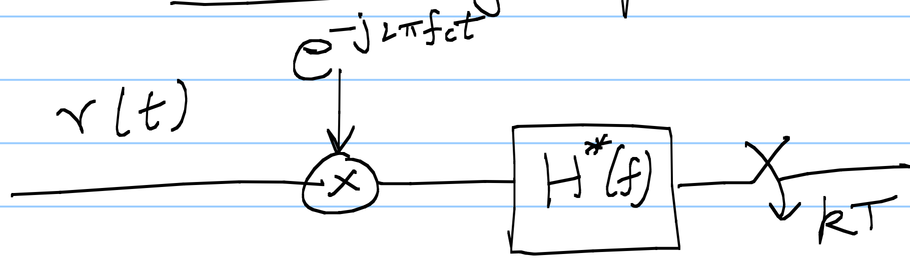
Lecture 35

Note Title 10/15/2008

Fractionally spaced equalizers



symbol rate.

sampling rate $= \frac{1}{T}$

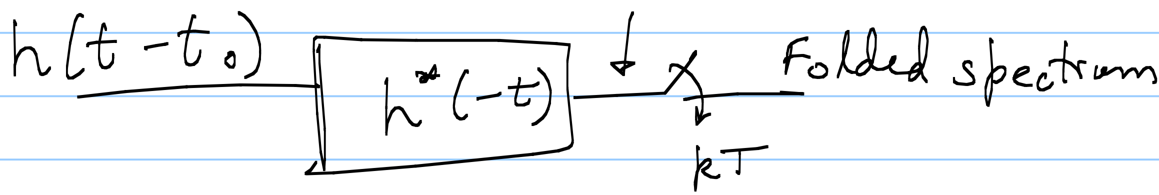
Transmit pulse: uses excess BW

$\frac{1+\alpha}{2T}$ for $\alpha > 0$

→ First motivation for $\frac{2}{T}$ -sampling is that $\frac{1}{T}$ -sampling cannot be used to reconstruct signal.

Problem with $1/T$-sampling

Typical: Assume kT is precise, $\rightarrow$ may not be true.



$$S(e^{j2\pi fT}) = \frac{1}{T}\sum_{m=-\infty}^{\infty} e^{-j2\pi\left(f-\frac{m}{T}\right)t_0} \cdot H\left(f-\frac{m}{T}\right)H^*\left(f-\frac{m}{T}\right)$$

$\omega = 2\pi fT$

$0 \le f \le 1/2T$

$$= \frac{e^{-j2\pi f t_0}}{T}\sum_{m=-\infty}^{\infty}\left|H\left(f-\frac{m}{T}\right)\right|^2 e^{j\frac{2\pi m t_0}{T}}$$

$$S(e^{j\omega}) = e^{-j\frac{\omega t_0}{T}} \cdot \frac{1}{T}\left|H\left(\frac{\omega}{2\pi T}\right)\right|^2\left(1+\gamma e^{-j\frac{2\pi t_0}{T}}\right)$$

$$S(e^{j\omega}) = e^{-j\frac{\omega t_0}{T}} \cdot \frac{1}{T} \left| H\left(\underset{f}{\frac{\omega}{2\pi T}}\right)\right|^2 \left(1 + \gamma e^{-j\frac{2\pi t_0}{T}}\right)$$

$$\gamma = \frac{\left| H\left(f - \frac{1}{T}\right)\right|^2}{|H(f)|^2} \underline{\underline{(< 1)}}$$

