channel Estimation (hest)

$$y_p = Rk_p + \text{noise}$$

$$Rk_p = x_p * h$$

To make y_p as circular convolution of $x_p * h + \text{noise}$

$$z_p = \text{flip}(y_p)$$

$$y_p = y_p(1:L-1) + \text{flip}\left(z_p(1:L-1)\right)$$

$$X = \text{fft}(x_p) \quad , \quad Y = \text{fft}(y)$$

$$H = X / Y$$

$$h_{est} = \text{ifft}(H)$$

MMSE Equalization :

$$H = \text{Toeplitz}(h_{est})$$

$$w = \left(H^* H + \frac{I}{SNR}\right)^{-1} H^* \longrightarrow \text{MMSE filter}$$

↳ Least Squares problem

$$\hat{x} = w * y$$

where, $y = x * h + \text{noise}$