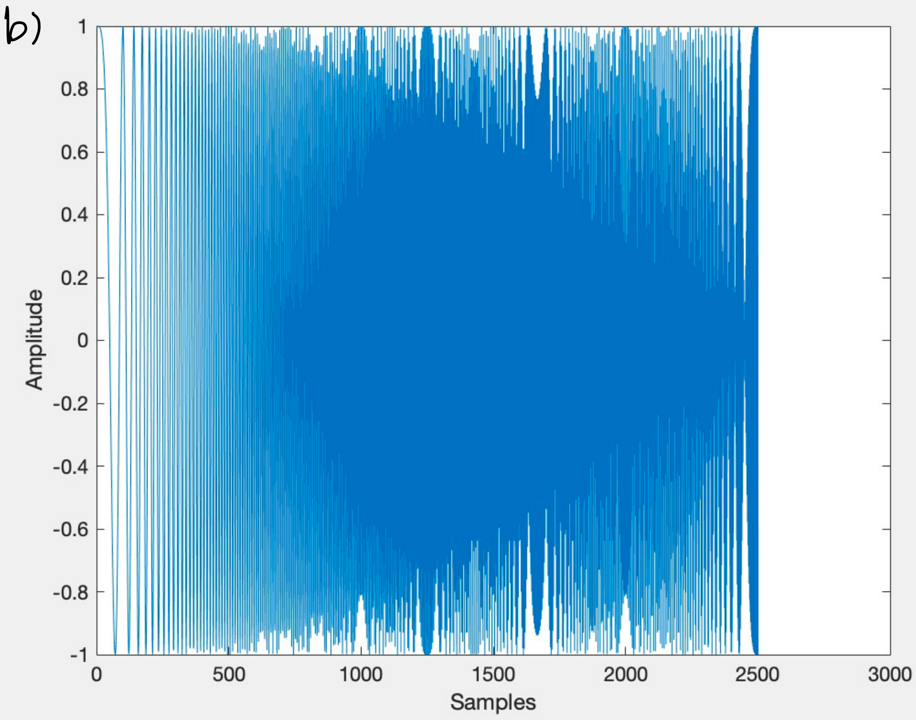
Q2 : (a) $w(n) = \frac{4\pi n}{10000}$

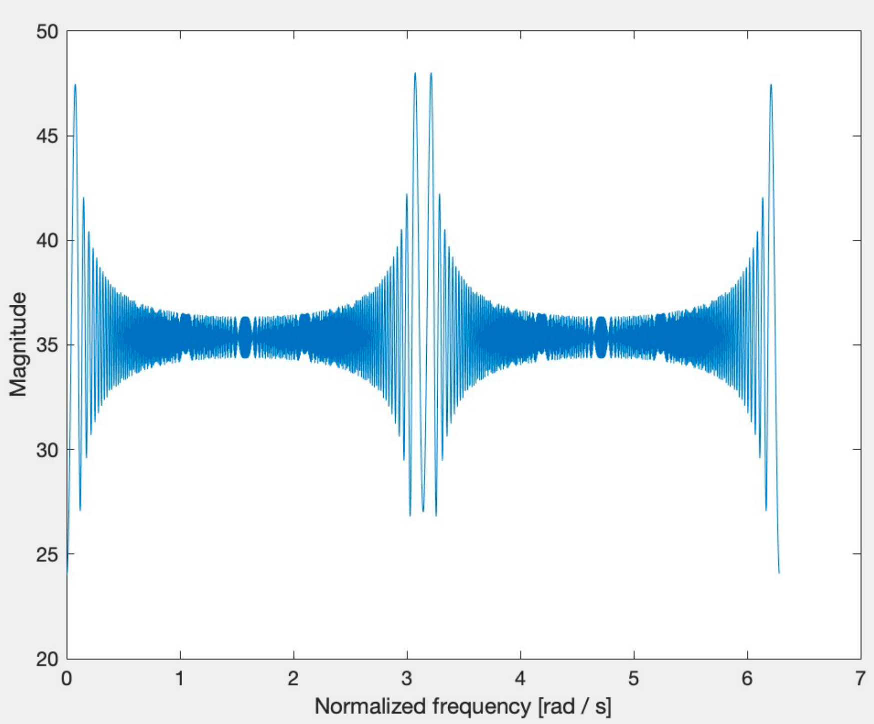