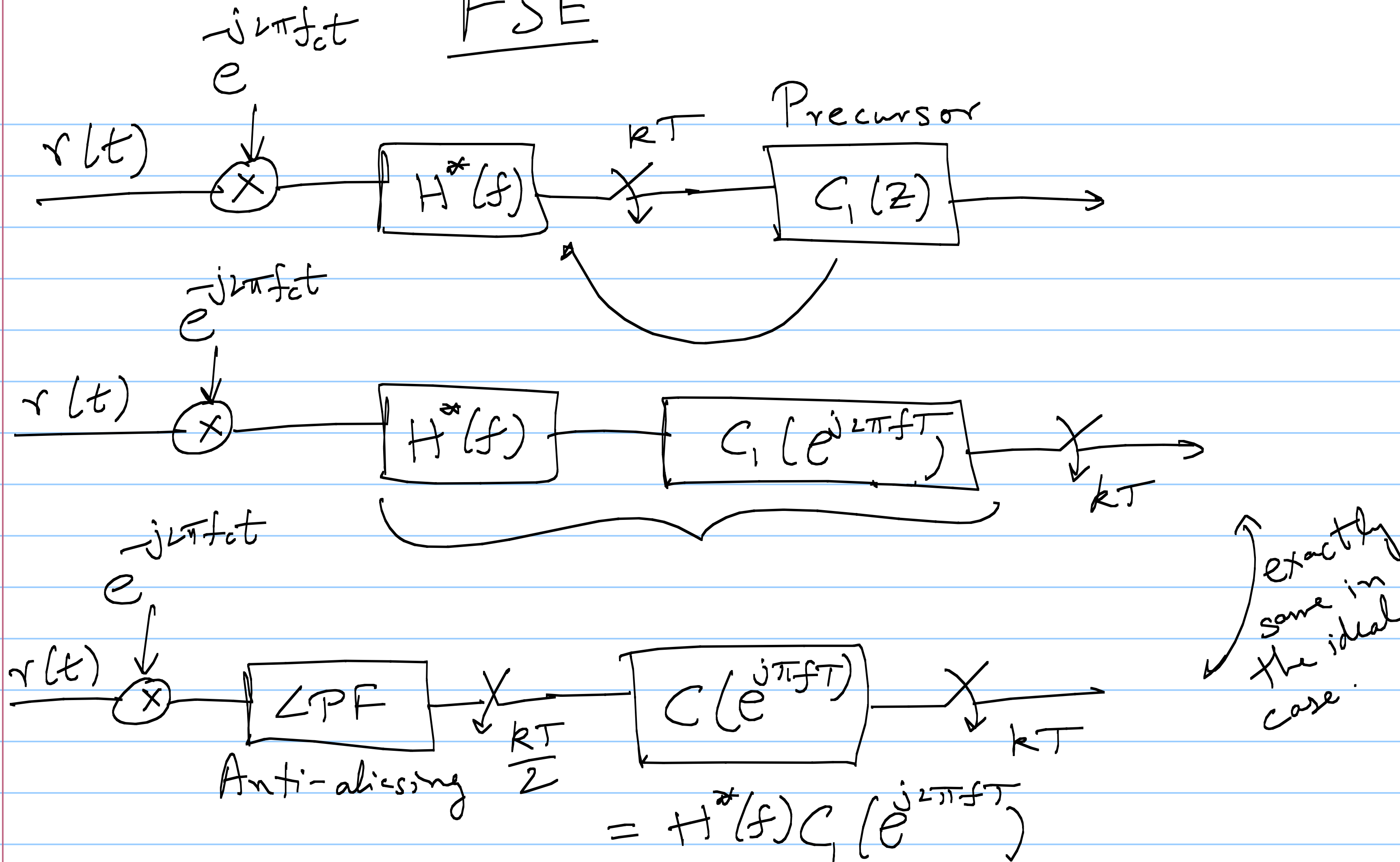
$$0 \leq f \leq \frac{1}{2T}$$

$$\left| 1 + \gamma e^{-j\frac{2\pi t_0}{T}} \right|^2 = 1 + \gamma^2 + 2\gamma \cos\frac{2\pi t_0}{T}$$

$S(e^{j\omega})$: varies according to t_0

→ Unknown delay can result in a poor folded spectrum.

FSE



$e^{-j2\pi f_c t}$
$r(t)$
$H^*(f)$
kT
Precursor
$C_1(z)$
$e^{-j2\pi f_c t}$
$r(t)$
$H^*(f)$
$C_1(e^{j2\pi fT})$
kT
$e^{-j2\pi f_c t}$
$r(t)$
LPF
Anti-aliasing
$\frac{kT}{2}$
$C(e^{j\pi fT})$
kT
$= H^*(f)C_1(e^{j2\pi fT})$
exactly same in the ideal case.

