

- Since $\mathbf{X}' = Q^\top \mathbf{X}$ and Q^\top is an orthogonal matrix, by Proposition 10.9,

$$E \sum_i (X'_i)^2 = E \sum_i X_i^2.$$

- Therefore, the input power constraint

$$E \sum_i X_i^2 \leq P$$

of the original system translates to the input power constraint

$$E \sum_i (X'_i)^2 \leq P$$

of the equivalent system.