$n = 0, \quad w(n) = 0$

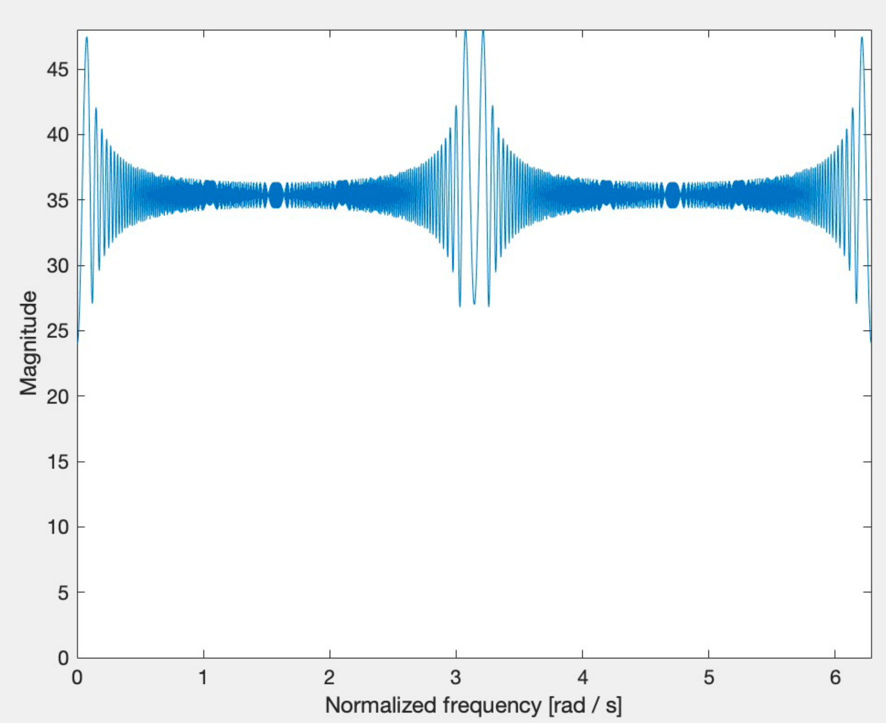
$n = 1000, \quad w(n) = \frac{2\pi}{5}$

$n = 2500, \quad w(n) = \pi$

(b)

