Xingran Chen

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Research Fields

Research Interests: My research interests are in the modeling, analysis, and decision making of networked systems, with focus on the intersection of Information Theory and Networking (e.g., the Internet of Things, information networks, communication networks).

Methodologies: Information and Coding Theory, Learning Theory, Optimization, Game Theory, and Control Theory.

Education

Ph.D. in Information and Decision Systems   2018 - present
University of Pennsylvania   Philadelphia, PA
Department of Electrical and Systems Engineering   GPA: 3.94/4.0
Advisor: Shirin Saeedi Bidokhti

M.A. in Applied Mathematics and Computational Science   2016 - 2018
University of Pennsylvania   Philadelphia, PA
Applied Mathematics and Computational Science Program   GPA: 4.0/4.0
Master Thesis Advisor: Saswati Sarkar

M.S. in Operations Research   2015 - 2016
Central South University   Changsha, China
School of Mathematics and Statistics   Transfer to Upenn
Advisor: Zhong Wan

B.S. in Statistics   2011 - 2015
Central South University   Changsha, China
School of Mathematics and Statistics   90.41/100

Research Experience

Remote Estimation in Decentralized Random Access Channels

University of Pennsylvania   Philadelphia, PA, USA
Graduate Researcher   03/2020 - 07/2020
Advisor: Shirin Saeedi Bidokhti

- Sampling and remote estimation of M independent autoregressive Markov processes over a wireless collision channel. Oblivious and non-oblivious policies were considered.
- Proved that minimizing the expected time-average estimation error, in the class of oblivious policies, is equivalent to minimizing the age of information. The lower and upper bounds on the minimum achievable estimation error were obtained.
- Proposed a (non-oblivious) threshold policy based on the collision feedback and the local information of each node. An accurate approximation was obtained.
- The journal version has been submitted to *IEEE Journal on Selected Areas in Communications (JSAC)*.

Information Freshness in Decentralized Random Access Channels

University of Pennsylvania — Philadelphia, PA, USA
Graduate Researcher — 05/2019 - 03/2020
Advisor: Shirin Saeedi Bidokhti, Hamed Hassani

- An analytic expression for AoI under stationary randomized policies was provided.
- Proved that the age performance of a (stabilized) slotted ALOHA algorithm is approximately optimal in large number of sources when the sum arrival rate θ is below the infamous critical point $\frac{1}{e}$.
- Proposed two age-based thinning methods (adaptive and stationary) in which transmitters discard packets in order to reach an effective (sum) arrival rate. Proved that our proposed thinning mechanism can reduce age to $1/2C$ for any random access technologies which can achieve the throughput C.
- The conference version has been published in *2020 IEEE International Symposium on Information Theory (ISIT)*, the journal version has been submitted to *IEEE Transactions on Information Theory (TIT)*.

Information Freshness in Broadcast Channels

University of Pennsylvania — Philadelphia, PA, USA
Graduate Researcher — 09/2018 - 04/2019
Advisor: Shirin Saeedi Bidokhti

- Randomized policies were devised, and explicit conditions were found for symmetric dependent channels under which coded randomized policies strictly outperform the corresponding uncoded policies.
- Deterministic policies with or without other constraints (throughput, transmitting cost and sampling cost) were devised. Coded deterministic policies strictly outperforms uncoded ones when channel erasure is larger than a threshold, otherwise coded and uncoded deterministic policies reach the same EWSAoI.
- One paper has been published in *2019 IEEE Information Theory Workshop (ITW)*, the journal version is in preparation.

Non-asymptotic Coded Slotted Aloha

University of Pennsylvania — Philadelphia, PA, USA
Graduate Researcher — 02/2018 - 06/2018
Advisor: Hamed Hassani, Shirin Saeedi Bidokhti

- Coded Slotted Aloha (CSA) was considered and its performance was analyzed in the non-asymptotic regime where the frame length and the number of users are finite.
- A density evolution framework was provided to describe the dynamics of decoding, and fundamentally limits were found on the maximum channel load (the number of active users per time slot) that allows reliable communication.
- Scaling laws were established, describing the non-asymptotic relation between the probability error, number of users, and the channel load.
- One paper has been published in *2019 IEEE International Symposium on Information Theory (ISIT)*, the journal version is in preparation.

Resource Allocation in Wireless Networks

University of Pennsylvania — Philadelphia, PA, USA
Graduate Researcher — 04/2017 - 05/2018
Advisor: Saswati Sarkar

- Investigated the incentives of mobile networks (MNOs) for acquiring additional spectrum to offer mobile virtual network operators (MVNOs) and thereby inviting competition for a common pool of end users (EUs).

- Considered a sequential framework and a hybrid of a sequential and a bargaining frameworks in a base case (one MNO and one MVNO) and two generalizations ((i) one MNO, one MVNO and an outside option, (ii) two MNOs and one MVNO).
- The optimal strategies were characterized analytically and numerically: (i) cooperation between MNO and MVNO can enhance the payoffs of both, while increased competition due to the presence of additional MNOs is beneficial to EUs but reduces the payoffs of the service providers; (ii) whether and by how much the different entities benefit due to the cooperation in spectrum acquisition decision is evaluated.
- Two papers have been published in *IEEE Transactions on Network Science and Engineering (TNSE)*.

Online-Offline Supply Chain Management...

Central South University   Changsha, China
Graduate Researcher   09/2015 - 02/2016
Advisor: Zhong Wan

- Optimal strategies for Online-Offline retailing under BOPS (buy-on-line, pick-up-in-store) mode were proposed by constructing a *Stochastic* Nash equilibrium model.
- One paper has been published in *ANZIAM Journal*.

