

## Education:

**Ph.D. in Electrical and Computer Engineering**  
University of Southern California (USC)

Aug. 2015 — present  
Advisor: Prof. Urbashi Mitra

**B.E. in Electronic Engineering and Information Science**  
University of Science and Technology of China (USTC)

Aug. 2011 — Jun. 2015

## Research/Project Experience:

**Communication Science Insitute, USC**

Aug. 2015 — present

Advisor: Prof. Urbashi Mitra

- *Deep Learning for Policy Optimization*
  - Analyzed the property of gradients of the neural network and theoretically showed monotonicity properties of neural network weights.
  - Proposed smart initialization method for policy gradient using continual learning, 60% error reduction is achieved.
- *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 complexity reduction (80%) and negligible performance loss compared to the classical  $Q$ -learning algorithm.
  - Derived analytical error bounds for the proposed algorithms and showed polynomial decay rate.
  - Further proposed policy refinement algorithms, which achieved additional 50% error reduction with minor increase in complexity (less than 10%).
- *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.

**Communication Science Insitute, USC**

Aug. 2019 — Dec. 2019

- *Teaching Assistant:* EE562 Random Processes in Engineering

**Adaptive Spectrum and Signal Alignment, Incorporated (ASSIA)**

May. 2019 — Aug. 2019

Technical Manager: Jisung Oh

- *Improvement of Broadband Network Speed Measurement*
  - Software implementation of broadband and Wi-Fi speed test
  - Optimization on 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

- *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*, accepted.
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, “Policy Sampling and Interpolation for Wireless Networks: A Graph Signal Processing Approach”, *IEEE International Global Communications Conference (GLOBECOM)*, IEEE, 2019.
2. 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.
3. 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**
  - \* C    \* Matlab    \* Python    \* 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)  
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