

- $\mathbf{Y}' = Q^\top \mathbf{Y}$ and $\mathbf{X}' = Q^\top \mathbf{X}$ (since $\mathbf{X} = Q\mathbf{X}'$).

- Let $\mathbf{Z}' = Q^\top \mathbf{Z}$, and so \mathbf{Z}' is also Gaussian. Then

$$\mathbf{Y}' = Q^\top \mathbf{Y} = Q^\top (\mathbf{X} + \mathbf{Z}) = Q^\top \mathbf{X} + Q^\top \mathbf{Z} = \mathbf{X}' + \mathbf{Z}'.$$

- The equivalent noise vector \mathbf{Z}' is uncorrelated, because

$$K_{\mathbf{Z}'} = Q^\top K_{\mathbf{Z}} Q = Q^\top (Q \Lambda Q^\top) Q = \Lambda,$$

i.e., $Z'_i \sim \mathcal{N}(0, \lambda_i)$, and Z'_i , $1 \leq i \leq k$ are mutually independent.

- The “equivalent system” is a system of parallel Gaussian channels.