

# Xingran Chen

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## Research Fields

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**Research Interests:** My research interests are in the modeling, analysis, and decision making of distributed networked systems (e.g., the Internet of Things, communication networks, Blockchain), with emphasis on information freshness, resource allocation, economics, and security.

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

## Education

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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

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Age of Information in Random Access Channels.....

**University of Pennsylvania**

Philadelphia, PA, USA

Graduate Researcher

05/2019 - 10/2019

*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  $C$ .

## Age of Information 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.

## 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 fundamental 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.

## Resources 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.

## 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.

## 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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### Thesis.....

1. **X. Chen**. Competition and cooperation between service providers. Master's thesis, University of Pennsylvania, 2018

### Preprints.....

1. **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*, minor revision. [arXiv: 1906.01187]
2. **X. Chen**, H. Hassani, K. Gatsis, and S. Saeedi Bidokhti. Age of information in random access channels (journal version). *IEEE Transactions on Information Theory*, under review. [arXiv: 1912.01473]
3. M. Fereydounian, **X. Chen**, H. Hassani, and S. Saeedi Bidokhti. Non-asymptotic coded slotted ALOHA (journal version). under submission. <https://www.seas.upenn.edu/~mferey/ms.pdf>

### Journal Articles.....

1. **X. Chen**, S. Sarkar, M. H. Lotfi. The interplay of competition and cooperation among service providers (part I). *IEEE Transactions on Network Science and Engineering*, accept, 2020. [arXiv: 1905.13423]
2. **X. Chen**, Y. Liu, and Z. Wan. Optimal decision making for online and offline retailers under BOPS mode. *ANZIAM Journal*, 58:187–208, 2016

### Conference Papers.....

1. **X. Chen**, H. Hassani, K. Gatsis, and S. Saeedi Bidokhti. Age of information in random access channels. In *2020 IEEE International Symposium on Information Theory (ISIT)*, accept, 2020
2. **X. Chen** and S. Saeedi Bidokhti. Benefits of coding on age of information in broadcast networks. In *2019 IEEE Information Theory Workshop*, 2019
3. M. Fereydounian, **X. Chen**, H. Hassani, and S. Saeedi Bidokhti. Non-asymptotic coded slotted ALOHA. In *2019 IEEE International Symposium on Information Theory (ISIT)*, July 2019

### Technical Report.....

1. **X. Chen**, S. Sarkar, M. H. Lotfi. Supplementary material for the paper "the interplay of competition and cooperation among service providers (part i). arXiv: 1905.13423v2, 2019

## Conference Talks, Invited Talks & Conference Posters

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### Conference Talks.....

1. "Non-asymptotic coded slotted aloha", *2019 IEEE International Symposium on Information Theory (ISIT)*, Paris, France, 07/2019.
2. "Optimal Decision Making for Online and Offline Retailers under BOPS Mode", *The 6th International Conference on Optimization and Control with Applications*, Changsha, China, 12/2015.

### Invited Talks.....

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

## Conference Posters.....

1. "Benefits of coding on age of information in broadcast networks", 2019 IEEE Information Theory Workshop, Visby, Sweden, 08/2019.
2. "Benefits of coding on age of information in broadcast networks", 2019 IEEE International Symposium on Information Theory (ISIT), Paris, France, 07/2019.
3. "Benefits of coding on age of information in broadcast networks", 2019 North American School of Information Theory (NASIT), Boston, USA, 07/2019.

## Awards and Achievements

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### Awards in graduate (Ph.D.).....

The Dean's Fellowship (University of Pennsylvania)	2018 - present
Ganster Engineering Fellowship (University of Pennsylvania)	09/2018

### Awards in graduate (M.S./M.A.).....

National Scholarship of China (Top 1% in China)	12/2016
First Prize of the 12th Graduate Students' Mathematical Modeling Contest in China (Top 1%)	11/2015

### Awards in undergraduate (Selected).....

Student Representative at the 2015 Graduation Ceremony of Central South University	06/2015
Outstanding Graduates of Hu'nan Province (Top 1% in Hu'nan Province)	05/2015
Meritorious Winner of Mathematical Contest In Modeling (MCM)	04/2015
National Scholarship of China (Top 1% in China)	12/2014

## Teaching Experience

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

## Paper Review

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### Reviewer for Journals.....

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

### Reviewer for Conferences.....

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

## Selected Courses

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