

# 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**

University of Pennsylvania

Department of Electrical and Systems Engineering

*Advisor: Shirin Saeedi Bidokhti*

2018 - present

Philadelphia, PA

GPA: 3.94/4.0

M.A. in **Applied Mathematics and Computational Science**

University of Pennsylvania

Applied Mathematics and Computational Science Program

*Master Thesis Advisor: Saswati Sarkar*

2016 - 2018

Philadelphia, PA

GPA: 4.0/4.0

M.S. in **Operations Research**

Central South University

School of Mathematics and Statistics

*Advisor: Zhong Wan*

2015 - 2016

Changsha, China

Transfer to Upenn

B.S. in **Statistics**

Central South University

School of Mathematics and Statistics

2011 - 2015

Changsha, China

90.41/100

## Research Experience

**Information Freshness in 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  $\theta$  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  $C$ .

- One paper 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

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

## Publications

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corresponding author: \*

### Preprints.....

[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](http://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

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### 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

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

## Paper Review

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### Reviewer for Journals.....

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

### Reviewer for Conferences.....

- 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

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- **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.