Xinyu Wu

(+1)857-209-1712 xinyuwu1@mit.edu/wuxinyusjtu@gmail.com
Personal Website: https://xinyuwusjtu.github.io/wxy/
Massachusetts Institute of Technology (MIT), Cambridge, MA, 02139

EDUCATION

Massachusetts Institute of Technology, Laboratory of Information and Decision System (LIDS) Sep. 2018-Present

- **Ph.D. in Aeronautics and Astronautics & Interdisciplinary Doctoral Program in Statistics (IDPS)**
- **Ph.D. Advisor:** Eytan Modiano **GPA**: 5.0/5.0
- **Research Interest:** Network Robustness, Control, and Optimization
- **Courses:** Introduction to Linear Programming; Data Networks; Inference and Information; Statistical Communication and Localization Theory; Fundamentals of Probability; Statistical Learning Theory and Applications; Reinforcement Learning: Foundations and Methods; Mathematical Statistics: A Non-Asymptotic Approach

Shanghai Jiao Tong University, Electronic Engineering (GPA**:** 93.0/100, Rank 1/168) Sep. 2014-Jun. 2018

- **Courses:** C++ Programming (99); Data Structure (95); Algorithm & Complexity (94); Wireless Communication & Mobile Networks (99); ARM Embedded System & its Experiments (94)
- **Thesis**: Theoretical Analysis and Algorithm Design for Social Network De-anonymization (A+, Outstanding Thesis, top 1%)

Shanghai Jiao Tong University, Mathematics (minor) (GPA**:** 95.4/100, Rank 1/26) Feb. 2016-Jun. 2018

- **Courses:** Advanced Algebra (98); Probability and Statistics (99); Stochastic Process (93); Numerical Analysis (93); Ordinary Differential Equation (99); Real Analysis (96)
- **Thesis**: Study of Planar Interpolation Polynomial (A)

PUBLICATIONS

- **Xinyu Wu**, Dan Wu, Eytan Modiano, "Predicting Failure Cascades in Large Scale Power Systems via the Influence Model Framework", submitted to *IEEE Transactions on Power Systems*.
- **Xinyu Wu**, Dan Wu, Eytan Modiano, "An Influence Model Approach to Failure Cascade Prediction in Large Scale Power Systems", *the 2020 American Control Conference (ACC)*, Denver, USA, Jul. 1st-3rd, 2020.
- **Xinyu Wu**, Xiaohua Tian, Xinbing Wang, "Large-scale Wireless Fingerprints Prediction for Cellular Network Positioning'', *IEEE International Conference on Computer Communications (INFOCOM)*, Honolulu, USA, Apr. 15th-19th, 2018.
- Xiaohua Tian, **Xinyu Wu**, Hao Li, Xinbing Wang, "RF Fingerprints Prediction for Cellular Network Positioning: A Subspace Identification Approach'', *IEEE Transactions on Mobile Computing*, vol. 19, no. 2, pp. 450-465, 2019.
- **Xinyu Wu**, Zhongzhao Hu, Xinzhe Fu, Luoyi Fu, Xinbing Wang, Songwu Lu, "Social Network De-Anonymization with Overlapping Communities: Analysis, Algorithm, and Experiments", *IEEE International Conference on Computer Communications (INFOCOM)*, Honolulu, USA, Apr. 15th-19th, 2018.

RESEARCH EXPERIENCES

Finite-Buffer Communication System Analysis | MIT Sep. 2019 - Present

- We proposed an ordinary differential equation (ODE) model to characterize the dynamics of queue-based model in the finite-buffer system, and proved the sufficient condition of the transmission policy that can stabilize the networks when the flow arrival vector is strictly inside the admissible rate region, for both single and multi-commodity cases.
- We figured out the finiteness of buffer size may induce throughput reduction under the overloaded multi-commodity system, and formulated an optimization framework to capture the throughput and even designing link capacity values such that the throughput can be maximized.
- We proved that the backpressure policy can achieve the most balanced overloading rate vector under the finite-buffer system with given capacity values. We further clarified the condition of link capacity values to achieve the most balanced overloading rate, and extended to achieving any desirable overloading rate.

Failure Cascade Prediction and Analysis in Network Systems | MIT Nov. 2018 - Sep. 2019

- We characterized the failure cascade process in power systems by the influence model (IM), and proposed a hybrid learning scheme to train IM. First we applied a Monte-Carlo approach to quickly acquire the pairwise influence between any two transmission links; Then we formulated a quadratic programming to obtain the weights of each pairwise influence; Finally we proposed an adaptive threshold estimation and selection scheme to better predict cascade processes.
- We tested our prediction mechanism based on the 1354-bus, 2383-bus, and 3012-bus systems provided by IEEE in Matlab MATPOWER Toolbox. Our mechanism could predict the final state of each link within 10% error rate, final failure size

within 7% error rate, and failure time within 2 time units expectedly, with at most 3.4% of all possible initial link contingencies as training samples and two magnitudes faster in prediction than the original simulation method.

