4) MIMO - Channel Capacity

→ The research in the MIMO systems is motivated by an afford to increase the system capacity.

→ The capacity of the quadrastic channel depends purely on the transmitted signal power, noise and channel characteristics.

→ The channel capacity of a flat fading deterministic channel can be expressed as

$$C = \log_2 \left[\det \left(I + \frac{P}{M_T} H H^* \right) \right.$$

Where,

*) $P = \frac{P}{\sigma^2_n}$, P is transmitted signal

*) σ^2_n , noise power

*) H , matrix

*) * , denotes transpose conjugate of channel matrix H.

The enlargement of the MIMO system capacity can be described as multiplexing data streams into parallel subchannel (pipes) on the same frequency band.

However, by a singular value decomposition (SVD) the channel matrix can be decomposed into diagonal matrix $A^{1/2}$ and two unitary matrices U and V:

$$H = UA^{1/2}V^{*}.$$

The modified received signal is expressed by

$$\left[\tilde{y}(k) = A^{1/2}\tilde{x}(k) + \tilde{n}(k)\right]$$

By knowing the gain of the independent channels at the transmitter we can determine the optimum power distribution on each transmitter antenna to achieve the maximum capacity.

The MIMO Channel capacity is determined by Waterfilling theorem.

$$C = \sum_{i}^{N} \log_2 \left(1 + \lambda_i \frac{P_i}{\sigma_n^2}\right),$$

where P_i is the power allocated to channel i.

$$\left[C = \sum_{i}^{N} \log_2 \left(1 + \rho \frac{\lambda_i}{M_T}\right)\right].$$

Diversity gain

→ It is the increase in signal to interference ratio due to some diversity scheme.

→ It is usually expressed in decibels, and sometimes as a power ratio.

→ Diversity coding sends multiple copies through multiple transmit antennas, so as to improve the reliability of the data reception.