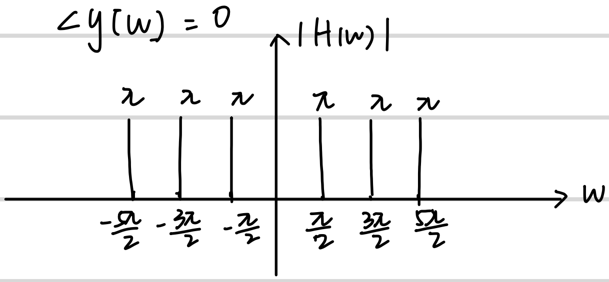


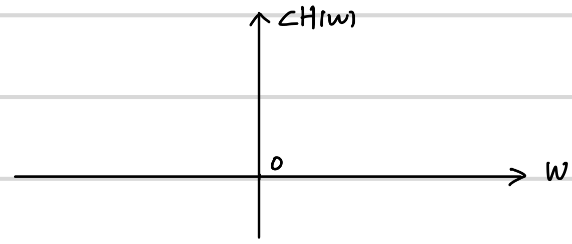




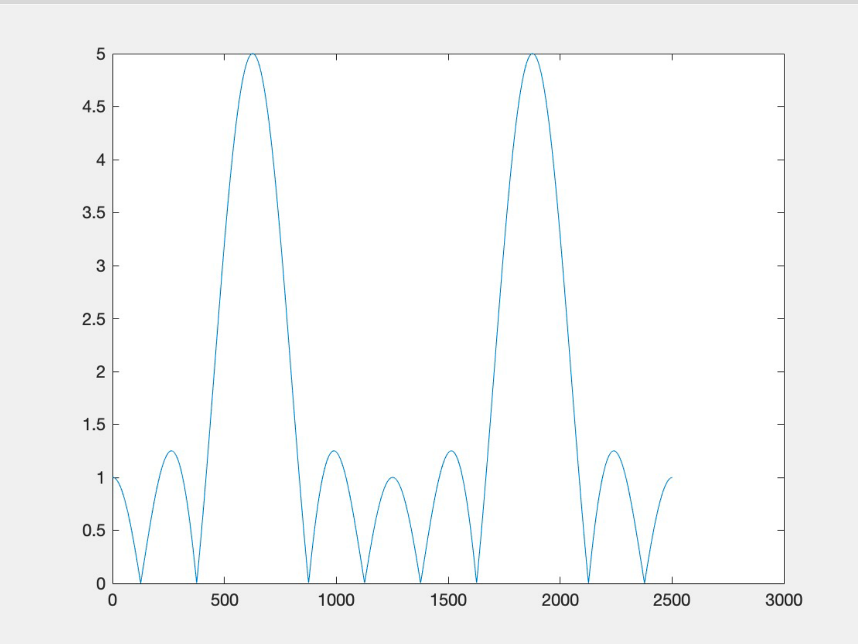
(c) $|Y(w)| = \pi\delta(w-\frac{\pi}{2}) + \pi\delta(w+\frac{\pi}{2})$

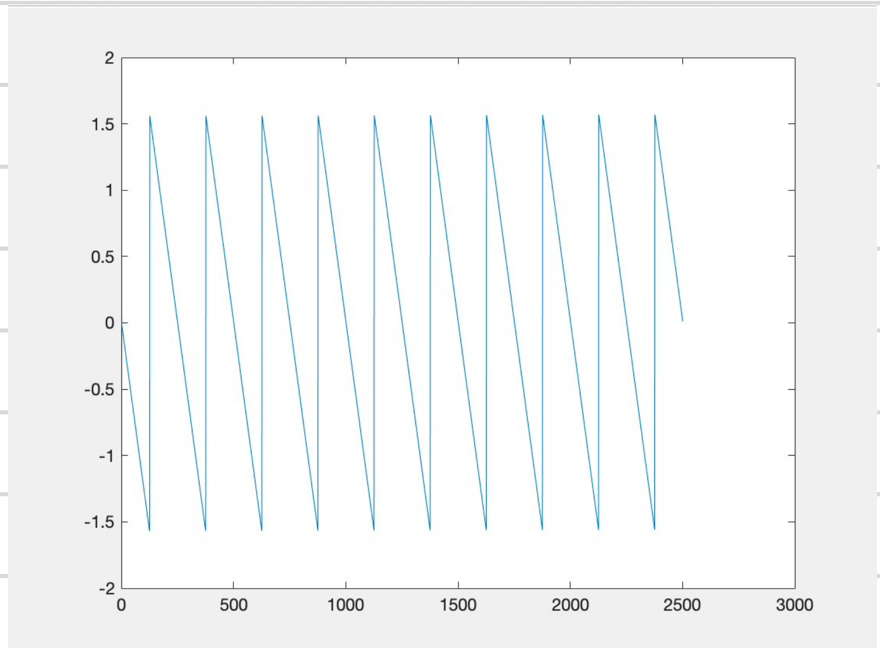
$\angle Y(w) = 0$





(d)





(e) $u[n] \longleftrightarrow \frac{1}{1-e^{-jw}} + \sum_{k=-\infty}^{\infty}\pi\delta(w-2\pi k)$

$w[n] = u[n] - u[n-1]$

$W(w) = (1-e^{-jwN})\left[\frac{1}{1-e^{-jw}} + \sum_{k=-\infty}^{\infty}\pi\delta(w-2\pi k)\right] = 0$

$\therefore 1-e^{-jwN} = 0$ $\quad e^{-jwN} = \cos wN - j\sin wN$

$\therefore 1-(\cos wN - j\sin wN) = 0$ $\quad \therefore wN = 2\pi k$ $\quad \therefore w = \frac{2\pi k}{N}$

Therefore, the 'bandwidth' is inversely proportional to the width of the DTFT of N.

(f)

From (e), we know that the bandwidth of $Z(w)$ is inversely proportional to the width of the rectanglar window N. It is impossible that if the window N exists, the time bandwidth cannot be big at the same time.

