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Transmission Strategy Design in Cognitive Radio Systems With Primary ARQ Control and QoS Provisioning

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System Model

- Underlay Cognitive Radio Network with ARQ control
- Both the primary and secondary transmitters employ adaptive transmission (AMC) in conjunction with ARQ.
- Link Layer QoS (throughput & PLR) constraint for the primary network
- Aim: to develop efficient analysis tools and primary QoS-aware link adaptation policies for the cognitive transmitter.

Contributions

- Analytical expressions for the throughput performance of the links when the cognitive transmitter employs a constant-power or a dynamic-power AMC scheme.
- Sub-optimal solution to the optimization problem of maximizing the cognitive throughput

Results

- Throughput of the adaptive power policy is superior w.r.t the constant-power throughput
- Throughput performance by proposed algorithm very close to that obtained numerically through the interior point algorithm

Future Work

- Incorporate sensing decision when the primary system follows an ON/OFF traffic pattern

Downlink Vertical Beam-forming Designs for Active Antenna Systems

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System Model

- BS with multiple directional antennas and users with single omnidirectional antennas

Aim:

- To jointly optimize the BS tilting angle and the precoding design for active antenna systems
- Analyze an average rate gain of the active antenna system over the passive antenna system.

Contributions

- PDF of the vertical angle
- Single User :
  - Active Antennas : Tilting angle = Vertical Angle
  - Passive Antennas : Optimize over all tilting angles (Jensen's Inequality)

    Solution : Mean of the vertical angle
  - Avg. rate gain proportional to variance of the vertical angle

- Multi-user
  - Zero – Forcing Beam forming scheme
  - Active Antennas :
    - Joint optimization of tilting angle and power allocation. (Complex)
    - Separate the joint problem into two sub-problems
    - Solution : Power allocation - Water filling

      Tilting angle - Mean of the vertical angle of the scheduled users
    - Performs as good as joint optimization
  - Passive Antennas :
    - Divide cell into multiple sectors according to the vertical angles
    - Divide tx. Antennas into no. of groups equal to the number of sectors
    - Tilting angle of a group = Mean of the vertical angle in the sector
    - Considerable gain over conventional schemes .
- Future Scope : Multi Cell Scenario

Interference Pricing Mechanism for Downlink Multi-cell Coordinated Beam-forming

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Alfredo Garcia
A. Armada, Senior Member, IEEE

System Model

- Multi-cell network: BSs have multiple antennas , users have single antenna
- BSs cooperate in sharing their local information
- Aim : Maximize the weighted sum rate of the network

Contributions

- Iterative Decentralized interference pricing beam-forming (IPBF) algorithm to identify the beam-former
- Algorithm converges to a KKT point of the sum-rate maximization problem.
- Propose IPBF-L (limited coordinated variant of IPBF)
  - Loss in sum-rate is very small
  - Convergence is much faster

Idea of the algorithm

- Randomly select a BS $\boldsymbol{m}$ and its user $\boldsymbol{i}$
- Each BS $\boldsymbol{q}$ updates its interference prices for all users $\boldsymbol{j}$ of BS $\boldsymbol{q}$, and send them to BS $\boldsymbol{m}$
- With this information, BS $\boldsymbol{m}$ optimizes the utility function
- Repeat till convergence

Results

- Little loss w.r.t. optimal sum-rate
- Faster convergence w.r.t. state of the art algorithms
- Reduced 'exchanged information' among BSs per iteration.

Interference Modeling and Performance Evaluation of Heterogeneous Cellular Networks

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Arafat D., Senior Member, IEEE
A. Shami, Senior Member, IEEE

Aim: A statistical model to represent interference in heterogeneous networks

Model

- Femtocells deployed in buildings of unknown internal structure
- Macro-cell users experience Nakagami fading

Contributions:

- An interference model based on **random** floor plan generator
- Composite shadowing/fading can be represented by a mixture distribution.
- Model used to evaluate the performance of macro-cell users
  - Closed form expressions for outage probability and SIR

Dual-Branch MRC Receivers Under Spatial Interference Correlation and Nakagami Fading

R. Tanbourgi, H. S. Dhillon, J. G. Andrews, and F. K. Jondral

On the Low SNR Capacity of MIMO Fading Channels With Imperfect Channel State Information

F. Benkhelifa, A. Tall, Z. Rezki, and M.-S. Alouini

Frequency-domain Equalization Techniques for Multi-h Continuous Phase Modulation

S. Saleem and G. L. Stuber