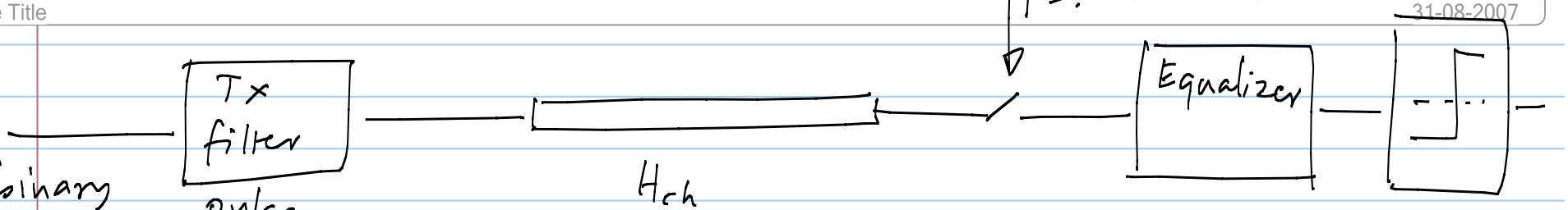
Linear Equalizers:

Note Title 31-08-2007



$$(h[0] + h[1]\cdot z^{-1})\,(g[0] + g[1]\,z^{-1} + \dots)$$

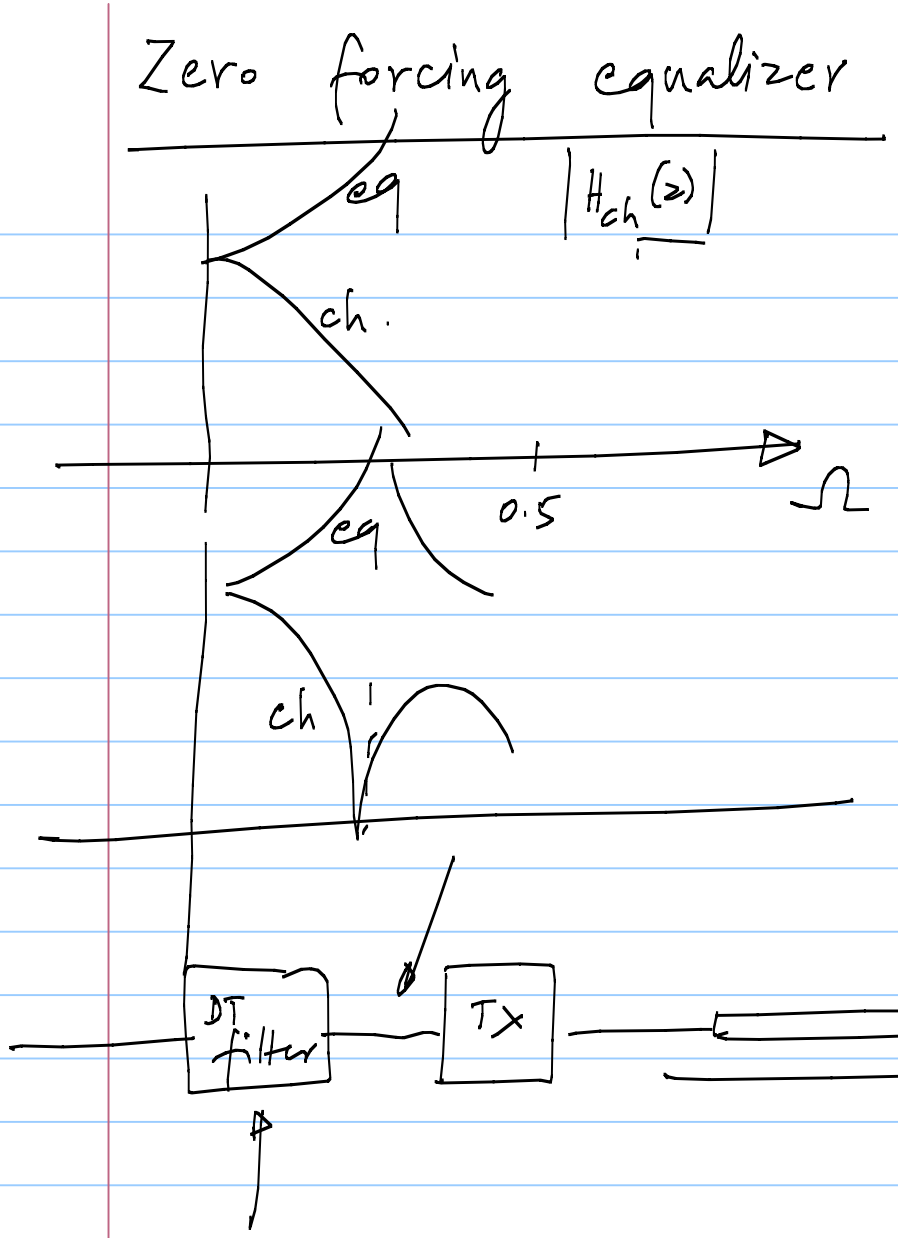
① Make the response of the channel + equalizer = $1, 0, 0, 0 \dots *$

