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B.N. BHARATH
SPC LAB, ECE Dept.

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

- State dependent channel with states available at the encoder and the decoder on demand bases which comes at a cost. Tx. has one of $[1, 2^{nR}]$ independent message to convey
- Should the encoder and the decoder probe the channel? If so, when?
- What is the data rate achievable?

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Probing Capacity: *Continued...*

- Solution:

Theorem

The "probing capacity" when the encoder generates channel inputs using partial state information non-causally as in Fig. 2 ***(See the paper)*** *with cost constraint* Γ*, is given by*

$$\max \left\{ I(U; Y, S_d) - I(U; S_e, A) \right\},$$

where maximization is over all $P_{A,S,S_e,S_d,U,X,Y}$

- How do they achieve this? Read the paper!
- Drawback?
  - If you choose to probe the channel you get the entire channel information perfectly
  - What if the cost Γ is a function of the accuracy of the state thus obtained
  - More suitable for memory with defects problem but not for the wireless channel scenarios! (I think so!)

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Limits on Support Recovery of Sparse Signals via Multiple-Access Communication Techniques:
Authors: Y. Jin, Y. Kim and B. D. Rao

- Problem statement:
  - $Y = A\mathbf{X} + \mathbf{Z}$, where $\mathbf{X} \in \mathcal{R}^n$ is k sparse.
  - what is the minimum number of measurements do we need to recover $\mathbf{X}$?
- Answer *(Necessary and Sufficient)*:
  - $m = \dfrac{\log n}{c(\mathbf{X})}$
  - How do they go about proving this?
- Information theoretic tools: Analogy between MAC channel and the problem of interest!

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- System Model:
  - $(N_t \times M), k = 1, 2, \ldots, K$ down-link channel with CSIR with the uplink channel sharing the same frequencies
  - Channel remains constant for a duration of the coherence time T
- How do we achieve high multiplexing gain? Fast transfer of CSI to the BS
- How do we achieve fast CSI transfer?
- Motivation:
  - Let r_k be the multiplexing gain of user k, $k = 1, \ldots, K$:

$$R_k(\rho) = R_k^{ideal}(\rho) - r_k \log\left(1 + \frac{M-1}{M}\rho D_k(\rho)\right) + \mathcal{O}(1)$$

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Channel State Feedback Over the MIMO-MAC: *Continued..*

- What is the right metric? min max distortion function ($D(\rho) := \max_{i=1,2,\ldots,K} D_k(\rho)$):

$$\max \left\{ - \lim_{\rho \to \infty} \frac{\log D(\rho)}{\log \rho} \right\}$$

- What is the right strategy that minimizes the above metric?
  - Joint source channel coding over MIMO MAC?
  - Hybrid coding?
  - Separate source channel coding?
- Which one to choose? See the paper!

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The Degrees of Freedom of Isotropic MIMO Interference Channels Without State Information at the Transmitters: *Authors*: Y. Zhu and D. Guo

- System Model:
  - $(M_1, M_2 \times N_1, N_2)$ Interference channel with no CSIT and perfect CSIR
  - Channel statistics: arbitrary with finite second moment $+$ *isotropic*
- Problem: What is the DOF?
- Result: Closes the existing gap of Vaze and Varanasi, and Huang, Jafar, Shamai, and Vishwanath
- What is the scheme? Use random Gaussian codebooks independent of the channel states
- The converse looks more involved than the direct part

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References:

- A Probabilistic and RIPless Theory of Compressed Sensing
  Authors: E. J. Candès and Y. Plan
- On the Error of Estimating the Sparsest Solution of Underdetermined Linear Systems
  Authors: M. Babaie-Zadeh, C. Jutten and H. Mohimani
- Unbiased Estimation of a Sparse Vector in White Gaussian Noise
  Authors: A. Jung, Z. Ben-Haim, F. Hlawatsch and Y. C. Eldar
- And many more!

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