Journal Watch: IEEE Transactions on Wireless Communications, March 2014

Adithya M Devraj

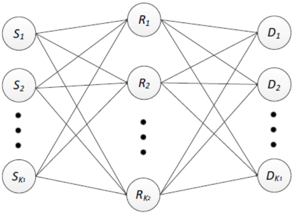
SPC Lab, IISc, Bangalore

April 05, 2014

Interference Alignment in Dual-Hop MIMO Interference Channel

Xiang Chen, S. H. Song and K. B. Letaief;
Hong Kong University of Science and Technology, Hong Kong

System Model



- $K_1 \times K_2 \times K_1$ dual-hop IC
  - K_1 sources; K_2 half-duplex AF relays; K_1 destinations
  - Source and destination: equipped with multiple antennas
  - Relays: single and multiple antennas looked into separately
- Direct links between the sources and destinations are ignored
- Sources, relays, and destinations have complete CSI

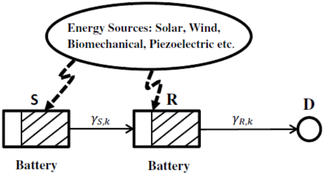
Contributions

1. Achievable DoF region with IA in the spatial domain
   - Obtain IA feasibility conditions to achieve a given DoF tuple
   - Derive the upper bound for the max. achievable DoF tuple
   - When sources and/or destinations have the same number of antennas: closed form upper bounds for the sum DoF is derived
2. Minimum number of relays required to achieve the upper bound is derived
   - Single antenna relays: grows quadratically with the number of $S - D$ pairs and the number of user antennas
   - Multiple antenna relays: grows linearly
3. Iterative algorithm to determine the processing matrices at all nodes to achieve a given DoF tuple

Power Allocation for Conventional and Buffer-Aided Link Adaptive Relaying Systems with Energy Harvesting Nodes

Imtiaz Ahmed; *University of British Columbia, Canada*
Aissa Ikhlef; *Toshiba Research Europe Limited, UK*
Robert Schober; *University of British Columbia, Canada*
Ranjan K. Mallik; *Indian Institute of Technology - Delhi, India*

System Model



- Source S and relay R (half-duplex) are energy harvesting
  - Battery capacities are finite
- Two types of relaying protocols are considered:
  - Conventional relaying protocol
  - Buffer-aided link adaptive relaying protocol
- Time is divided into slots: transmission occurs for K slots
  - Offline scheme: complete knowledge of channel SNRs and the energies harvested at S and R in all K slots is assumed
  - Online scheme: channel SNR and the energy harvested in the current slot is known
- **Objective:** Max. the overall system throughput in the K slots

Contributions (1)

Buffer-aided link adaptive relaying:

- Offline optimization problem: nonconvex mixed integer nonlinear program (MINLP)
  - Propose to use the Spatial Branch-and-Bound (sBB) method to solve it
- Online optimization problem:
  1. Stochastic DP approach can be used
     - High computational complexity because of link selection in every time slot
  2. Propose Suboptimal Harvesting Rate (HR) Assisted Online Power Allocation
     - Solved as a standard convex optimization problem
- Suboptimal Naive Online Power Allocation

Contributions (2)

Conventional relaying:

- Offline optimization problem: standard convex optimization
- Online optimization problem: stochastic DP approach (less complex: no link selection)
- Suboptimal algorithms:
  1. Suboptimal Simplified DP Power Allocation
  2. Suboptimal HR Assisted Power Allocation
  3. Suboptimal Naive Power Allocation

Power Allocation in MISO Interference Channels with Stochastic CSIT

Weiqiang Xu; *Zhejiang Sci-Tech University, China*
Ali Tajer; *Wayne State University, USA*
Xiaodong Wang; *Columbia University, USA*
Saleh Alshomrani; *King Abdulaziz University, Saudi Arabia*

System Model

- MISO interference channel with K transmitters and K receivers
  - Transmitter: M antennas; Receiver: single antenna;
  - Transmitters: imperfect CSI; Receivers: perfect CSI;
- Interference at each receiver is treated as Gaussian noise
- Beamforming directions: fixed; selected based on the channel estimates
  - Power allocation is the main focus

Contributions

1. Rate-Constrained Power Optimization:
   - Minimize average transmit power subject to rate constraints
2. Max-Min Rate Optimization:
   - Maximize the minimum rate among all users, s.t transmit power constraints

- Above problems are intractable due to probabilistic constraints:
  - Use Bernstein approximation technique to get convex deterministic constraints
- Long-step logarithmic barrier cutting plane (LLBCP) algorithm is used

Capacity of Large Wireless Networks with Generally Distributed Nodes

Guoqiang Mao; *the University of Technology, Sydney and NICTA, Australia*
Brian DO Anderson; *Australian National University and NICTA, Australia*

System Model

- Dense network model: network deployed in a finite area with a sufficiently large node density
  - n nodes distributed in a unit square A, following dist. $f(x)$
- 2 nodes are connected iff distance $\leq r(n)$ (transmission range)
- Each node chooses randomly and independently another node as destination (total n $S - D$ pairs)
  - Capacity of each link: W bits/s
- Saturated traffic scenario: node always has a packet to transmit when opportunity is available
- No packet loss due to collision
- **Objective:** find the capacity of the network $\mathcal{G}(n, r(n), A)$

Contributions

- Novel method to analyse communication across a closed curve
- Derive the capacity upper bound of networks with generally distributed nodes
  - Method is shown to be effective and efficient for large networks
- Necessary condition on $r(n)$ for networks to be a.a.s connected
- Asymptotic capacity upper bound is determined by four factors:
  - $f(x)$, W, n and $r(n)$ (in a multiplicative form)
  - Tightness of the upper bound is validated
- Analyse the lower bound of the asymptotic capacity of networks
  - Also presented as a product of the four factors