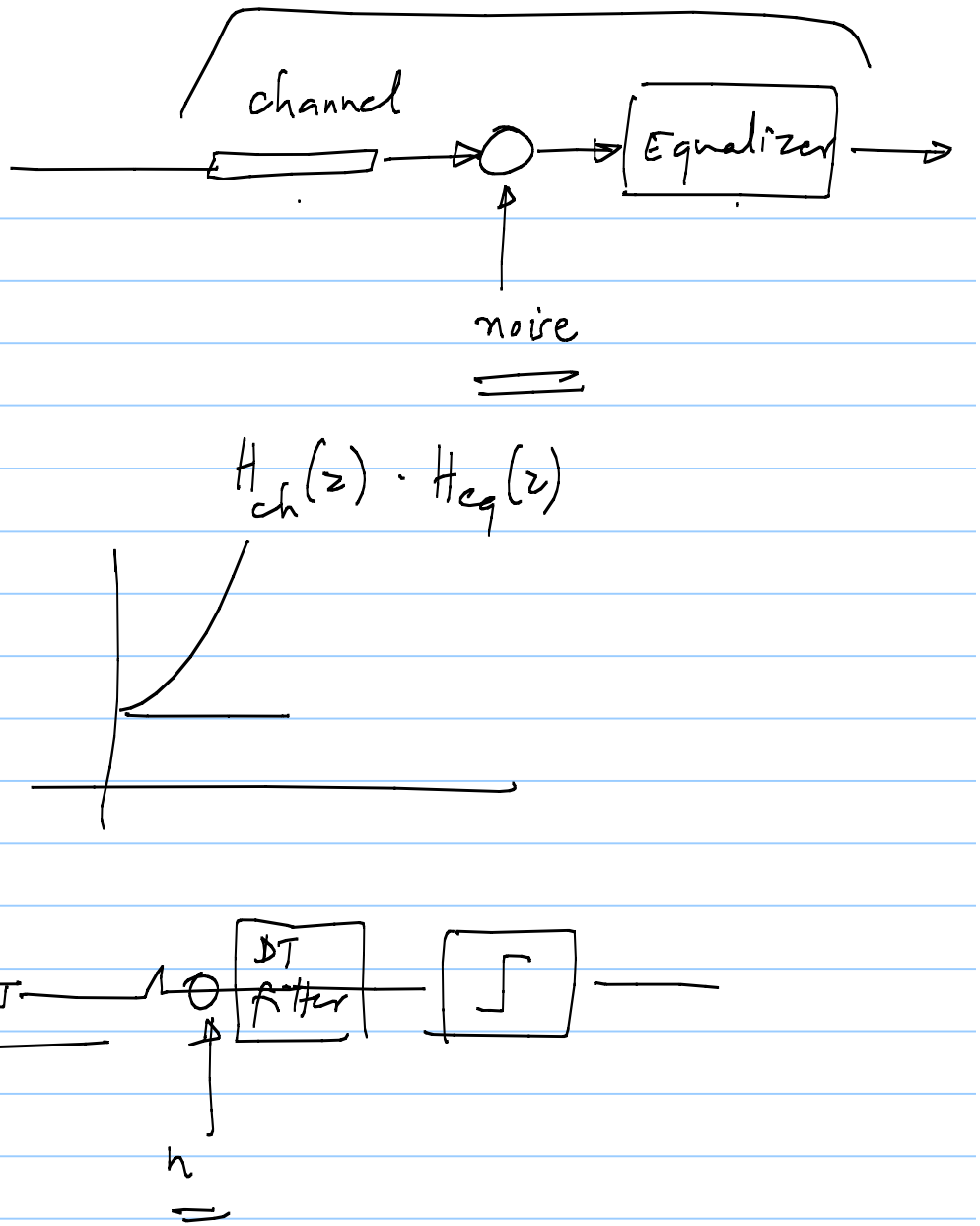
For exact equalization $H_{eq}(z) = \dfrac{1}{h[0] + h[1]z^{-1}}$

