EE 6880: Topics in Signal Processing - Space-time Coding and Signal Processing for Wireless Communications

Chapter 1: Capacity of MIMO channels

- Entropy, mutual information and channel capacity
  - Entropy, joint entropy, conditional entropy and their properties
  - Mutual information, conditional mutual information, and their properties
  - Channel capacity and channel coding theorem
- Complex Gaussian distribution
  - Definition of $\mathcal{N}_c(\boldsymbol{\mu}, \boldsymbol{C}, \tilde{\boldsymbol{C}})$
  - Properties of transformation $\boldsymbol{X} \in \mathbb{C}^{m \times n} \rightarrow \bar{\boldsymbol{X}} \in \mathbb{R}^{2m \times 2n}$
  - Pdf and entropy of $\mathcal{N}_c(\boldsymbol{\mu}, \boldsymbol{\Sigma})$
- Capacity of MIMO fading channels
  - Ergodic capacity result - no CSIT and perfect CSIR
  - Outage capacity
  - Analysis of independent Rayleigh fading - (i) $n_T = 1$; (ii) $n_R = 1$; (iii) $n_T = n_R$
  - Upper and lower bounds on capacity
  - Modelling of MIMO fading correlation and its effects on capacity

References:

◇ *Information theory:*

0. T.M. Cover and J.A. Thomas. *Elements of Information Theory*, Wiley, 1991.

◇ *MIMO capacity:*

1. I.E. Telatar. Capacity of multi-antenna Gaussian channels. *European Trans. on Telecomm.*, 10:585–595, Nov. 1999.
2. G.J. Foschini and M.J. Gans. On limits of wireless communications in a fading environment when using multiple antennas. *Wireless Personal Communications*, 6:311–335, 1998.

◇ *Modelling and effects of MIMO correlation:*

3. D.-S. Shiu, G.J. Foschini, M.J. Gans, and J.M. Kahn. Fading correlation and its effect on the capacity of multielement antenna systems. *IEEE Trans. Commun.*, 48(3):502–513, Mar. 2000.
4. C.-N. Chuah, D.N.C. Tse, J.M. Kahn, and R.A. Valenzuela. Capacity scaling in MIMO wireless systems under correlated fading. *IEEE Trans. Inform. Theory*, 48(3):637–650, Mar. 2002.