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Random Access Scheme for Sporadic Users in 5G

–Yihenew Dagne Beyene, Riku Jantti and Kalle Ruttik

Aim: Design a random access scheme in Machine-Type Communications (MTC) to eliminate signaling overhead and reduce energy consumption in the context of low-activity users

Contributions:

- Joint activity detection and channel estimation
- Analytical framework for the detection performance of a MIMO receiver in a frequency-selective channel

Approach:

x is $N \times 1$ channel response vector, since only s out of N users are active, x is s-sparse!

$$u = \Phi x + z$$

Φ is the $m \times N$ codeword matrix
u is the $m \times 1$ measurement vector

- Signal recovered from incomplete and inaccurate samples using CoSAMP
- Extended to joint pilot and data transmission, when MT-UEs transmit multiple symbols. Symbols estimated separately after active user identification

Distributed User Association in Energy Harvesting Dense Small Cell Networks: A Mean-Field Multi-Armed Bandit Approach

–Setareh Maghsudi and Ekram Hossain

Aim: Distributed solution to solve for user association in the presence of energy harvesting.

Context:

User association useful for interference management, capacity maximization, energy efficiency, mode selection, content caching etc

Regret matching methods or game theoretic solutions

- require prior knowledge atleast at some agents or heavy information exchange among agents
- cannot deal with uncertainty
- converge slowly for medium/large number of actions and agents

Details:

- Every agent regards the rest of the world as stationary $\Rightarrow$ interaction of individual with mass of others
- In every transmission round, each device transmits one data packet to an SBS of its choice; obtains energy, applies harvest-use strategy
- Reward is a Bernoulli random variable with success probability of user n selecting SBS m in every round, determined by the fraction of devices that select the same SBS

Contribution:

Theoretical results show that the mean field dynamics converge to a unique mean field equilibrium, given any initial condition

Distributed Power Allocation for D2D Communications Underalying/Overlaying OFDMA Cellular Networks

-Andrea Abrardo and Marco Maretti

Aim: Distributed power allocation scheme in D2D dedicated and reuse operating modes

Approach:

- Power allocation problem modeled as a potential game, preferences of players aligned with global objective
- Iterative algorithms based on the property of convergence of potential games under better response dynamics
- Proposed methods converge to the local maxima, achieve close to the optimal performance
- Extension to multi-cell scenario, and a practical and distributed approach

For dedicated mode,

$$\mathcal{R}(p^*) = \max_{\mathbf{p}\in\mathcal{P}} \sum_{k\in\mathcal{K}} \sum_{n\in\mathcal{N}} \log_2\left(1 + \frac{G^n_{k,k} p_{k,n}}{\sum_{j\in\mathcal{K}\setminus k} G^n_{j,k} p_{j,n} + \sigma^2_{k,n}}\right)$$

$$s.t. \sum_{n\in\mathcal{N}} p_{k,n} \leq P_k, k \in \mathcal{K}$$

Linearize the log function using first order Taylor series expansion
For reuse mode, consider interference constraint at the BS

Fairness-Constrained Maximum Sum Rate of Multi-Rate CSMA Networks

Aim: Maximize sum rate of a saturated M-group multi-rate CSMA network, nodes in different groups have distinct packet transmission rates

Contributions:

- Derived expression for network sum rate
- Proposed two constraints, throughput fairness and data-rate fairness
- Determined optimal initial backoff window sizes to achieve maximum sum rate under fairness constraints in IEEE 802.11 networks

Approach:

- Slotted CSMA network where n nodes transmit to a single receiver
- Queue at each node regarded as an independent queueing system with identically distributed service time
- Model behavior of Head-Of-Line(HOL) packet behavior - collision and successful transmission using discrete-time Markov renewal process
- Obtain steady-state probability of successful transmission of HOL packets given that the channel is idle

Other interesting papers

- Vitaly Ptrov, Mikhail Komarov, Dmitri Moltchanov, Josep Miquel Jornet and Yevgeni Koucheryavy, "Interference and SINR in Millimeter Wave and Terahertz Communication Systems With Blocking and Directional Antennas".
- Jun Fang, Xingjian Li, Hongbin Li and Feifei Gao, "Low-Rank Covariance-Assisted Downlink Training and Channel Estimation for FDD Massive MIMO Systems".
- Miguel Calvo-Fullana, Javier Matamaros and Carles Anton-Haro "Reconstruction of Correlated Sources With Energy Harvesting Constraints in Delay-Constrained and Delay-Tolerant Communication Scenarios".