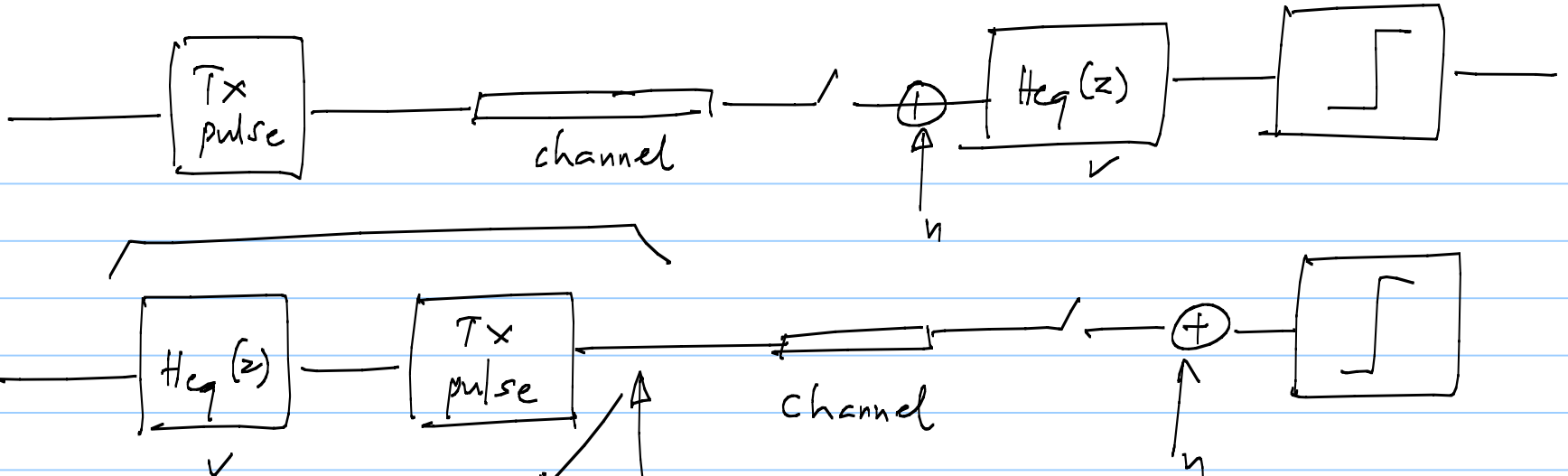
$$\frac{1}{h[0] + h[1]z^{-1}} = f[0] + f[1]z^{-1} + f[2]z^{-2} + \dots$$

② $G(z)$: FIR by truncating the inverse of the channel.

