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Energy efficient transmission for wireless energy harvesting nodes

Maria Gregori, Miquel Payaro; *Centre Technológic de Telecomunicacions de Catalunya (CTTC)*

- Goal
  - To develop an optimal transmission strategy for a WEHN
  - Study the impact of QOS constrains
- System Model
  - Finite battery capacity C_{max} is considered
  - Dynamic data and energy arrivals
  - Offline approach is used
- Problem

$$min_{D(t)}\, T$$

s.t.

$$E(t) \leq B_A(t;t)$$

$$D_{QOS}(t) \leq D(t) \leq D_A(t)$$

$$D(T) = \sum_{i=0}^{N-1} D_i$$

- Problem is not convex, cannot be solved directly
- Study the properties that optimal solution must satisfy
- Then construct the optimal data departure curve

- Results and Conclusion
  1. The problem might not have a feasible solution
  2. With no battery overflow adopt constant rate transmission
  3. If battery overflows increase the data rate before overflow until there is no overflow or data left
  4. Algorithm to determine optimal transmission strategy

Throughput Maximization for Multi-Hop Wireless Networks with Network-Wide Energy Constraint

Canming Jiang, Yi Shi, Y. Thomas Hou, Wenjing Lou, Hanif D. Sherali; *Virginia Tech*

- Goal
  1. To maximize network throughput under a total network energy constraint
  2. Use multicriteria optimization framework to generalize the problem
- System Model
  1. Multihop wireless Ad Hoc network
  2. Non zero device power
- Contribution
  1. Throughput maximization under total network energy constrains
  2. Formulate the problem as a mixed-integer nonlinear program (MINLP)
  3. Optimizing both throughput and network wide energy

- Results and Conclusion
  - Throughput Maximization
    - Near optimal solution with asymptotic optimality
  - Joint Optimization: Network Throughput and Network Wide Energy
    - Showed how to generate Pareto-optimal solutions
- Device power significantly affects network throughput

Spectrum Sharing Scheme Between Cellular Users and Ad-hoc Device-to-Device Users

Brett Kaufman, Jorma Lilleberg; *Renesas, Finland*, Behnaam Aazhang; *Rice University, University of Oulu, Finland*

- Goal
  - To facilitate ad hoc communication between devices
  - Devices use same frequency resources as the cellular network
  - To develop a distributed dynamic spectrum D2D communication protocol
- System Model
  - Multicell base station architecture
  - Macro Users (MU)
  - Clustered device to device (D2D) users
  - Single Hop/ Multi Hop communication

- Contributions
  1. Power control for D2D users
  2. Discovery Protocol for route establishment
  3. Outage probability analysis
- Results and Conclusions
  - Including network information in discovery packet is beneficial
  - Tradeoff in performance of MU and D2D users
  - Large improvement in D2D; small loss in MU performance
  - Significant power savings using D2D routes

Unified Performance Analysis of Orthogonal Transmit Beamforming Methods with User Selection

Serdar Ozyurt; *University of Texas, Dallas*, Murat Torlak; *Yildirim Beyazit University, Ankara, Turkey*

- Problem Statement
  - To study sum rate capacity of two orthogonal Beamforming schemes with scheduling
    1. Adaptive Orthogonal Beamforming (OBF)
    2. Orthogonal Linear Beamforming (OLBF)
- System Model
  - MISO broadcast channel
  - M antenna BS and K single antenna users ($K \geq M$)
- Signal at the scheduled users

$$d_{k_i} = \sqrt{\frac{P}{n}} \mathbf{h}_{k_i}{}^H \mathbf{w}_{k_i} l_{k_i} + \sqrt{\frac{P}{n}} \mathbf{h}_{k_i}{}^H \sum_{j \in U_n, j \neq i} \mathbf{w}_{k_j} l_{k_j} + e_{k_i}$$

- Contribution
  1. Derivation of joint probability distributions of user SINR's
  2. Closed form expressions for PDF of SINR of scheduled users
  3. Relationship between SINR of ordered and unordered SINR
- Results and Conclusion
  1. Comparison with greedy zero forcing dirty paper coding (ZF-DP) algorithm
  2. For fixed power ZF-DP performs better than Adaptive OBF and OLBF
  3. For varying power the two schemes outperform ZF-DP
  4. Adaptive OLB performs better than OLBF

Other Papers

- Throughput Analysis of Primary and Secondary Networks in a Shared IEEE 802.11 System
  Kumar, Santhosh ; Shende, Nirmal ; Murthy, Chandra R. ; Ayyagari, Arun
- Quantized CSI-Based Tomlinson-Harashima Precoding in Multiuser MIMO Systems
  Sun, Liang ; Lei, Ming
- One-Bit CSI Feedback Selection Schemes for Energy-Efficient Multiuser and Multirelay Systems
  Le, Viet-Anh ; Pitaval, Renaud-Alexandre ; Blostein, Steven D. ; Riihonen, Taneli ; Wichman, Risto
- Beamformer Designs for MISO Broadcast Channels with Zero-Forcing Dirty Paper Coding
  Tran, Le-Nam ; Juntti, Markku ; Bengtsson, Mats ; Ottersten, Bjorn