Q3

(a)

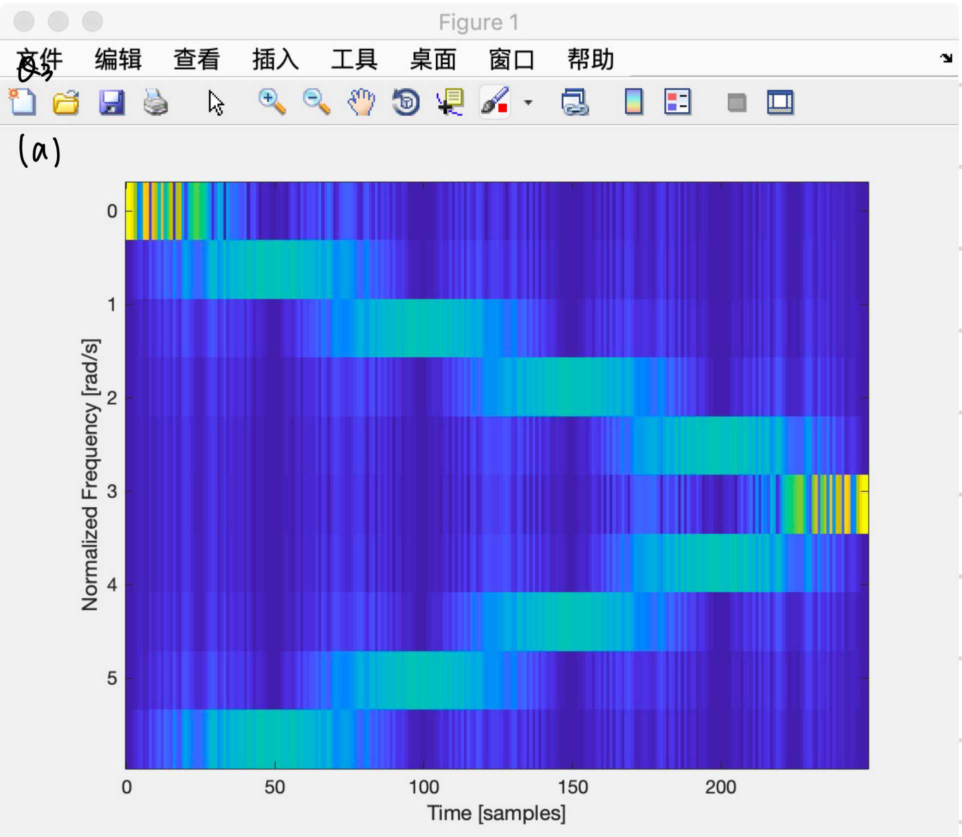
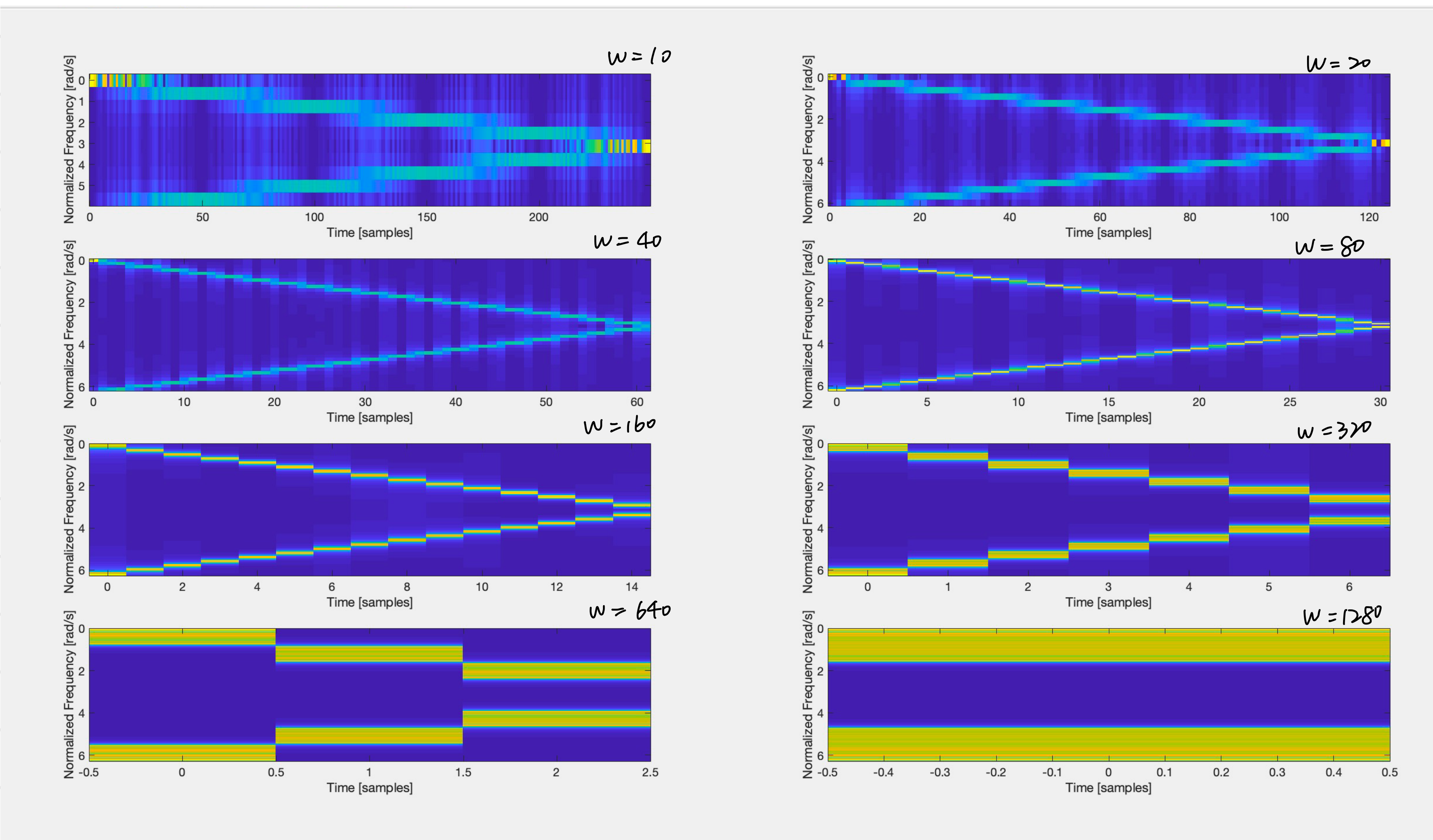


