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Group Testing Algorithms: Bounds and Simulations

Matthew Aldridge, Leonardo Baldassini, and Oliver Johnson

- Problem: Non-adaptive noiseless group testing of N items of which $K (\ll N)$ are defective
  - require no knowledge of K, or even bounds on K
- Existing Algorithm: Combinatorial Orthogonal Matching Pursuit (COMP)
  - find guaranteed not defective set $\mathcal{ND}$;
  - $\hat{\mathcal{K}}_{\mathrm{COMP}} = \mathcal{PD} = \mathcal{ND}^{\mathrm{C}}$; $\hat{\mathcal{K}}_{\mathrm{COMP}} \supseteq \mathcal{K}$
- Proposed Algo1: Definite Defectives (DD)
  - an item $i \in \hat{\mathcal{K}}_{\mathrm{DD}}$ if i is the only element from $\mathcal{PD}$ included in a positive test
  - $\hat{\mathcal{K}}_{\mathrm{DD}} \subseteq \mathcal{K}$

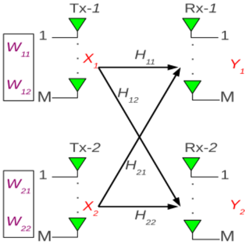
Group Testing Algorithms: Bounds and Simulations

- Proposed Algo2: Sequential COMP
  - terminate if group testing with defective set $\hat{\mathcal{K}}_{\text{SCOMP}}$, lead to correct outcomes
  - else add $i \in \mathcal{PD}$ which appears in the largest number of tests which are unexplained by $\hat{\mathcal{K}}$
- Proposed Algo3: Smallest Satisfying Set (SSS)
  - $\min \mathbf{1}^{\mathsf{T}} \boldsymbol{z}^*$ s.t $\boldsymbol{X}^* \boldsymbol{z}^* \geq 1$ and $\boldsymbol{z}^* \in \{0,1\}^{|\mathcal{N}^*|}$; $\mathcal{N}^* = \mathcal{N} / (\mathcal{ND} \cup \hat{\mathcal{K}}_{\text{DD}})$
- Achievable rates $\left(= \binom{N}{K} / T\right)$ with Bernoulli tests: $K = N^{1-\beta}$
  - $R_{\text{COMP}} \geq 0.53\beta$; $R_{\text{SSS}} \leq 0.53\frac{\beta}{1-\beta}$; $R_{\text{SCOMP}} \geq R_{\text{DD}}$
  - $R_{\text{DD}\geq} 0.53 \min\{1, \frac{\beta}{1-\beta}\}$: optimal for $\beta \leq 0.5$

Interference Alignment With Diversity for the 2×2 X-Network With Four Antennas

Abhinav Ganesan and B. Sundar Rajan

- (K, J, M) X-Network
  - Gaussian interference network
  - J receivers require one independent message from each of the K transmitters
  - M antennas at each node



System Model.

- sum-capacity $\approx d \log_2 \mathrm{SNR} + o(\log_2 \mathrm{SNR})$, where d is sum DoF

Interference Alignment With Diversity for the 2×2 X-Network With Four Antennas

- Assumptions: Global CSIR and local CSIT
- Proof of sum DoF of $\frac{8}{3}$ by the Li–Jafarkhani–Jafar(LJJ) scheme - (2,2,2) X-Network
  - using the Alamouti code and appropriate channel dependent precoding
  - the real and imaginary parts of the channel gains are distributed independently according to an arbitrary continuous distribution
- Extend the LJJ scheme to $(2, 2, 4)$ X-Network
  - using SR code possesses a repetitive Alamouti structure upto scaling by a constant
  - achieves the maximum possible sum DoF of $\frac{16}{3}(=\frac{4M}{3})$
  - achieves a diversity gain≥ 4, when fixed finite constellations appropriate rotation at each Tx

Other Papers

- **The Approximate Sum Capacity of the Symmetric Gaussian K-User Interference Channel**
  - O. Ordentlich, U. Erez, and B. Nazer
- **Interference Channels With Coordinated Multipoint Transmission: Degrees of Freedom, Message Assignment, and Fractional Reuse**
  - A. El Gamal, V. S. Annapureddy, and V. V. Veeravalli
- **Impact of Feedback and Side-Information on the Asymptotic Capacity of Single-Input Multiple-Output Fading Channels With Memory**
  - S. M. Moser
- **On the Capacity of the Half-Duplex Diamond Channel Under Fixed Scheduling**
  - H. Bagheri, A. S. Motahari, and A. K. Khandani