Zero forcing equalizer

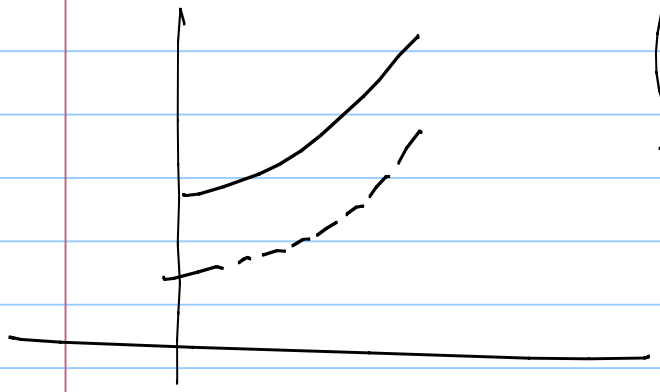


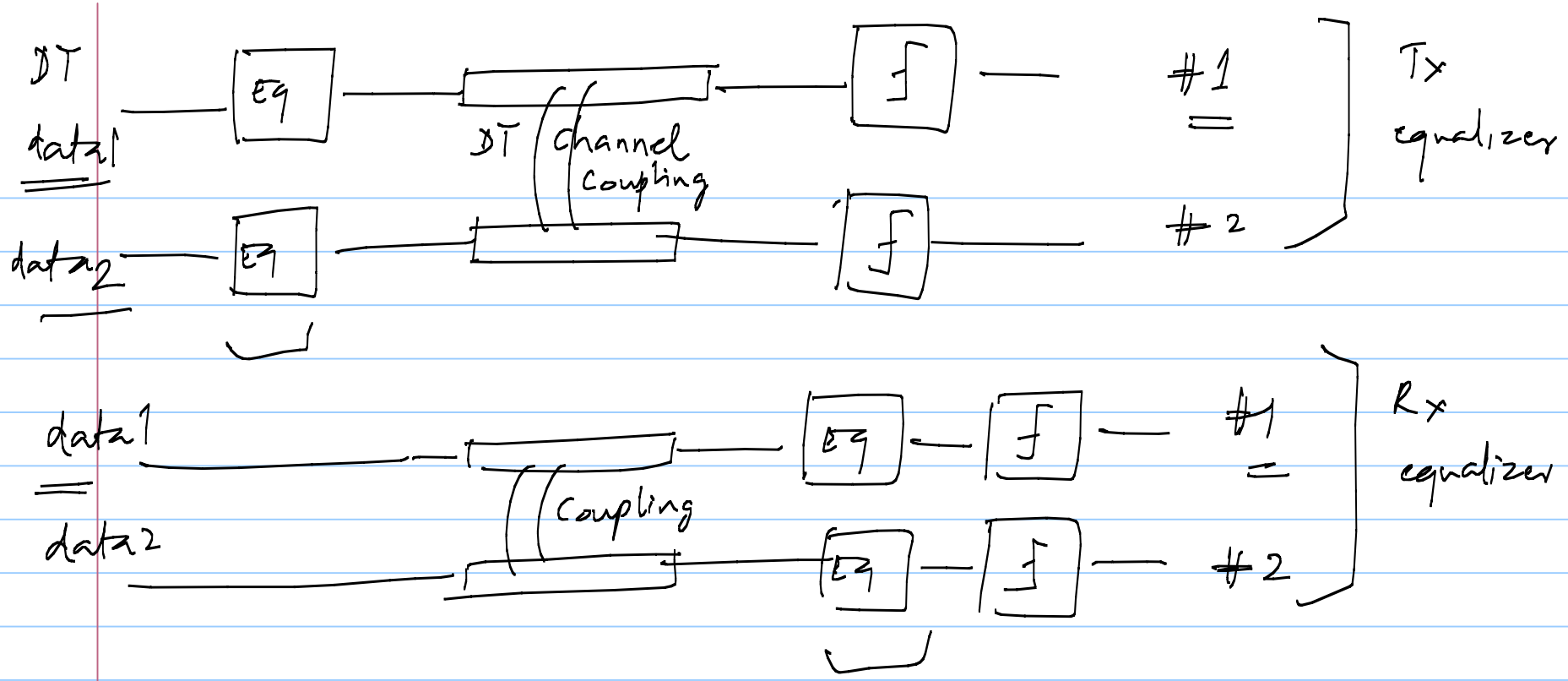




(Much larger signal strength)