- We implemented Logistic Regression (LR) in Matlab and LSTM by Tensorflow for comparison, and showed prediction accuracy: LSTM > IM≈LR, while our IM-based approach was much more efficient and could further unveil useful network properties, including remote failure propagation and critical transmission links in the systems, compared with LR and LSTM.
- Python Code for LSTM: https://github.com/xinyuwusjtu/FailureCascadePredictionLSTM (Matlab Code to be uploaded)

Social Network De-Anonymization | SJTU Mar. 2017 - May. 2018

- We intended to identify anonymized users by another correlated public social networks, based on the Minimum Mean Square Error criterion. We showed its NP-hardness, and then derived an approximated alternative to this problem via the restriction by Sequence Inequality, with the approximation ratio at most 2. We then proposed a convex-concave based algorithm to solve the problem, and showed that overlapping communities in social networks can enhance de-anonymization accuracy.
- We further unveiled that the network symmetry, including intra-network and inter-network symmetry, fundamentally determines the de-anonymizability. We further derived the de-anonymizable region for Erdos-Renyi model, Power Law model, and Stochastic Block model, mainly by probability and matrix theory. Results of all cases echoed our claim based on the Microsoft Academic Graphs with at most 2000 nodes.

Large-Scale Wireless Fingerprinting Prediction and Localization | SJTU Sep. 2016 - Mar. 2017

- We intended to do outdoor localization based on limited samples of wireless signal strength from different base stations, termed as 'fingerprints'. We modeled the fingerprint prediction as a matrix completion problem, and proposed a Stiefel-manifold based algorithm for prediction based on Singular Value Decomposition and QR Decomposition.
- We further designed a sliding-window mechanism to overcome the sparsity of fingerprints that solely gathered on main roads in real situations, by means of firstly applying our method in small windows around main roads, and gradually percolating to the whole region with larger windows as more fingerprints had been predicted.
- We reconstructed the fingerprints in a 69.8km^2 region in Ningbo, China, and showed that 71% and 98% users can respectively be localized within an error of 100m and 300m, triumphing over the accuracy of Cell-ID and Gaussian Mixture Model approaches, and achieving E911's requirements: "within 100m for 67% and 300m for 90%."

HONORS & AWARDS

- Outstanding Bachelor's Thesis Award, top 1%, highest honor of undergraduate thesis in SJTU 2018
- Outstanding Winner (INFORMS Award), Mathematical Contest of Modeling (Problem C), only 1 in all 4748 teams 2018
  - We built a novel framework for Characterization, Analysis, Forecast, and Evaluation (CAFE) on energy profile of four states in America: We utilized the Gaussian Process Regression (GPR) to characterize the energy evolving trend, and used Gray Relational Analysis and Kendall Rank to measure similarities of energy profile among the states. We finally proposed an ARMA-GPR Hybrid model to predict the energy profile in 2025 and 2050.
- Shanghai Honorable Graduate, ~10% of all senior students in SJTU 2018
- IEEE INFOCOM Travel Grant, only for student presenters in INFOCOM 2018

COURSE PROJECT

Cipher Breaking using Markov Chain Monte Carlo, Course 6.437: Inference and Information, MIT. Apr. 2019

- I implemented Metropolis-Hasting MCMC algorithm to identify the cipher function over 28 characters (a-z, space, comma), and tested on the ciphertext with length more than 10,000 characters.
- I utilized the bisection method and examined the abrupt drop of likelihood function to identify the possible breakpoint, at which the cipher function changed, in the ciphertext.
- Python Code and Technical Report: https://github.com/xinyuwusjtu/MCMC_decipher

TEACHING EXPERIENCE

Teaching Assistant, Course 16.36/16.363: Communication Systems & Networks, MIT. Spring 2020

- I constructed problem sets including modulation, channel coding, ARQ, CSMA, etc., and exams.

Teaching Assistant, Course CS214: Algorithm and Complexity, SJTU. Spring 2018

- I formulated problem sets for Greedy Algorithm, Amortized Analysis, Graph Algorithm, Turing Machine, and Approximation Algorithm, and exams.
- I prepared course slides about Linear Programming and Simplex Algorithm.
- Course Website: http://anl.sjtu.edu.cn/gao-xf/course/CS214-2018

ACADEMIC SERVICES & ACTIVITIES

- Reviewer
  - *Discrete Mathematics, Algorithms and Applications (DMAA)*

- External Reviewer
  - *IEEE/ACM Transactions on Networking (ToN)*
  - *IEEE Transactions on Network Science and Engineering (TNSE)*
  - *IEEE International Conference on Computer Communications (INFOCOM)*