Figure 1
文件 编辑 查看 插入 工具 桌面 窗口 帮助
Normalized Frequency [rad/s]
0
1
2
3
4
5
0
50
100
150
200
Time [samples]

(b)

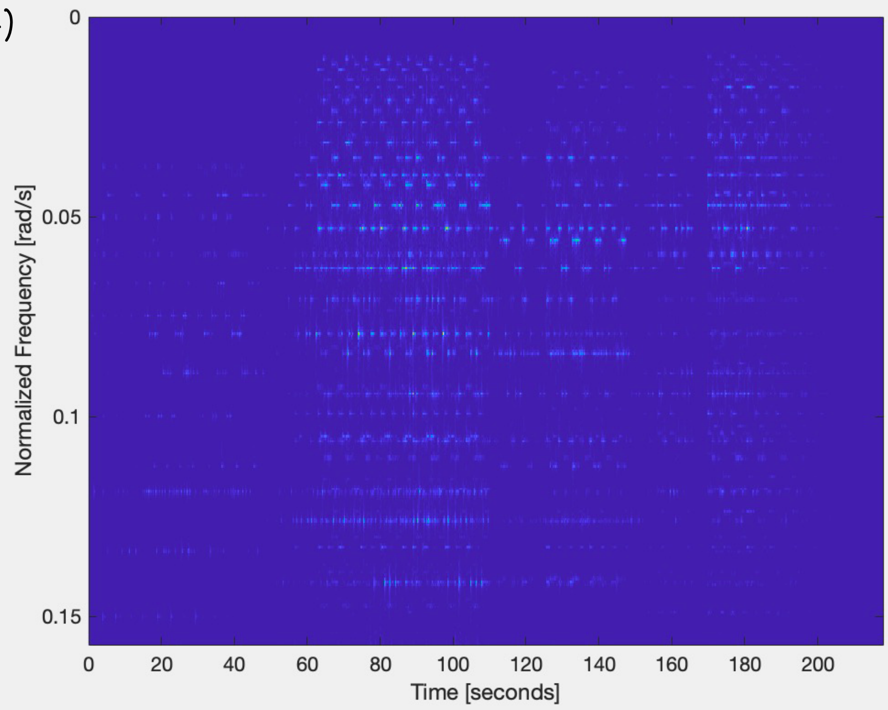


W = 10
W = 20
W = 40
W = 80
W = 160
W = 320
W = 640
W = 1280
Normalized Frequency [rad/s]
Time [samples]