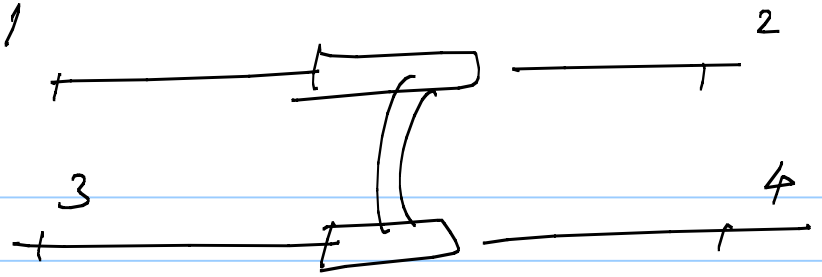
[Random noise unrelated to the signal





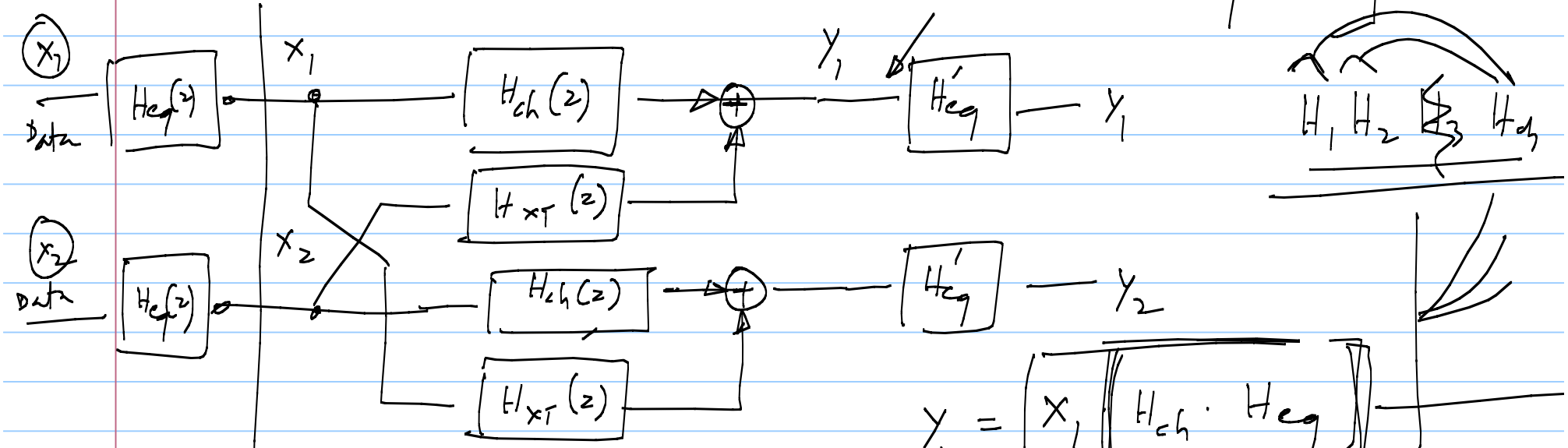
$a_0\ a_1\ a_2$

$b_0\ b_1\ b_2$



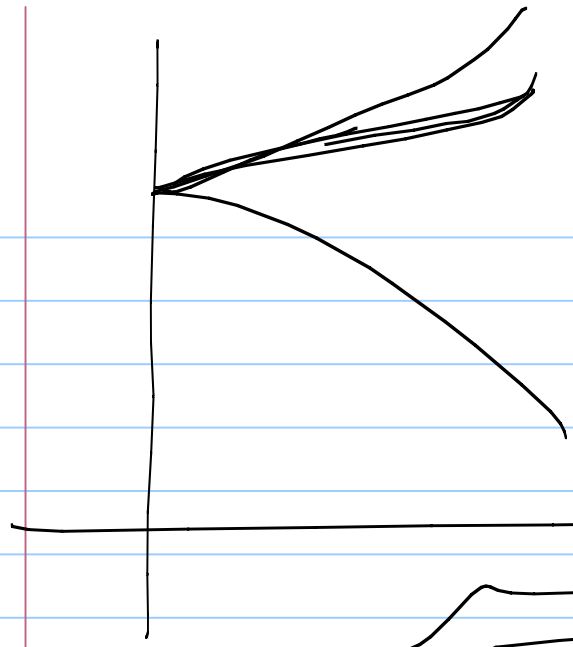
$$Y_1 = X_1 \boxed{H_{eq} \cdot H_{ch}} + X_2 \cdot H_{eq} \cdot H_{xT}$$

