

# Libin Liu

**Phone:** +1 213-706-1808

**Email:** liulibin1993@gmail.com

**Webpage:** <https://liulibin1993.github.io/>

**Address:** EEB 540, 3740 McClintock Avenue, Los Angeles, CA 90089

## Education:

**Ph.D. in Electrical and Computer Engineering** Aug. 2015 — present  
University of Southern California (USC) Advisor: Prof. Urbashi Mitra

**B.E. in Electronic Engineering and Information Science** Aug. 2011 — Jun. 2015  
University of Science and Technology of China (USTC)

## Research/Work Experience:

**Communication Science Insitute, USC** Aug. 2015 — present  
**Graduate Research Assistant** Advisor: Prof. Urbashi Mitra

- *Application of Graph Signal Processing to Reinforcement Learning*
  - Proposed policy sampling and reconstruction algorithms for structured optimal policy in reinforcement learning problems. The proposed algorithms achieved both runtime reduction (80%) and negligible performance loss compared to the classical  $Q$ -learning algorithm.
  - Derived analytical error bounds for the proposed algorithms and showed polynomial error decay rate.
  - Further proposed policy refinement algorithms, which achieved additional 50% error reduction with minor increase in complexity (less than 10% in runtime).
- *Efficient Representation and Policy Optimization for Markov Decision Processes Problems with Large State Space*
  - Derived one optimal subspace design method for reduced dimensional Markov Decision Processes, perfect reconstruction of value functions and optimal policy is guaranteed.
  - Proposed various subspace design methods for reduced dimensional Markov Decision Processes using graph signal processing techniques. One particular method achieved both complexity reduction and perfect reconstruction of the optimal policy.
  - Exploited policy structure to accelerate policy iteration, achieving 50% runtime reduction.
- *Deep Learning for Policy Optimization*
  - Analyzed the property of gradients of the neural network and theoretically showed monotonic property of neural network weights.
  - Proposed smart initialization method for policy gradient using continual learning, 60% error reduction is achieved.

**Adaptive Spectrum and Signal Alignment, Incorporated (ASSIA)** May. 2019 — Aug. 2019  
**System Engineering Intern** Technical Manager: Jisung Oh

- *Improvement of Broadband Network Speed Measurement*
  - Implemented software algorithm for broadband and Wi-Fi speed test
  - Optimized on C++ codes for improved performance
  - Conducted comparison with the current flooding algorithm and showed robustness and up to 50% performance improvement of the developed algorithm under heavy network traffic scenario.
- *Multi-AP (Wi-Fi Mesh) Network*
  - Investigation and understanding of WFA (Wi-Fi Alliance) Mesh Standard

**Communication Science Insitute, USC** Aug. 2019 — Dec. 2019

- *Graduate Teaching Assistant:* EE562 Random Processes in Engineering

**Department of Electronic Engineering and Information Science, USTC** Jan. 2014 — Oct. 2014  
**Undergraduate Research Assistant** Advisor: Prof. Wenyi Zhang

- *Impact of Coordinated Transmission on Delay and Energy Efficiency in Wireless Networks*
  - Derived formulas for delay and energy efficiency in non-coordinated transmission and coordinated transmission.
  - Conducted numerical comparisons and analyzed their engineering significance.
  - Demonstrated that networks can strongly benefit from coordinated transmission.

## Publications:

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### Journal Papers

1. L. Liu and U. Mitra, "Policy Gradient in Wireless Network: Neural Network Analysis and Improvement", in preparation.
2. L. Liu and U. Mitra, "On Sampled Reinforcement Learning in Wireless Networks: Exploitation of Policy Structures", *IEEE Transactions on Communications*, vol. 68, no. 5, pp. 2823-2837, 2020.
3. L. Liu, A. Chattopadhyay and U. Mitra, "On Solving Large Scale MDPs: Exploitation of Policy Structures and Spectral Properties", *IEEE Transactions on Communications*, vol. 67, no. 6, pp. 4151-4165, 2019.
4. L. Liu, Y. Zhong, W. Zhang and M. Haenggi, "On the impact of Cooperation on Local Delay and Energy Efficiency in Poisson Networks", *IEEE Wireless Communications Letters*, vol. 4, no. 3, pp. 241-244, 2015.

### Conference Articles

1. L. Liu and U. Mitra, "Neural Policy Gradient in Wireless Network: Analysis and Improvement", *IEEE International Global Communications Conference (GLOBECOM)*, IEEE, 2020, submitted.
2. L. Liu, and U. Mitra, "Policy Sampling and Interpolation for Wireless Networks: A Graph Signal Processing Approach", *IEEE International Global Communications Conference (GLOBECOM)*, IEEE, 2019.
3. L. Liu, A. Chattopadhyay and U. Mitra, "Exploiting Policy Structure for Solving MDPs with Large State Space", *52nd Annual Conference on Information Sciences and Systems (CISS)*, IEEE, Mar, 2018.
4. L. Liu, A. Chattopadhyay and U. Mitra, "On Exploiting Spectral Properties for Solving MDP with Large State Space", *55th Annual Allerton Conference on Communication, Control and Computing*, pp. 1213-1219, IEEE, Oct, 2017.

## Courses and Skills:

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### • Graduate Courses

- Introduction to Computer Networks
- Digital Communication and Coding Systems
- Probability for Electrical and Computer Engineers
- Fundamental Concepts of Analysis
- Information Theory and Compression
- Random Processes in Engineering
- Applied Matrix Analysis
- Stochastic Processes
- Analysis of Algorithms
- Computational Solution of Optimization Problems
- Stochastic Network Optimization
- Wavelets and Graphs for Signal Processing and Machine Learning
- Dynamic Programming and Markov Decision Processes

### • Software skills and Packages

- **Programming and Toolbox**
  - \* Python
  - \* Matlab
  - \* C
  - \* SDR simulink Matlab
  - \* SQL
- **Others**
  - \* L<sup>A</sup>T<sub>E</sub>X
  - \* VHDL

## References:

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- Prof. Urbashi Mitra (Ph.D advisor)  
Ming Hsieh Department of Electrical and Computer Engineering, University of Southern California, USA.  
Email: ubli@usc.edu
- Prof. Antonio Ortega (Project collaborator)  
Ming Hsieh Department of Electrical and Computer Engineering, University of Southern California, USA.  
Email: antonio.ortega@gmail.com
- Dr. Jisung Oh (Internship manager)  
Adaptive Spectrum and Signal Alignment. Inc, USA.  
Email: joh@assia-inc.com