Journal Watch: IEEE Transactions on Transaction Information Theory, December 2016

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March 26, 2016

- Wireless Max-Min Utility Fairness with General Monotonic Constraints by Perron-Frobenius Theory

Authors: Liang Zheng, Y. W. Peter Hong, Chee Wai Tan, Cheng-Lin Hsieh, and Chia-Han Lee

Problem Statement

$$\text{maximize}_{\mathbf{p}} \min_{i=1,\ldots,L} u_i(\mathbf{p})$$

$$\text{subject to } \mathbf{g}(\mathbf{p}) \leq \bar{\mathbf{g}}$$

Theorem 1 [21]: Let $\mathbf{T} : \mathcal{R}_+^L \rightarrow \mathcal{R}_+^L$ be a linear mapping defined by $\mathbf{T}(\mathbf{x}) = \mathbf{A}\mathbf{x}$, for any $\mathbf{x} \in \mathcal{R}_+^L$, where $\mathbf{A}$ is an $L \times L$ irreducible nonnegative matrix. Then,

(a) the conditional eigenvalue problem $\mathbf{T}(\mathbf{x}) = \lambda \mathbf{x}$ has a unique solution with $\mathbf{x}^* > \mathbf{0}$, $\|\mathbf{x}^*\| = 1$ and $\lambda^* > 0$;

(b) the solution is $\mathbf{x}^* = \lim_{n\rightarrow\infty} \tilde{\mathbf{T}}^n(\mathbf{x})$, where $\tilde{\mathbf{T}}(\mathbf{x}) = \mathbf{T}(\mathbf{x})/\|\mathbf{T}(\mathbf{x})\|$, for all $\mathbf{x} \geq \mathbf{0}$.

Perron-Frobenius Theorem for general mappings

Theorem 2 [20]: Suppose that $\beta : \mathcal{R}_+^L \rightarrow \mathcal{R}_+$ is not identically 0, positively homogeneous (i.e., $\beta(\lambda \mathbf{x}) = \lambda\beta(\mathbf{x})$ for $\mathbf{x} \geqq \mathbf{0}$ and $\lambda \geqq 0$), and monotonic (i.e., $\mathbf{0} \leqq \mathbf{x} \leqq \mathbf{y}$ implies $\beta(\mathbf{x}) \leqq \beta(\mathbf{y})$), and that $\mathbf{T} : \mathcal{R}_+^L \rightarrow \mathcal{R}_+^L$ satisfies the following conditions: (i) there exists $a > 0$, $b > 0$, and a vector $\mathbf{e} > \mathbf{0}$ such that $a\mathbf{e} \leqq \mathbf{T}(\mathbf{x}) \leqq b\mathbf{e}$, for all $\mathbf{x} \in \mathcal{R}_+^L$ with $\beta(\mathbf{x}) = 1$; (ii) for any $\mathbf{x}, \mathbf{y} \in \mathcal{R}_+^L$ with $\beta(\mathbf{x}) = \beta(\mathbf{y}) = 1$ and $0 \leqq \lambda \leqq 1$: If $\lambda\mathbf{x} \leqq \mathbf{y}$, then $\lambda\mathbf{T}(\mathbf{x}) \leqq \mathbf{T}(\mathbf{y})$; and, if $\lambda\mathbf{x} \leq \mathbf{y}$ with $\lambda < 1$, then $\lambda\mathbf{T}(\mathbf{x}) < \mathbf{T}(\mathbf{y})$. Then, the following properties hold:

(a) $\lambda\mathbf{x} = \mathbf{T}(\mathbf{x})$ has a unique solution $\mathbf{x}^* \in \mathcal{R}_+^L$ with $\beta(\mathbf{x}^*) = 1$ and $\lambda^* > 0$.

(b) $\mathbf{x}^* = \lim_{n\rightarrow\infty} \tilde{\mathbf{T}}^n(\mathbf{x})$, where $\tilde{\mathbf{T}}(\mathbf{x}) = \mathbf{T}(\mathbf{x})/\beta(\mathbf{T}(\mathbf{x}))$, for any $\mathbf{x} \geqq \mathbf{0}$ with $\beta(\mathbf{T}(\mathbf{x})) > 0$.

- Non-adaptive group testing with Random Set of Defectives

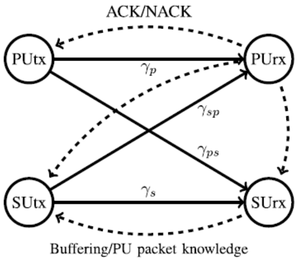
  Authors: Arya Mazumdar

- Model 1: each item can be defective with probability $\frac{t}{N}$
- Model 2: each t-set of items can be defective with uniform probability
- **Goal:** Explicit deterministic construction of test scheme which achieve as close to minimum $\Theta(t \log N)$ as possible.
- Designing a *non-adaptive* test scheme is equivalent to construction of a disjunct matrix
- Constant-weight error-correcting codes used to construct Non-adaptive scheme.
- Achieve $\Theta\left(t \frac{\log^2 N}{\log t}\right)$ for successful recovery with high probability
- Main contribution: parameters of group testing schemes are connected to hamming distance of the codes

- Optimal Cognitive Access and Packet Selection Under a Primary ARQ Process via Chain Decoding

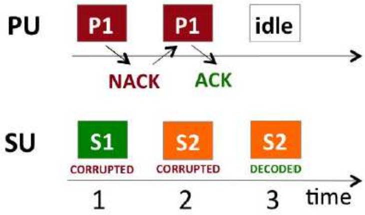
Authors: Nicolo Michelusi, Peter Popovski, and Michele Zorzi

System Model and Goal



- PU uses ARQ
- SU uses selective retransmission
- Chain decoding helps SU improve its own throughput under a constraint on long-term PU performance

Chain decoding and Results



- Issues:
  1. Secondary access scheme and packet selection for retransmission
  2. Optimality of decoupled decision making.
  3. CD protocol
  4. How design an SU access scheme: dynamic programming.

- Diversity Backpressure Scheduling and Routing With Mutual Information Accumulation in Wireless Ad-Hoc Networks

  Authors: Hao Feng and Andreas F. Molish

System Model,Goal & Contributions

- Consider routing problem in a multi-commodity multi-flow network with mutual information accumulation
- Average channel state information is available locally
- Scenarios considered: renewal mutual information accumulation and full mutual information accumulation.
- Analyze the performance of diversity backpressure algorithm with mutual information accumulation.
- Network capacity region with MIA is greater than simple repetition
- DIVBAR-RMIA achieves the network capacity region and DIVBAR-FMIA performs at least as well as DIVBAR-RMIA.

Other Papers

- “SHO-FA: Robust Compressive Sensing With Order-Optimal Complexity, Measurements, and Bits”, *M. Bakshi, S. Jaggi, S. Cai, and M. Chen*
- ‘Fixed Points of Generalized Approximate Message Passing With Arbitrary Matrices”, *S. Rangan, P. Schniter, E. Riegler, A. K. Fletcher*
- “Minimum Energy to Send k Bits Over Multiple-Antenna Fading Channels” *W. Yang, G. Durisi, and Y. Polyanskiy*
- “Improving Compressed Sensing With the Diamond Norm”, *M. Kliesch, R. Kueng, J. Eisert, and David Gross*