

Xu Chen

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RESEARCH INTERESTS

Wireless communications, coding theory and information theory. Hardware architecture design and implementation of communication systems. Compressed sensing and its application in communications. Neighbor discovery in Internet of Things (IoT).

EDUCATION

Northwestern University Evanston, IL
Ph.D. candidate in Electrical Engineering and Computer Science 2011-present
Thesis: Internet of Things: Fundamental Limits and Practical Algorithms
Advisor: Professor Dongning Guo
GPA: 3.98/4.0

Purdue University, West Lafayette West Lafayette, IN
Master of Science in Electrical and Computer Engineering 2007-2009
Thesis: MIMO Precoder Design in the Relay-Assisted Cellular Network
Advisor: Professor David J. Love
GPA: 4.0/4.0

Zhongshan (Sun Yat-sen) University Guangzhou, China
Bachelor of Engineering with Distinction in Electronics Engineering 2003-2007
Overall GPA: 91/100 Major GPA: 94/100 Rank: 1/72

AWARDS & HONORS

- IEEE International Symposium on Information Theory (ISIT) Travel Grant. 2015
- Outstanding paper award in International Conference on Advanced Communication Technology. 2013
- Best paper award in International Conference on Advanced Technologies for Communications. 2011
- Walter P. Murphy Fellowship, Northwestern University 2011-2012
- Graduation with distinction, Zhongshan University 2007

SKILLS

- *Programming Languages:* C, C++, C#, Python, Java, Matlab, VHDL.
- *Web Programming:* PHP, HTML, Javascript.
- *Hardware Skills:* Experience of work with Stratix IV and Stratix V FPGAs. Experience of work with USRP2.

WORK EXPERIENCE

Calterah Shanghai, China
Co-Founder, Vice President of Algorithm December 2014 - present

- Developed MIMO radar signal processing algorithms.
- Built the radar platform integrating the front-end millimeter wave chip and back-end radar detection implemented on FPGA.

Nokia Research Center Berkeley, CA
Research Intern - Wireless System June 2012 - September 2012

- Implemented LTE channel estimation algorithms on a next-generation software-defined radio platform.
- Investigated the float-point and fix-point effects on the performance of MIMO-OFDM channel estimation.

**RESEARCH
EXPERIENCE**

Northwestern University

*Research Assistant, Communications and Networking Laboratory
Many-user information theory*

Evanston, IL
2011 - present

- Proposed a new paradigm referred to as *many-access* channel to study the fundamental limits of IoT.
- Proved the achievability of capacity using compressed sensing based decoding. The analytic framework can be used to achieve the capacity of point-to-point channels with almost linear dictionary size.

Heterogeneous network

- Proposed a drone-assisted architecture for LTE-based public safety network and analyzed the achievable throughput.
- Jointly optimized the spectrum and power allocation for the heterogeneous network.

Sparse Hadamard transform

- Proposed a random hashing and successive cancellation framework to compute the Hadamard transform with arbitrary sparse support.
- Designed a sublinear robust algorithm to compute noisy Hadamard transform by leveraging the expander codes.

DARPA spectrum challenge

- Ranked top 15 out of 90 teams to qualify the final stage of DARPA spectrum challenge.
- Designed and implemented using USRP software-defined radio a closed-loop system that efficiently communicate under 0 dB SNR and feedback under -20 dB SNR.

Massachusetts Institute of Technology

Visiting Student, Research Laboratory of Electronics (RLE)
Advisor: Professor Gregory W. Wornell

Cambridge, MA
Feb - Mar 2015

Neighbor discovery in IoT

- Proposed a fast and low complexity *asynchronous* neighbor discovery scheme.

The Hong Kong Polytechnic University

*Research Associate, Department of Electronic & Information Engineering
Cooperative communications*

Hong Kong
2009-2011

- Derived the asymptotic outage probabilities for amplify-and-forward and decode-and-forward relaying based on the maximum harmonic mean selection.
- Proposed a generalized framework for relay selection in opportunistic relaying, which achieves an optimal diversity-multiplexing gain tradeoff in relay systems.

Coding theory

- Derived an achievable code rate bound for array codes as LDPC codes.
- Proposed a code construction algorithm leveraging results from Sidon sequence construction in number theory.
- Investigated the optimal degree distribution of LDPC code with deterministic unequal error properties.

FPGA implementation of LDPC for optical communications

- Devised and implemented a 2.0 Gb/s high-throughput decoder for protograph-based LDPC convolutional codes on an Altera Stratix IV FPGA, attaining an error floor lower than $\text{BER} = 10^{-13}$.
- Designed and implemented a RAM-based decoder for irregular QC-LDPC on a Stratix V FPGA, attaining a coding gain of 11.4 dB at $\text{BER} = 10^{-15}$.

**TEACHING
EXPERIENCE**

Northwestern University

Evanston, IL

Teaching Assistant, Department of Electrical Engineering and Computer Science Fall 2013

- EECS 302 Random Signals: Delivered a weekly lecture and led a homework discussion session.
- EECS 307 Communications Systems: Led the lab sessions and provided guidance on assignments.

Purdue University, West Lafayette

West Lafayette, IN

Teaching Assistant, Department of Electrical and Computer Engineering 2007-2009

- ECE 208 Electronic Devices: Delivered lectures in lab and guided students on experiments.
- ECE 201 Linear Circuit Analysis: Provided guidance to students on homework assignments.

