SOLUCIONES TDS - ENERO 2014

P1

(a) Equivalente a fig. 2.10

(b) Seudo código

(c) Ejemplo 2.13

P2

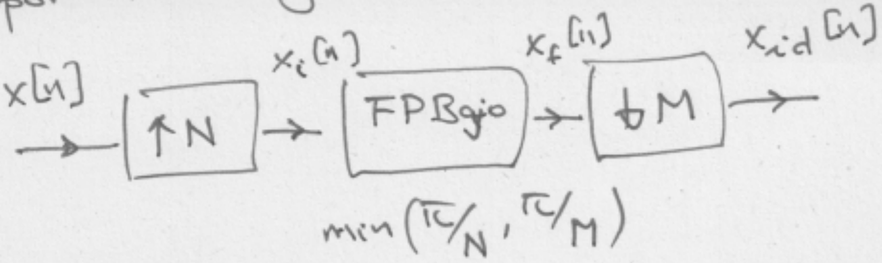
Ejemplos 2.22 y 2.28

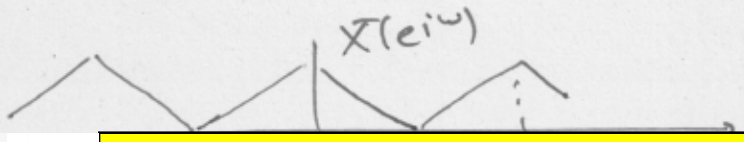
P3

$$f_s = \frac{1}{T} = 2 f_N$$

$$T' = \frac{4T}{3} \Rightarrow f'_s = \frac{3 f_s}{4} < 2 f_N \text{ !!!}$$

(a) $\Rightarrow$ ÚNICAMENTE podemos conseguir f'_s (sin pasar por el dominio continuo) interpolando por $N=3$ y diezmando por $M=4$





P3 (cont.)

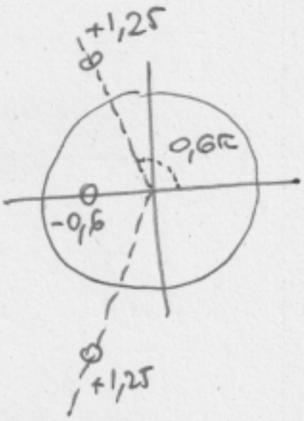
(b) Con la solución expuesta en (a), NO podemos recuperar la señal original ya que $f'_s < 2 f_N$

P4 $H_d(z) = (1+0{,}6\,z^{-1})(1-1{,}25\,e^{j0{,}6\pi} z^{-1})(1-1{,}25 \cdot e^{-j0{,}6\pi} \cdot z^{-1})$

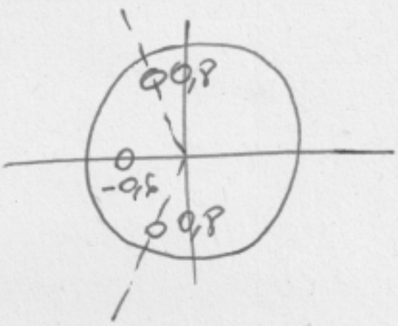
(a) 3 ceros: $z_1 = -0{,}6$

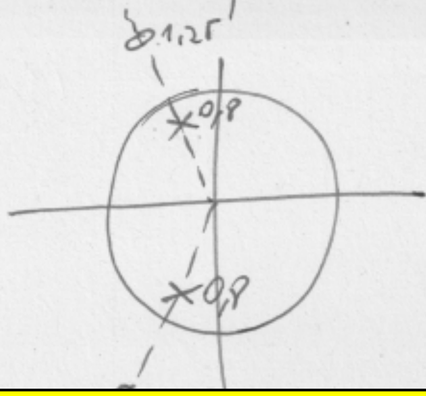
$z_2 = 1{,}25 \cdot e^{j0{,}6\pi}$

$z_3 = 1{,}25 \cdot e^{-j0{,}6\pi}$



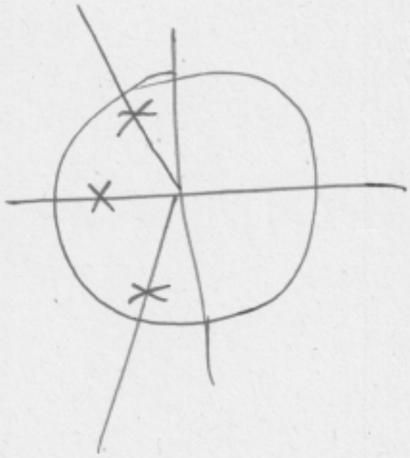
(b) $H_{d\,min}(z)$ $\qquad \dfrac{1}{1{,}25} = 0{,}8 \qquad H_{ap}(z)$





