Journal Watch:

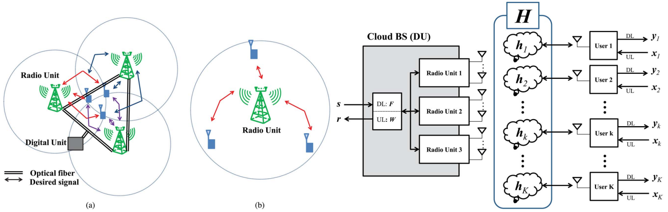
Transanctions on Wireless Communication, December, 2015

Saurabh Khanna,
Signal Processing for Communication, ECE, IISc

Performance Analysis of Massive MIMO for Cell Boundary Users

Authors: Yeon-Geun Lim, Chan-Byong Chae and Giuseppe Caire

- Multi user massive MIMO scenario



- **Question 1**. What is the sum rate expression for K-user, massive MIMO system for the two precoding strategies?
  - Zero-Forcing (ZF), precoding matrix $F = H^*(HH^*)^{-1}$
  - Maximum Ratio Transmission (MRT), precoding matrix $F = H^*$
- **Question 2**. Which is a better technique for enforcing power constraints? Vector or Matrix normalization
- **Question 3**. How to select between ZF and MRT modes?

Performance Analysis of Massive MIMO for Cell Boundary Users

- **Question 1**. Sum rate expression for K-user, massive MIMO system ?
  - For Zero Forcing (ZF):

$$R_{\text{downlink},ZF,vec} \approx K \log \left\{ 1 + \frac{P_t(M-K+1)}{K} \right\}$$

  - For Maximum Ratio Transmission (MRT):

$$R_{\text{downlink},MRT,mat} \approx K \log \left\{ 1 + \frac{P_t(M+1)}{P_t(K-1)+K} \right\}$$

  - Sum rate approximations also derived for uplink.

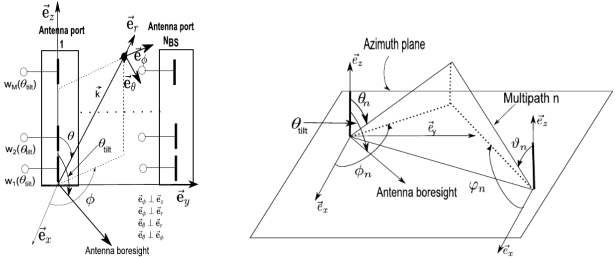
- **Question 2**. Which is a better technique for enforcing power constraints? Vector or Matrix normalization
  - For ZF, vector normalization is better
  - For MRT, matrix normalization is better

- **Question 3**. How to select between ZF and MRT modes?
  - Based on thresholding rule on no. of users, whichever gives higher rate

3D Massive MIMO systems: Modeling and Performance Analysis

Authors: Qurrat Ul Ain Nadeem, Abla Kammoun, Merouane Debbah, Mohamed S. Alouini

- 3D MIMO Channel Model:



$$[H]_{su} = \frac{1}{N}\sum_{n=1}^{N} \alpha_n \sqrt{g_t(\phi_n, \theta_n, \theta_{tilt})} e^{ik(s-1)d_t sin\phi_n sin\theta_n} \cdot \sqrt{g_r(\psi_n, \nu_n,)} e^{ik(u-1)d_r sin\psi_n sin\nu_n}$$

- Why 3D Massive MIMO systems ?
  - 3D beamforming can unlock variety of network capacity enhancing strategies such as (i) user specific elevation beamforming (ii) 3D cell splitting.

3D Massive MIMO systems: Modeling and Performance Analysis

- Distribution of Mututal Information (MI) or Capacity is needed to evaluation and characterization of system performance.
- The key ingredient for MI characterization is a handle on the distribution of 3D-channel (matrix).
- By using maximum entropy principle, a distribution for **H** (3D-channel matrix) is obtained which is consistent with the apriori knowledge of AoA, AoD and no. of scatterers.

$$\mathbf{H} = \frac{1}{\sqrt{N}}\mathbf{B}\,\mathrm{diag}(\alpha)\,\mathbf{A}^H, \qquad \alpha \sim \mathcal{N}(0, \mathbf{I})$$

  where matrices **A** and **B** capture the array responses and antenna patterns.
- Special structure of **H** allows us to say something about evals of $\mathbf{H}\mathbf{H}^H$, which is helpful in characterizing the outage probability, i.e., $\mathbb{P}(I(\sigma^2) < y)$, where

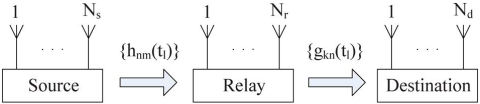
$$I(\sigma^2) = \log\det\left\{\mathbf{I}_{N_{MS}} + (\mathbf{R} + \sigma^2\mathbf{I}_{N_{MS}})^{-1}\mathbf{H}\mathbf{H}^H\right\}.$$

Social Aware Resource Allocation for Device to Device Communication Underlaying Cellular Networks

- **Problem Statement**
  - Resource block allocation in underlay D2D communication system.
- **Proposed solution**
  - Resouce allocation problem treated as a cooperative game.
  - Exploiting social structure between D2D users helps in improving system performance.
  - Link feasibility profile is obtained by assuming fixed transmit powers for the BS, D2D and cell users.
  - Each D2D user *d* maximizes its own social group utility subject to link feasibility constraints.
  - The social group utility of user *d* is weighted sum of 'rates' of all communication links which belong to user *d*'s social group.
  - Existence of Nash equilibrium is shown.
  - A distributed algorithm to attain Nash equilibrium is also proposed.

Channel Estimation for Time Varying MIMO Relay Systems Authors: Choo W. R. Chiong, Yue Rong and Yong Xiang

- Three hop, two node MIMO relay communication: ('Amplify and Forward')



- In conventional schemes, channel matrices H and G are estimated separately, which is claimed to be sub-optimal.
- Channel is modelled using basis expansion model (BEM) to capture its time varying nature.

$$h_{nm}(t) = \sum_{q=0}^{Q} \mu_{nm}(q) e^{j2\pi t \frac{(q-Q/2)}{T}} \qquad m \in [Ns], n \in [Nr], t \in [T]$$

- High level strategy:
  - The received signal $\mathbf{y}$ at destination is linearly related to G and signal $\mathbf{x}$ transmitted by relay.
  - Estimate $\mathbf{x}$ and G from observed $\mathbf{y}$ via LMMSE.
  - Once $\mathbf{x}$ is estimated, one can estimate H using a linear measurement model, once again.
- Optimal training sequences and optimal relay gain are derived such that MSE of channel estimates is minimized.