Adaptation:

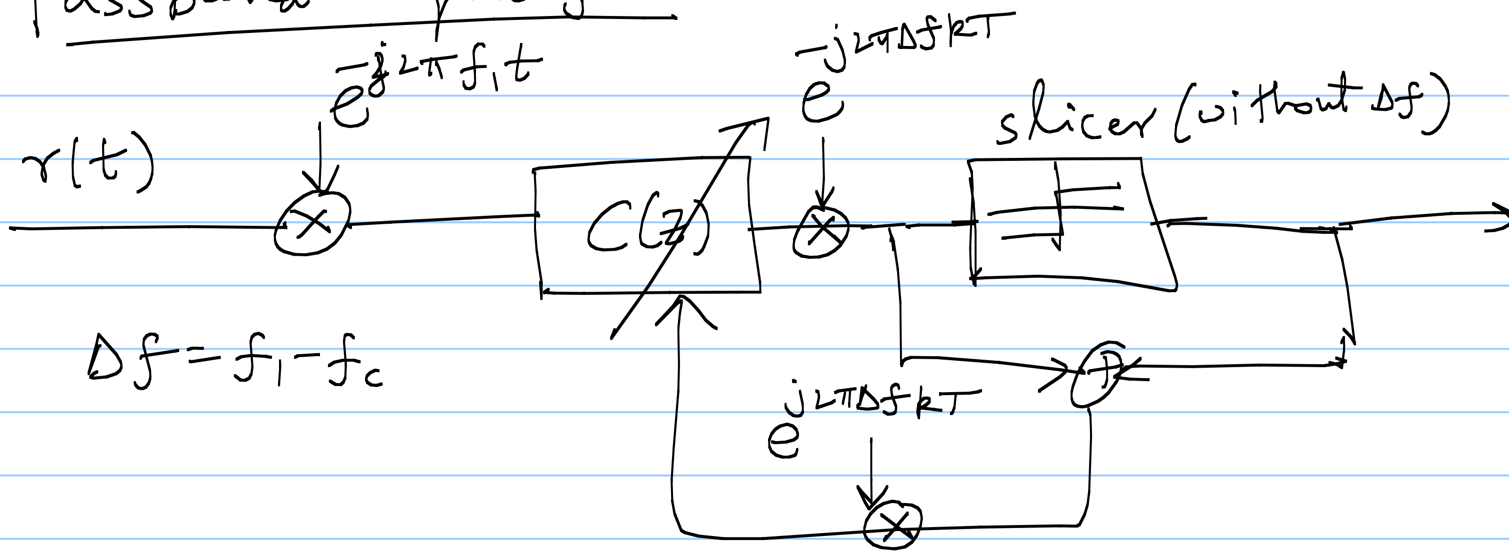
→ Drop alternate sample

→ $\frac{2}{T}$ -sampling ⇒ eigenvalues of ϕ going to zero.

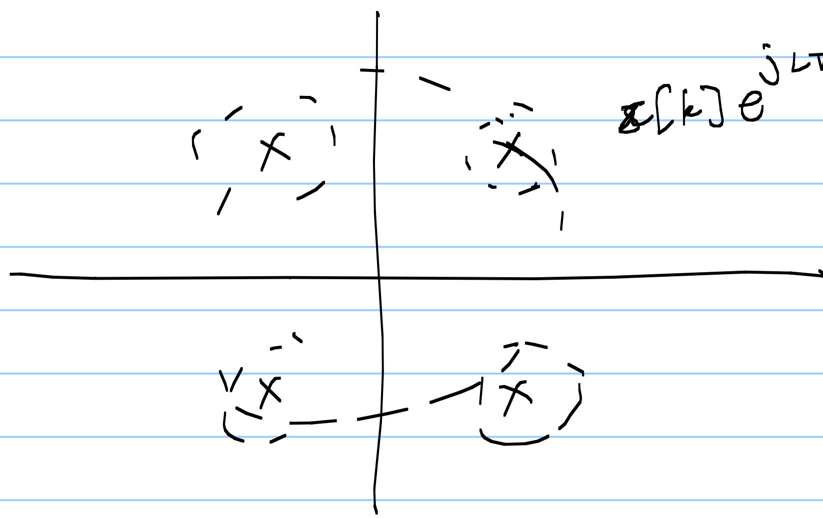
Complexity:

↳ Same # of taps for $\frac{2}{T}$ & $\frac{1}{T}$ -sampled precursors.

Passband equalizers



$\Delta f = f_1 - f_c$



$x[k]\, e^{j2\pi \Delta f\, kT}$