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- Decentralized Wireless Networks: Spread Spectrum Communications Revisited

Authors: K. Moshksar and A. K. Khandani

Affiliations: Department of Electrical and Computer Engineering, University of Waterloo, Waterloo

- Decentralized wireless network: K transmit-receive pairs
- Distributed signaling scheme: randomly spread CDMA system
- Statistics of signature generation of other users
    - Non-causal knowledge of its signature at its transmitter and receiver
    - Users are not aware of each other signature
- Users are unaware of each other codebook
    - Treat interference as noise

- Problem: Multiplexing gain of such network
- Key results:
  - SMG[1]: arbitrarily close to $\frac{K}{N}$ $(K < N)$
  - With match filtering: SMG $> \frac{1}{2e}$ regardless of number of users
  - Possible to achieve SMG of orthogonal scheme in decentralized network

[1] SMG: sum multiplexing gain

- Dynamic Network Delay Cartography

Authors: K. Rajawat, E Dall'Anese, and G. B. Giannakis

Affiliations: Department of Electrical and Computer Engineering, University of Minnesota, USA

- Monitor global network behavior: delay or loss of rates
- Measure and store the delays of all possible S-D pairs
  - No. of path grows almost with square of the number of nodes
- Problem: Predicting network wide performance using measurement only on a subset of nodes
  - Kriging: tool for spatial prediction
  - Dynamic network kriging approach: real-time spatio-temporal delay predictions

- Kriged Kalman filter (KKF)
  - Variation due to queuing delay
  - Topology based kriging predictor
- Advantages
  - Lower prediction error
  - Flexible: delay measurements can be taken on random subsets of paths
- Problem of choosing optimal path for delay measurement
  - Optimization problem: submodular
  - Solution: greedy algorithm

- Fundamental limits of caching

Authors: Mohammad Ali Maddah-Ali and U. Niesen

Affiliations: Bell Labs, Alcatel-Lucent, USA

- Caching: reduce peak traffic rates
  - Placement phase
  - Delivery phase
- Placement phase
  - N/W is not congested
  - Limitation: size of cache memories
- Delivery phase
  - N/W is congested
  - Limitation: rate required to serve the requested content

- Goal: Design the placement and delivery phases such that the load of the shared link in the delivery phase is minimized

- Coded caching scheme attains a rate of

$$\overbrace{\underbrace{\underbrace{K}_{\text{without caching}}\left(1-\frac{M}{N}\right)}_{\text{with caching}}\frac{1}{1+\frac{KM}{N}}}^{\text{with coded caching}}$$

- Multipath Matching Pursuit

Authors: S. Kwon, J. Wang, and B. Shim

Affiliations: School of Information and Communication, Korea University, Korea and Dept. of Statistics, Rutgers University, USA

- Recall: $\mathbf{x} \in \mathcal{R}^n$ can be reconstructed from $y = \Phi\mathbf{x} \in \mathcal{R}^m$ $(m < n)$ provided x is sparse
- OMP: index of the column that is best correlated with the modified measurements is chosen as new element of the support
- Problem in OMP: Error propagation
- Key steps of MMP
  - All combinations of K-sparse indices can be interpreted as candidates in a tree
  - Each layer of the tree sorted by the magnitude of correlation between column of Φ and residual
  - Candidate that minimizes the residual: can be formed as a combinatoric search problem
    - Tree search: greedy strategy

- Contributions
  - Sparse signal recovery algorithm (as mentioned in previous slide)
  - Perfect recovery of any K-sparse signal in the noiseless case

$$\delta_{L+K} < \frac{\sqrt{L}}{\sqrt{K} + 2\sqrt{L}}$$

  - Also, condition for true support recovery: noisy case
  - MMP-DF[2]: low complexity

[2] depth-first MMP

1. I. Shomorony and A. S. Avestimehr: Degrees of Freedom of Two-Hop Wireless Networks: Everyone Gets the Entire Cake
2. S. K. Jakobsen: Mutual Information Matrices Are Not Always Positive Semidefinite
3. U. S. Kamilov, S. Rangan, A. K. Fletcher, and M. Unser: Approximate Message Passing With Consistent Parameter Estimation and Applications to Sparse Learning
4. C. L. Chan, S. Jaggi, V. Saligrama, and S. Agnihotri: Non-adaptive Group Testing: Explicit Bounds and Novel Algorithms