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Education

- Ph.D. in Electrical and Computer Engineering
Syracuse University September 2011 - May 2016.
Thesis: “Nonparametric Anomaly Detection and Secure Communication”
Advisor: Prof. Yingbin Liang
- B.E. (with honors) in Information Engineering
Shanghai Jiao Tong University September 2007 - May 2011.

Research Interest

- Detection and estimation theory
- Machine learning
- Information theory
- Stochastic control

Research Experience

- **Postdoc Research Associate**
University of Illinois at Urbana Champaign
July 2016 - Present
Advisor: Prof. Venugopal V. Veeravalli
- **Research Assistant**
Syracuse University
September 2011 - May 2016
Advisor: Prof. Yingbin Liang
- **Visiting Research Assistant**
University of Illinois at Urbana Champaign
Aug 2015 - Jan 2016
Advisor: Prof. Venugopal V. Veeravalli

Research Projects

1. Nonparametric detection of geometric structures over large networks

Collaborators: Yingbin Liang, H. Vincent Poor

- Design statistically consistent and distribution-free tests
- Innovated kernel methods based on estimating distance between distributions in reproducing kernel Hilbert space

- Order-level optimality of proposed tests

2. Nonparametric anomalous sequence detection and identification in large datasets

Collaborators: Yuheng Bu, Yingbin Liang, Venugopal V. Veeravalli, H. Vincent Poor, Xinghua Shi

- Design statistically consistent and distribution-free tests
- Novel kernel methods, KL divergence based methods and comprehensive analysis
- Order-level optimality of proposed tests
- Improved computational complexity using clustering algorithm with little loss in detection error

3. An information theoretic approach to secret sharing

Collaborators: Yingbin Liang, Lifeng Lai, Shlomo Shamai (Shitz)

- Multiple secret sharing in a broadcast network
- Build connection between multiple secret sharing and secure communication
- Design capacity achieving secret sharing scheme based on information theoretic tools

4. Degraded broadcast channel with secrecy outside a bounded range

Collaborators: Yingbin Liang, Lifeng Lai, H. Vincent Poor, Shlomo Shamai (Shitz)

- Secure communication with secrecy outside a bounded range
- Novel design of critical scheme of rate splitting and sharing to achieve secrecy capacity region
- Design induction algorithm to solve intractable Fourier-Motzkin elimination
- Recursive construction of rate bounds in the converse proof
- Characterize the full secrecy capacity region

5. Estimation of KL divergence: optimal minimax rate

Collaborators: Yuheng Bu, Yingbin Liang, Venugopal V. Veeravalli

- Estimate Kullback-Leibler divergence between two large-alphabet distributions
- Design augmented plug-in estimator and characterize the minimax risk
- Derive lower bound on minimax risk and demonstrate the sub-optimality of the plug-in approach
- Design minimax optimal estimator based on joint plug-in approach and polynomial approximation

6. Quickest change detection under transient dynamics

Collaborators: Georgios Rovatsos, Georgios Fellouris, Venugopal V. Veeravalli

- Quickest change detection with multiple transient periods
- Design innovated algorithms that can incorporate prior statistical information about durations of transient periods, and also adapt to the unknown change point
- Demonstrate the optimality of proposed algorithms.

7. Nonparametric offline change detection

Collaborators: Venugopal V. Veeravalli, Biao Chen

- Detecting change in distribution of a sequence of temporally or spatially ordered observations offline

- Generalized likelihood test and kernel based methods
- Optimality and/or exponential consistency of proposed tests

8. Load control in power system with line outage

Collaborators: Georgios Rovatsos, Venugopal V. Veeravalli, Alejandro Dominguez-Garcia

- Optimal load control to prevent the system from breaking down and shut down the system quickly if line outage happens
- Solve partially observable Markov decision process
- Devise approximate solution techniques

Publications

Journal Papers & Preprints

1. **S. Zou**, Y. Liang, L. Lai, H. V. Poor, S. Shamai (Shitz). “Degraded Broadcast Channel with Secrecy Outside a Bounded Range”, *submitted to IEEE Transactions on Information Theory*, under review, available at arXiv:1609.06353
2. Y. Bu, **S. Zou**, Y. Liang, V. V. Veeravalli. “Estimation of KL Divergence: Optimal Minimax Rate”, *submitted to IEEE Transactions on Information Theory*, under review, available at arXiv:1607.02653
3. **S. Zou**, Y. Liang, H. V. Poor. “Nonparametric Detection of Geometric Structures over Networks”, *submitted to IEEE Transactions on Signal Processing*, under review, available at arXiv:1604.01351
4. **S. Zou**, Y. Liang, H. V. Poor, X. Shi. “Nonparametric Detection of Anomalous Data Streams”, *submitted to IEEE Transactions on Signal Processing*, under review, available at arXiv:1405.2294
5. **S. Zou**, Y. Liang, L. Lai, H. V. Poor, S. Shamai (Shitz). “Broadcast Networks with Layered Decoding and Layered Secrecy: Theory and Applications” *Proceedings of the IEEE*, vol.103, no.10, pp.1841-1856, Oct 2015.
6. **S. Zou**, Y. Liang, L. Lai, S. Shamai (Shitz). “An Information Theoretic Approach to Secret Sharing” *IEEE Transactions on Information Theory*, vol.61, no.6, pp.3121-3136, June 2015

