Journal Watch
IEEE Transactions on Wireless Communications, February, March 2012 (Vol. 11, Issues 2,3)

Reuben George Stephen

SPC Lab,
Dept. of ECE,
Indian Institute of Science,
Bangalore-560012

April 14, 2012

User Partitioning for Less Overhead in MIMO Interference Channels

Steven W. Peters and Robert W. Heath, Jr.
The Univ. of Texas at Austin

- Study on MIMO interference channels, accounting for general overhead
- Training is known to effectively reduce the DOF of a point-to-point link
- Training required to estimate K^2 wireless channels in K-user MIMO interference channel can last nearly as long as coherence time
- As network grows, sum rate with overhead of IA goes to zero.
- Address question: How much overhead makes IA infeasible?

System Model

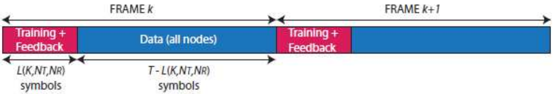

Figure: Communication frame used for the model

- Distributed MIMO network with $2K$ nodes (K tx-rx. pairs)
- Narrowband block fading model, block length T symbol periods
- All nodes have identical coherence times
- Overhead $\alpha = \min\{\mathcal{L}(K, N_t, N_r)/T, 1\}$

- If overhead scales faster than linearly with # of users, sum rate of network may be increased through partitioning
- Frame is divided into P sub-frames, each with an overhead and data portion

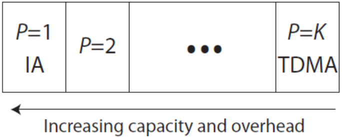

Figure: Illustration of parameterized transmission strategies

- Optimal solution requires brute force search over all possible partitions and full CSI
- Greedy Partitioning with only CQI:
  - Balanced Time Allocation
  - Sum Rate Fairness
  - Geographic Grouping

Optimum Transmission Policies for Battery Limited Energy Harvesting Nodes

Kaya Tutuncuoglu, Aylin Yener
Pennsylvania State University, USA

System Model

- Single-link continuous time system
- Tx. can choose to txmt. with power $p(t)$, at any t, achieving rate $r(p(t))$
- $r(\cdot)$ nonnegative, increasing, strictly concave
- Finite battery capacity $E_{\max}$
- Discrete energy replenishment process with E_n arriving at s_n, known non-causally

- **Problem 1** $\max_{p(t)} \int_0^T r(p(t))dt$ s. t. $p(t) \in \mathcal{B}$
- Optimal power allocation policy expends all harvested energy by the end of the transmission
- **Problem 2** $\min_{p(t)} T$, s. t. $B - \int_0^T r(p(t))dt \leq 0$, $p(t) \in \mathcal{B}$
- If the max.-throughput policy for $[0, T]$ departs a total of B bits, then the min.-time policy for B bits completes the transmission at time T, and vice versa.
- Propose algorithms that yield the optimal solution of both problems and prove their optimality

Decentralized Relay Selection Schemes in Uniformly Distributed Wireless Sensor Networks

Farrokh Etezadi	Keyvan Zarifi	Ali Ghrayeb	Sofiène Affes
Univ. of Toronto	Huawei Tech.	Concordia Univ.	INRS-EMT

System Model I

- Identical sensor nodes uniformly $\sim$ two-dimensional homogeneous Poisson process

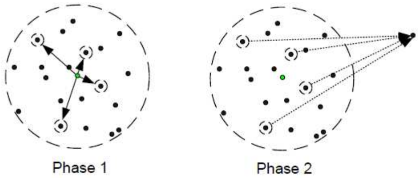

Figure: Two-phase collaboration system description.

- No CSI at source, no sync. or info. exchange among relays, no channel feedback from destination to nodes
- Node k knows $D_{s,k}$, $h_{s,k}$, periodically transmits info. to destination

- Optimal relay selection:
  - CTS flag triggers each node k to start down-counter from initial value $T_k^{(o)} = \lambda^{(o)} D_{s,k}^{\nu} / |h_{s,k}|^2$
  - Node switches from listening to tx. mode at end of countdown
  - SNR-optimal but energy-inefficient
- Geometry-based relay selection
  - Initial counter values set to $T_k^{(g)} = \lambda^{(g)} D_{s,k}$
  - When K-th relay's tx. ends, all nodes that that did not relay switch to sleeping mode for $T^{(g)}$ seconds
  - Achieves close-to-optimal average SNR at destination, energy-efficient
  - Tendency to over-exploit group of nodes that stay close to source in networks with a more static topology
- Random relay selection
  - Every node on $O(s, R)$ sets initial counter to random $T_k^{(r)} = \lambda_k^{(r)}$
  - At end of relaying phase, nodes that did not relay sleep for $T^{(r)}$ seconds

- After $T^{(r)}$, all nodes switch back to listening mode, initialize counter with new random quantities
- Energy-efficient and fair but noticeably suboptimal
- Defining suitable outage probability, systematic approach to select R proposed

- Avg. SNR performances of proposed techniques analyzed at relays and destination
- SNR variance at destination analytically studied

Cooperative Precoding with Limited Feedback for MIMO Interference Channels

Kaibin Huang — Yonsei University, S. Korea

Rui Zhang — NUS, Singapore

- New precoding design for 2-user MIMO interference channel based on finite-rate CSI exchange between users — cooperative feedback.
- Precoder design that maximizes sum throughput of MIMO interference channel is a non-convex optimization problem and remains open
- Sub-optimal linear precoders commonly used for simplicity, designed assuming perfect transmit CSI
- Existing designs fail to exploit interference channel realizations

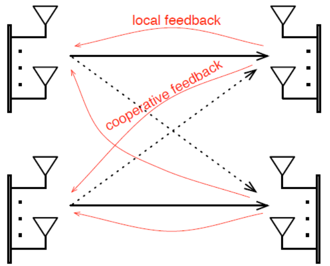

Figure: MIMO interference channel with data-link (local) and cooperative feedback.

- 2 interfering wireless links
- Assume perfect CSI estimation and data-link feedback
- Propose inner and outer precoder and equalizer design to suppress residual interference
- Propose scalar cooperative feedback algorithms for controlling transmission power based on different criteria

Other Papers

1. Broadcasting with an Energy Harvesting Rechargeable Transmitter
   - Jing Yang, Omur Ozel, Sennur Ulukus (Univ. of Maryland)
2. Paranoid Secondary: Waterfilling in a Cognitive Interference Channel with Partial Knowledge
   - Debashis Dash and Ashutosh Sabharwal (Rice University)
3. A Characterization of Delay Performance of Cognitive Medium Access
   - Shanshan Wang, Junshan Zhang (Arizona State Univ.), and Lang Tong (Cornell Univ.)
4. Interference Alignment with Analog Channel State Feedback
   - Omar El Ayach and Robert W. Heath, Jr. (The Univ. of Texas at Austin)
5. Adaptive Polar-Linear Interpolation Aided Channel Estimation for Wireless Communication Systems
   - Ming Jiang, Siji Huang, and Wenkun Wen (New Postcom Equipment Co., Ltd., LTE R&D Center, Guangzhou, China)


Thanks!