PUBLICATIONS

Book Chapters

1. **Xu Chen** and Dongning Guo, "A Novel Architecture for Public Safety Network", submitted to Public Safety Networks Series, Wiley-ISTE Press.

Journal Papers

1. **Xu Chen**, C. W. Sham, Francis Lau, Yue Zhao, and W. M Tam, "A 2.0 Gb/s Throughput Decoder for QC-LDPC Convolutional Codes", IEEE Transactions on Circuits and Systems I: Regular Papers, vol.60, no.7, pp.1857,1869, July 2013.
2. **Xu Chen**, Qing F. Zhou, Ting-wai Siu, and Francis Lau, "Asymptotic Analysis of Opportunistic Relaying based on the Max-Generalized-Mean Selection criterion", IEEE Trans. Wireless Commun., vol. 10, no. 4, pp 1050 - 1057, April 2011.
3. **Xu Chen** and Francis Lau, "Optimization of LDPC codes with Deterministic UEP Properties", IET Communications, vol. 5, issue 11, pp 1560-1565, July 2011.
4. **Xu Chen**, Ting-wai Siu, Qing F. Zhou and Francis Lau, "High-SNR Analysis of Opportunistic Relaying based on the Maximum Harmonic Mean Selection Criterion", IEEE Signal Processing Letter, vol.17, no.8, pp.719-722, Aug. 2010.
5. **Xu Chen** and Francis Lau, "Constructing High-Rate QC-LDPC Codes with Large-Girth Based on Shortened Array Codes", REV Journal on Elect. and Commun., vol. 1, no.3, pp. 137-144, 2011. (Invited Paper)

Conference Papers

1. **Xu Chen** and Dongning Guo, "Robust Sublinear Complexity Walsh-Hadamard Transform with Arbitrary Sparse Support", in Proc. IEEE Int. Symp. Inf. Theory (ISIT), Hong Kong, 2015, to appear.
2. **Xu Chen** and Dongning Guo, "Gaussian Many-Access Channels with Random Transmitter Activities", in Proc. IEEE Int. Symp. Inf. Theory (ISIT), Honolulu, HI, 2014
3. Tsung-yi Chen, **Xu Chen** and Dongning Guo, "Many-Broadcast Channels: Definition and Capacity for the Degraded Case", in Proc. IEEE Int. Symp. Inf. Theory (ISIT), Honolulu, HI, 2014.
4. **Xu Chen** and Dongning Guo, "Gaussian Many-Access Channels: Definition and Symmetric Capacity", in Proc. Information Theory Workshop (ITW), Seville, Spain, 2013.
5. **Xu Chen**, Dongning Guo, and John Grosspietsch, "Public Safety Wireless Networks: A Novel Architecture with Stationary and Mobile Base Stations", in Proc. IEEE International Conference on Communications (ICC), Budapest, Hungary, 2013.

6. **Xu Chen**, Q.F. Zhou, T. Siu, and F. Lau, "A Class of Selection Criteria Achieving Full Diversity in Amplify-and-Forward Opportunistic Relaying", in Proc. International Conference on Advanced Communication Technology, (ICACT), Phoenix Park, Korea, 2013. (*Outstanding Paper Award*).
7. C. W. Sham, **Xu Chen**, W. M. Tam, Y. Zhao and F. Lau, "A Layered QC-LDPC Decoder Architecture for High Speed Communication System", in Proc. IEEE Asia Pacific Conference on Circuits and Systems (APCCAS), Kaohsiung, Taiwan, 2012.
8. **Xu Chen** and Francis Lau, "Construction of High-Rate QC-LDPC Codes", in Proc. International Conference on Advanced Technologies for Communications (ATC), August 2011. (*Best Paper Award*)
9. Y. Zhao, **Xu Chen**, C. W. Sham, W. M. Tam and Francis Lau, "Efficient Decoding of QC-LDPC Codes Using GPUs", in Proc. International Conference on Algorithms and Architectures for Parallel Processing(ICA3PP), 2011.

PATENTS

1. C. W. Sham, **Xu Chen**, W. M. Tam, Y. Zhao, F. Lau and F. Yu, Efficient RAM-Based Pipelined Decoder Architecture for Quasi-Cyclic Low-Density Parity-Check Codes, International patent filed, application no. PCT/CN2011/077678.
2. C. W. Sham, **Xu Chen**, W. M. Tam, Yue Zhao, and Francis Lau, A 2.0 Gb/s High Throughput Decoder for Protograph-based LDPC Convolutional Codes, US patent filed, application no. 13/371,067.

ACTIVITIES & INVOLVEMENT

- Reviewer for IEEE Trans. Inform. Theory, IEEE Trans. Commun., IEEE J. on Select. Areas Commun., IEEE Commun. Letter, IEEE Sensors Journal, Eur. Trans. Telecommun., IET Commun., ISIT, ICC.
- Participant in the 2013 DARPA Spectrum Challenge on software-defined radio (final round).
- Participant in the 2012 North American School of Information Theory, Cornell University, Ithaca, NY.
- Participant in the 2011-2012 Wharton Business Plan Competition.
- Student member of IEEE.
- TPC member of ICACCI 2015.