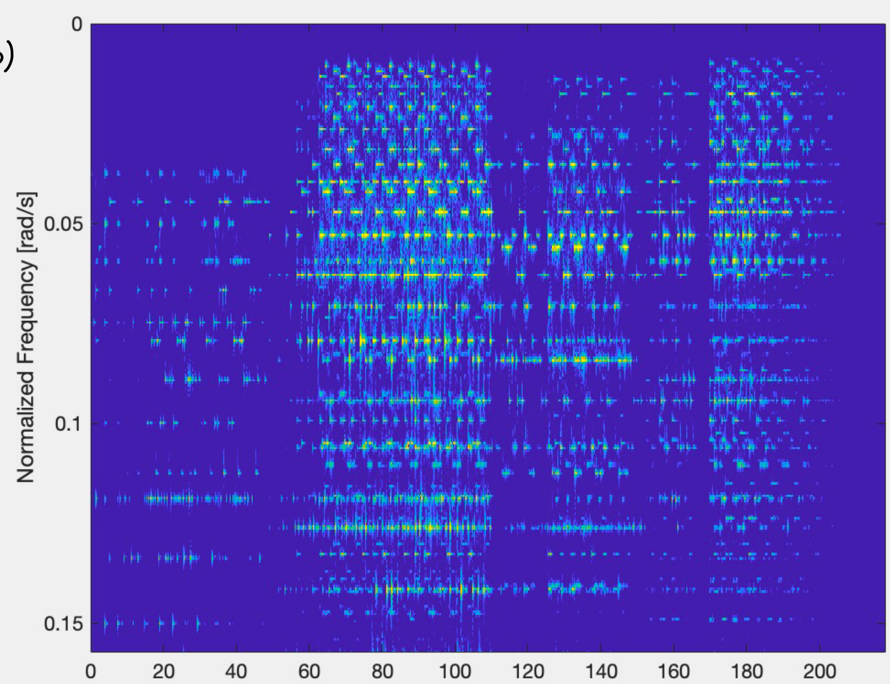
(c) W = 320

Q4

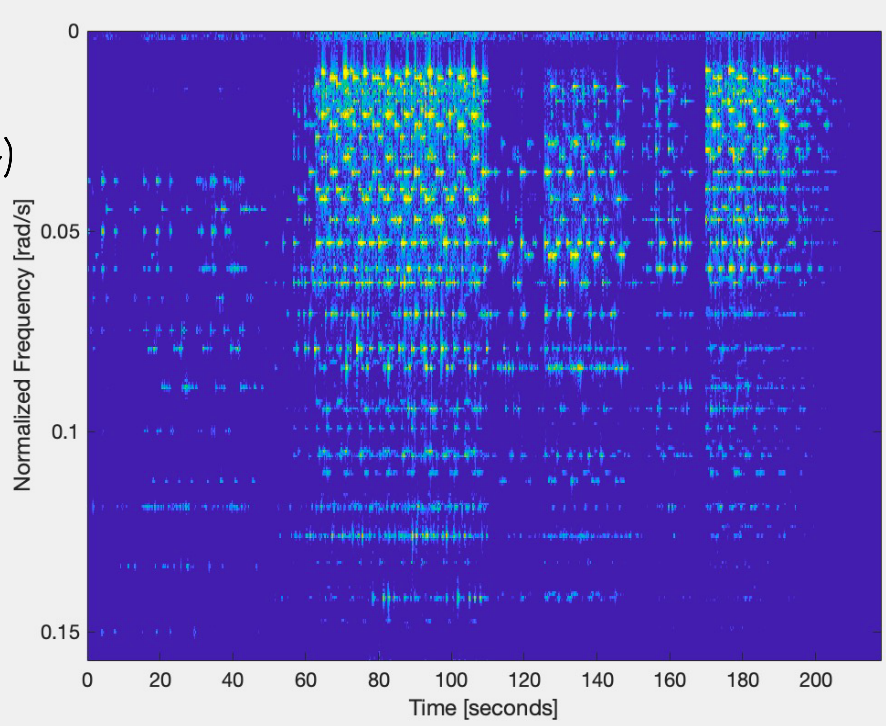
(a)



(b)



(c)



(d) The filte influences the low frequency signal.
It makes music smoothy.