Tx equalizer



$$Y_1 = \boxed{X_1 \boxed{H_{ch} \cdot H_{eq}}} + X_2 \cdot H_{xT} \cdot H_{eq}$$

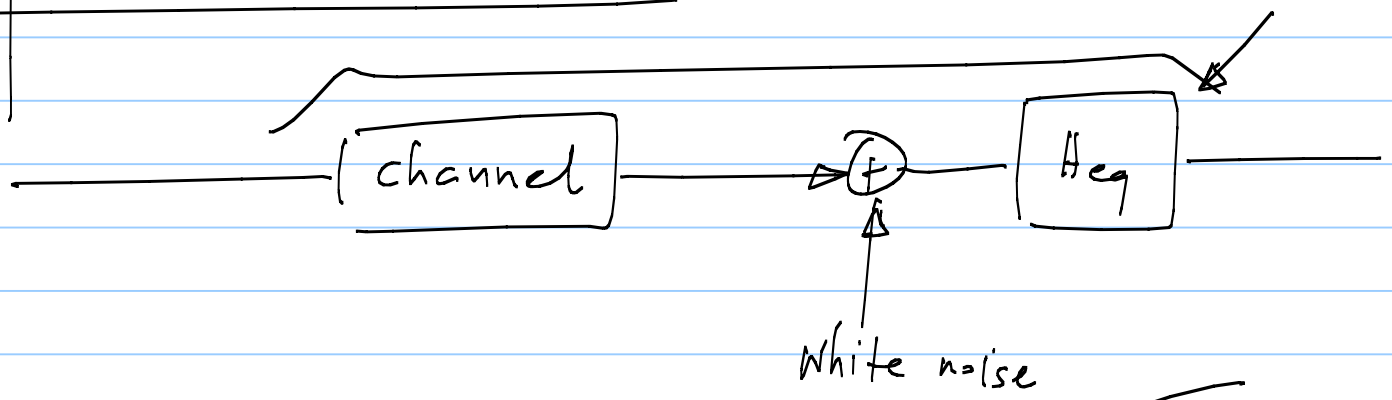
Crosstalk: makes no difference whether the equalizer is in the transmitter or the receiver