Teaching Experience

- **Information Theory**, teaching assistant, graduate course, University of Pennsylvania, Electrical and Systems Engineering Department, 2020 Spring.

Publications

corresponding author: *

Preprints...

[P3] **X. Chen***, X. Liao and S. Saeedi-Bidokhti. Remote Estimation in Decentralized Random Access Channels. IEEE Journal on Selected Areas in Communications (JSAC), under review. [arXiv: 2007.03652]

[P2] **X. Chen***, K. Gatsis, H. Hassani, and S. Saeedi-Bidokhti. Age of Information in Random Access Channels (Journal Version). *IEEE Transactions on Information Theory (TIT)*, under review. [arXiv: 1912.01473]

[P1] M. Fereydounian*, **X. Chen**, H. Hassani, and S. Saeedi-Bidokhti. Non-asymptotic coded slotted ALOHA (Journal Version). In preparation. available online, www.seas.upenn.edu/mferey/ms.pdf

Journal Articles...

[J3] **X. Chen***, S. Sarkar, M. H. Lotfi. The Interplay of Competition and Cooperation among Service Providers (Part II). *IEEE Transactions on Network Science and Engineering (TNSE)*, In Press.

[J2] **X. Chen***, S. Sarkar, and M. H. Lotfi. The Interplay of Competition and Cooperation among Service Providers (Part I). *IEEE Transactions on Network Science and Engineering (TNSE)*, In Press.

[J1] **X. Chen**, Y. Liu, and Z. Wan*. Optimal Decision Making for Online and Offline Retailers under BPOS Mode. *ANZIAM Journal*, 58:187-208,2016

Conference Papers..

[C3] **X. Chen**, K. Gatsis, H. Hassani, and S. Saeedi-Bidokhti. Age of Information in Random Access Channels. *2020 IEEE International Symposium on Information Theory (ISIT)*, June, 2020

[C2] **X. Chen** and S. Saeedi-Bidokhti. Benefits of Coding on Age of Information in Broadcast Networks. *2019 IEEE Information Theory Workshop (ITW)*, August, 2019

[C1] M. Fereydounian, **X. Chen**, H. Hassani, and S. Saeedi-Bidokhti. Non-asymptotic coded slotted

ALOHA. *2019 IEEE International Symposium on Information Theory (ISIT)*, July, 2019

Technical Report..

[TR1] **X. Chen**, S. Sarkar, and M. H. Lotfi. Supplementary Material for the Paper "The Interplay of Competition and Cooperation among Service Providers (Part I)". *Technical Report*, [arXiv: 1905.13423]

Thesis..

[Th1] **X. Chen**. Competition and Cooperation between Service Providers. *Master's Thesis*, University of Pennsylvania, 2018.

Talks & Posters

Talks...

[06/2020]: "Age of Information in Random Access Channels", *2020 IEEE International Symposium on Information Theory (ISIT)*, virtual conference (due to COVID-19).

[07/2019]: "Non-asymptotic coded slotted aloha", *2019 IEEE International Symposium on Information Theory (ISIT)*, Paris, France.

[08/2019]: "Benefits of coding on age of information in broadcast networks", Southwest University, Chongqing, China.

[12/2015]: "Optimal Decision Making for Online and Offline Retailers under BOPS Mode", *The 6th International Conference on Optimization and Control with Applications*, Changsha, China.

Posters...

[08/2019]: "Benefits of coding on age of information in broadcast networks", *2019 IEEE Information Theory Workshop*, Visby, Sweden.

[07/2019]: "Benefits of coding on age of information in broadcast networks", *2019 IEEE International Symposium on Information Theory (ISIT)*, Paris, France.

[07/2019]: "Benefits of coding on age of information in broadcast networks", *2019 North American School of Information Theory (NASIT)*, Boston, USA.

Awards and Achievements

o IEEE International Symposium on Information Theory (ISIT) Student Travel Grant	2019
o The Dean's Fellowship (University of Pennsylvania)	2018 - 2019
o Ganster Engineering Fellowship (University of Pennsylvania)	2018
o National Scholarship of China (Top 1% in China)	2016
o National Scholarship of China (Top 1% in China)	2016
o First Prize of the 12th Graduate Students' Mathematical Modeling Contest in China (Top 1%)	2015
o Student Representative at the 2015 Graduation Ceremony of Central South University	2015
o Outstanding Graduates of Hu'nan Province (Top 1% in Hu'nan Province)	2015
o Meritorious Winner of Mathematical Contest In Modeling (MCM)	2015
o National Scholarship of China (Top 1% in China)	2014

Paper Review

Reviewer for Journals...

o IEEE Wireless Communications Letters
o ANZIAM Journal
o Journal of Industrial and Management Optimization (JIMO)

- 2020 IEEE International Symposium on Information Theory (ISIT)
- The 3rd Age of Information Workshop (AoI'20)
- The Joint Optimization Conferences 2017 (JOC 2017)

Selected Courses

- **Mathematics:** Complex Analysis, Real Analysis, Functional Analysis, Topology, Advanced Algebra, Advanced Probability, Stochastic Process.
- **Engineering Mathematics:** Machine Learning, Convex Optimization, Linear Systems, Information Theory, Finite Element Analysis.
- **Statistics:** Mathematical Statistics, Regression Analysis, Multivariable Statistical Analysis, Time Series Analysis, Sampling Survey.
- **Economics & Finance:** Macro Micro Economics, Econometrics, Monetary Finance, Financial Management.