Conference Papers

1. G. Rovatsos, **S. Zou**, V. V. Veeravalli, “Quickest Change Detection under Transient Dynamics” *to appear in Proc. IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, New Orleans, USA, March, 2017
2. **S. Zou**, Y. Liang, L. Lai, H. V. Poor, S. Shamai (Shitz). “K-User Degraded Broadcast Channel with Secrecy Outside a Bounded Range” *in Proc. IEEE Information Theory Workshop (ITW)*, Cambridge, September, 2016
3. Y. Bu, **S. Zou**, Y. Liang, V. V. Veeravalli. “Estimation of KL Divergence Between Large-Alphabet Distributions” *in Proc. IEEE International Symposium on Information Theory (ISIT)*, Barcelona, Spain, July, 2016
4. Y. Bu, **S. Zou**, Y. Liang, V. V. Veeravalli. “Universal Outlying Sequence Detection for Continuous Observations” *in Proc. IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, Shanghai, March, 2016

5. **S. Zou**, Y. Liang, H. V. Poor “Nonparametric Detection of an Anomalous Disk over a Two-Dimensional Lattice Network” in *Proc. IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, Shanghai, March, 2016
6. **S. Zou**, Y. Liang, L. Lai, H. V. Poor, S. Shamai (Shitz). ”Recent Results on Broadcast Networks with Layered Decoding and Secrecy: an Overview”, *International Zurich Seminar on Communications (IZS)*, Zurich, March, 2016
7. **S. Zou**, Y. Liang, L. Lai, S. Shamai (Shitz). “Rate Splitting and Sharing for Degraded Broadcast Channel with Secrecy Outside a Bounded Range” in *Proc. IEEE International Symposium on Information Theory (ISIT)*, Hongkong, June, 2015
8. **S. Zou**, Y. Liang, L. Lai, S. Shamai (Shitz). “Degraded Broadcast Channel: Secrecy Outside of a Bounded Range” in *Proc. IEEE Information Theory Workshop (ITW)*, Jerusalem, April, 2015
9. **S. Zou**, Y. Liang, H. V. Poor, X. Shi. “Unsupervised Nonparametric Anomaly Detection: A Kernel Method” in *Proc. of 52th Annual Allerton Conference on Communication, Control, and Computing*, Monticello, IL, October, 2014
10. **S. Zou**, Y. Liang, H. V. Poor. “A Kernel-Based Nonparametric Test for Anomaly Detection over Line Network” in *Proc. IEEE International Workshop on Machine Learning for Signal Processing (MLSP)*, Reims, September, 2014
11. **S. Zou**, Y. Liang, H. V. Poor, X. Shi. “Kernel-Based Nonparametric Anomaly Detection” in *Proc. IEEE 15th Workshop on Signal Processing Advances in Wireless Communications (SPAWC)*, Toronto, June, 2014
12. **S. Zou**, Y. Liang, L. Lai, S. Shamai (Shitz). “Layered Decoding and Secrecy over Degraded Gaussian MIMO Broadcast Channels and Application in Secret Sharing” in *Proc. IEEE International Symposium on Information Theory (ISIT)*, Honolulu, June, 2014
13. **S. Zou**, Y. Liang, L. Lai, S. Shamai (Shitz). “Layered Decoding and Secrecy over Degraded Broadcast Channels” in *Proc. IEEE 14th Workshop on Signal Processing Advances in Wireless Communications (SPAWC)*, Darmstadt, June, 2013
14. **S. Zou**, Y. Liang, S. Shamai (Shitz). “Multiple Access Channel with State Uncertainty at Transmitters” in *Proc. IEEE International Symposium on Information Theory (ISIT)*, Istanbul, June, 2013

Book Chapters

1. **S. Zou**, Y. Liang, H. V. Poor, X. Shi. “Data-Driven Approaches for Detecting Anomalous Data Streams”, under review

Honors & Awards

- **National Scholarship**, the Ministry of Education of China, 2008
- **Outstanding Graduate of Shanghai**, Shanghai Ministry of Education, 2011
- **National Encouragement Scholarship**, the Ministry of Education of China, 2009 and 2010
- **Excellent Student Scholarship**, Shanghai Jiao Tong University, 2008, 2009, 2010

Service & Professional Activities

Member: IEEE, IEEE Information Theory Society, IEEE Communications Society

Reviewer: Proceedings of the IEEE, IEEE Transactions on Information Theory, IEEE Transactions on Signal Processing, IEEE Transactions on Wireless Communications, IEEE Transactions on Communications, IEEE ISIT 2013, IEEE ITW 2013, IEEE SPAWC 2013, IEEE ISIT 2015

Teaching & Mentoring Experience

- Teaching Assistant, Syracuse University
Course: ELE 352, Digital Signal Processing, 2012; ELE 756, Random Process, 2012
- Yuheng Bu, University of Illinois at Urbana Champaign, Ph.D. student
- Georgios Rovatsos, University of Illinois at Urbana Champaign, Ph.D. student
- Yixian Liu, Syracuse University, visiting Ph.D. student

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