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Mohit Sharma

Signal Processing for communication Lab.
Department of ECE, IISc

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- The Degrees of Freedom of MIMO Networks With Full-Duplex Receiver Cooperation but no CSIT

Authors: Chinmay S. Vaze and Mahesh K. Varanasi

System Model

- MIMO IC with receiver cooperation

$$Y_1(t) = H_{11}(t)X_1(t) + H_{12}(t)X_2(t) + G_{12}(t)X_{R2}(t) + W_1(t)$$
$$Y_2(t) = H_{21}(t)X_1(t) + H_{22}(t)X_2(t) + G_{21}(t)X_{R1}(t) + W_2(t)$$

- MIMO BC with receiver cooperation

$$Y_1(t) = H_1(t)X(t) + G_{12}(t)X_{R2}(t) + W_1(t)$$
$$Y_1(t) = H_2(t)X(t) + G_{21}(t)X_{R1}(t) + W_2(t)$$

- Each receiver has perfect knowledge of all channel metrices, except of the one cooperative link which originates from it to the other receiver
- Full-duplex receiver cooperation
- No CSIT

Results

- In general for IC with no receiver cooperation,

$$\mathbf{D}^{\text{no}} \subseteq \mathbf{D}^{\text{d}} \subseteq \mathbf{D}^{\text{S}} \subseteq \mathbf{D}^{\text{p\& i}} = \mathbf{D}^{\text{coop}}$$

- With perfect and instantaneous CSIT, receiver cooperation doesn't enhance the DoF, compared to half-duplex receivers.
- With no CSIT receiver cooperation appears to yield most of the gains promised by delayed CSIT, or even Shannon feedback.
- DoF benefits with receiver cooperation are realized using *retro-cooperative* interference alignment scheme.
- These schemes are DoF-region optimal for certain classes of MIMO ICs and BCs
- The outer bounds provided for DoF do not appear to be tight for unequal number of antennas at the receiver.

- Feasibility of Interference Alignment for the MIMO Interference Channel

Authors: Guy Bresler, Dustin Cartwright and David Tse

System Model

- K-user MIMO interference channel
- Cadambe and Jafar: For time-varying or frequency selective channels with *unbound diversity*, total degrees of freedom are $\frac{K}{2}$, i.e., DoF/per-user *independent* of K.
- How diversity affects the ability to align interference?
- Goal: Impact of spatial diversity on interference alignment
- No time or frequency diversity
- Linear precoding scheme

Results

- Problem Statement: Given a number of user K, number of antennas $M_1 \ldots, M_K$ and $N_1, \ldots, N_K$, and desired subspace dimensions $d_1, \ldots, d_K$. Find subspaces $U_1, \ldots, U_K$ with the desired dimensions s.t.

$$\mathbf{H}^{[ij]} U_j \perp U_i, 1 \leq i, j \leq K, i \neq j$$

- Total degrees of freedom with only spatial diversity is two.
- Necessary conditions for alignment and a achievable linear precoding scheme is provided for symmetric $K = 3$.
- For $K \geq 3$, $d_i = d$, and $M_i = N_i = N$ for all users i, there is a feasible strategy iff $2N \geq (K+1)d$
- Achievable DoF for fully symmetric is also provided.

- An Improved RIP-based Performance Guarantee for Sparse Signal Recovery Via Orthogonal Matching Persuit

Authors: Ling-Hua Chang and Jwo-Yuh Wu

Earlier Result

- Signal model:

$$\mathbf{y} = \Phi\mathbf{x} + \mathbf{w}$$

- OMP with stopping criteria
- Wu, Huang, and Chen, 2013
  1. (ℓ_2-bounded noise): Under $||\mathbf{w}||_2 \leq \epsilon_1$, and stopping criterion $||\mathbf{r}^j||_2$, the support of the K-sparse signal $\mathbf{x}$ can be identified if $\delta_{K+1} < \frac{1}{\sqrt{K+1}}$ and the non zero entries satisfies

$$\min_{i \epsilon T} |(\mathbf{x})_i| > \frac{(\sqrt{1+\delta_{K+1}}+1)\epsilon_1}{1-\delta_{K+1}-\sqrt{K}\delta_{K+1}}$$