Zero forcing : Inverts the channel

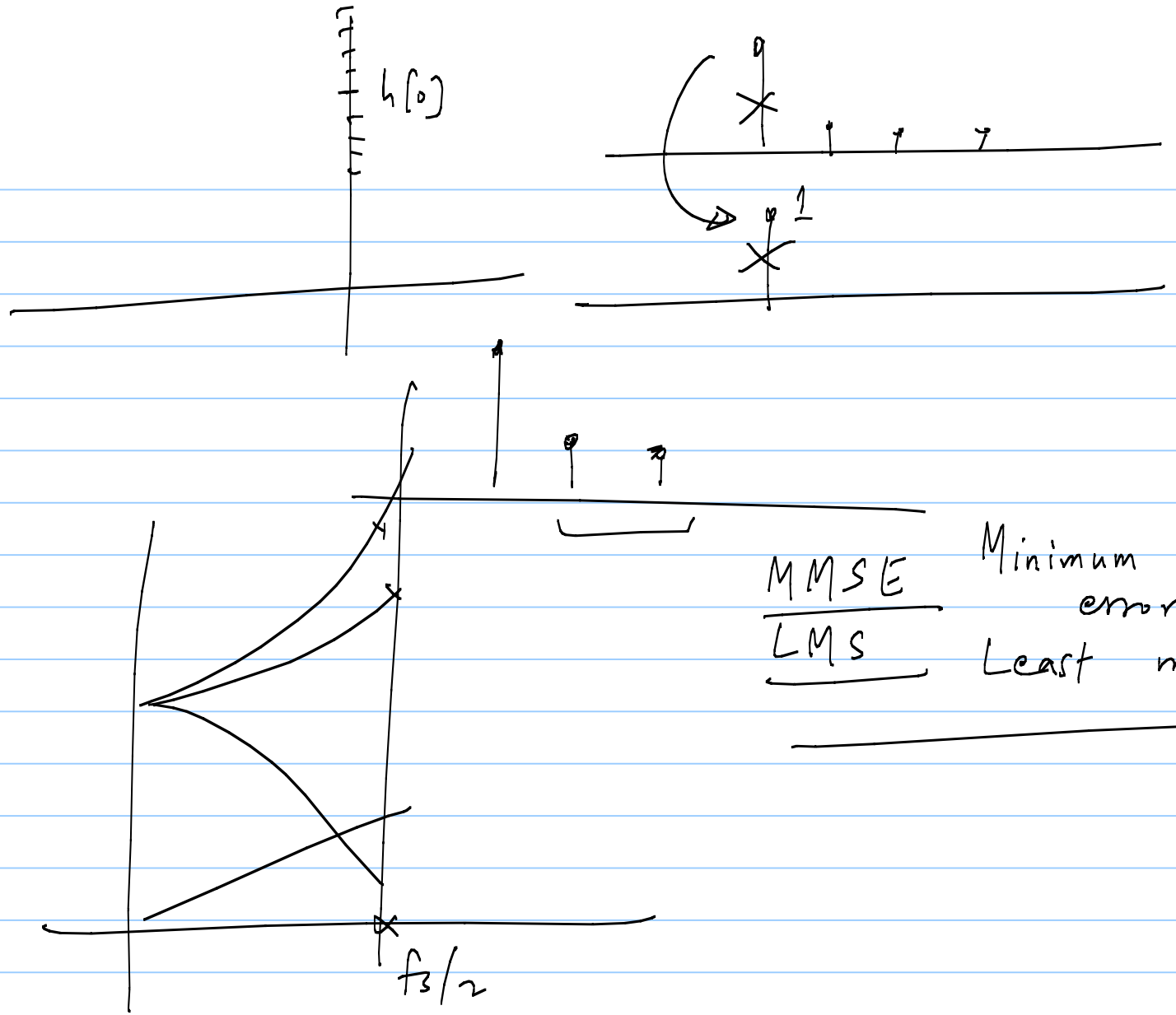
→ Minimizes $I s I$

But can amplify the noise a lot



$H_{ch}(z) \cdot H_{eq}(z) \longrightarrow h_{ch}[n] * h_{eq}[n] = h_{total}[n]$

Minimize $\sum_{n \neq 0} h_{total}[n]^2$



MMSE — Minimum mean squared error

LMS — Least mean square

* channel: high frequency attenuation

* Equalizer: Needs to provide high freq. boost

* Invert the channel
  - Zero forcing equalizer ✓

Large gain where the channel has a large attenuation
  - Large gain for hf noise & crosstalk

* - Minimize MSE in the channel + equalizer response ✓
  - Lesser boost at hf
  - Better with noise & crosstalk