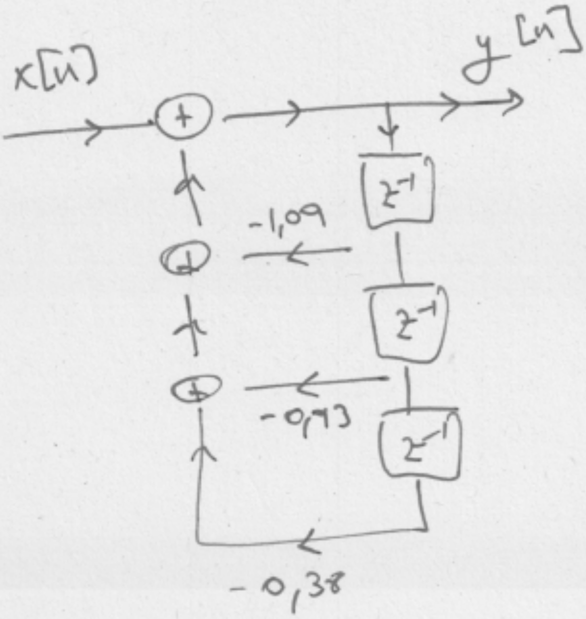
(c)

$$H_C(z) = \frac{1}{H_{dmin}(z)} = \frac{1}{(1+0{,}6z^{-1})(1+0{,}49z^{-1}+0{,}64z^{-2})} =$$



$$= \frac{1}{1+1{,}09z^{-1}+0{,}93z^{-2}+0{,}38z^{-3}} = \frac{Y(z)}{X(z)}$$

$$y[n]+1{,}09\,y[n-1]+0{,}93\,y[n-2]+0{,}38\,y[n-3]=x[n]$$



P5 $\quad f_s = 8\,kHz$

$\delta_a = 10\,dB = 10^{-10/20} = 0{,}3162$

Transf. bilineal: $\omega_a = 2\,\mathrm{arctg}\left(\frac{\Omega_a}{2}\right)$, $\Omega_a = 2\,\mathrm{tg}\,\frac{\omega_a}{2}$

$f_a = 1590\,Hz \rightarrow \omega_a = 1590 \cdot \frac{2\pi}{8000} = 1{,}25$

$f_p = 1180\,Hz \rightarrow \omega_p = 0{,}9273$

$\Rightarrow \Omega_a = 1{,}44$

$\Omega_p = 1$

$$\Rightarrow \quad N = \frac{1}{2}\,\frac{\log 0{,}1265}{\log \frac{1}{1{,}45}} = 2{,}18 \Rightarrow \underline{\underline{N=3}}$$

$$1+\left(\frac{\Omega_p}{\Omega_c}\right)^{2N} = 1+\left(\frac{1}{\Omega_c}\right)^{2N} = \left(\frac{1}{0{,}6838}\right)^2 = 2{,}1387 \Rightarrow \Omega_{c\,min} = 0{,}9786$$

$$1+\left(\frac{\Omega_a}{\Omega_c}\right)^{2N} = 1+\left(\frac{1{,}45}{\Omega_c}\right)^{2N} = \left(\frac{1}{0{,}3162}\right)^2 = 10 \Rightarrow \Omega_{c\,max} = 1{,}0054$$

$\Rightarrow$ Elegimos $\Omega_c = 1$ (pero cualquier en el rango $\Omega_{c\,min} \le \Omega_c \le \Omega_{c\,max}$ es válida)

Sustituimos $s = 2\left(\frac{1-z^{-1}}{1+z^{-1}}\right) \Rightarrow H(z)$

P6 $f_s = 48\ kHz$

$f_1 = 2850\ Hz$

$f_2 = 2875\ Hz$

(a) Para tener barras espectrales al menos en f_1 y f_2, la separación máxima entre barras es:

$$\Delta f = f_2 - f_1 = 25\ Hz = \frac{f_s}{N}$$

$$\Rightarrow N = \frac{48K}{25} = 1920$$

$\Rightarrow$ el tamaño buscado de la DFT es $N = 1920$ puntos ó múltiplos enteros de N.

Con esta resolución espectral, los tonos buscados estarán en $k_1 = 114$ y $k_2 = 115$

(b) Usando $M = N$ (por el enunciado)

$$\Delta\omega_{HANNING} = \frac{8\pi}{N}$$

mientras el ancho deseado es $\Delta\omega = \frac{2\pi}{N}$

$$\Rightarrow \Delta\omega_{HAN} = 4 \cdot \Delta\omega$$