  2. (ℓ_∞-bounded noise): If $||\Phi^*\mathbf{w}||_\infty \leq \epsilon_2$, and stopping criteria $||\Phi^*\mathbf{r}^j||_\infty \leq \epsilon_2$, then for exact support recovery

$$\min_{i \epsilon T} |(\mathbf{x})_i| > \frac{(\sqrt{\delta_{K+1}}+1)\sqrt{K}\epsilon_2}{1-\delta_{K+1}-\sqrt{K}\delta_{K+1}}$$

Improved Results

1. (ℓ_2-bounded noise): $\delta_{K+1} < \frac{\sqrt{4K+1}-1}{2K}$ and $\min_{i \epsilon T} |(\mathbf{x})_i| > \frac{(\sqrt{1+\delta_{K+1}}+1)\epsilon_1}{1-\delta_{K+1}-\sqrt{1-\delta_{K+1}}\sqrt{K}\delta_{K+1}}$
2. (ℓ_∞-bounded noise): $\min_{i \epsilon T} |(\mathbf{x})_i| > \frac{(\sqrt{K}+1)\epsilon_2}{1-\delta_{K+1}-\sqrt{1-\delta_{K+1}}\sqrt{K}\delta_{K+1}}$

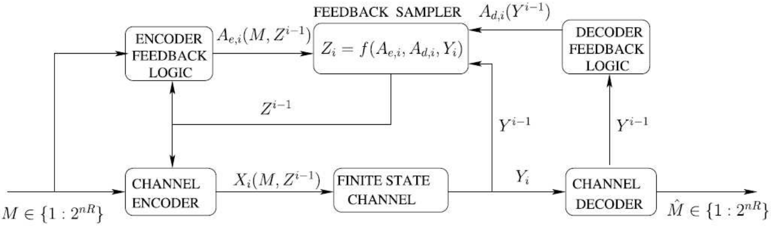
- In noiseless case, it ensures exact support recovery in K iteration.
- *Near-Orthogonality* condition: Let $\mathbf{u} \perp \mathbf{v}$ s.t. $|T_u \cup T_v| \leq K$, and Φ satisfies RIP of order K with RIC δ_K. Then

$$|\cos \measuredangle(\Phi_{\mathbf{u}}, \Phi_{\mathbf{u}})| \leq \delta_K$$

- To Feed or Not to Feedback

  Authors: H. Asnani, H. H. Permuter, and T. Weissman

Setup



The codes satisfy the cost constraint

$$E\left[\Lambda\left(A_e^N, A_d^N\right)\right] = E\left[\frac{1}{N}\sum_{i=1}^{N}\Lambda\left(A_{e,i}, A_{d,i}\right)\right] \leq \Gamma$$

Contributions

- Exactly characterize the capacity of finite state channels when $P(s_0) > 0, \forall\, s_0$
- Capacity of indecomposable FSC without ISI
- Blahut-Arimoto algorithm is provided for the case when actions are cost-constrained.
    - To feed or not to feedback
- Characterization of capacity using a dynamic programming formulation

Other Papers

- *“Compress-and-Forward Scheme for Relay Networks: Backword Decoding and Connection to Bisubmodular Flows”*, A. Raja and P. Viswanath
- *“Index Coding - An Interference Alignment Perspective”*, H. Maleki, V. R. Cadambe, and S. A. Jafar
- *“Private Broadcasting over Independent Parallel Channels”*, A. Khisti and T. Liu
- *“Fading Channels With Arbitrary Inputs: Asymptotics of the Constrained Capacity and Information and Estimation Measures”*, A. G. C. P. Ramos and M. R. D. Rodrigues