

HANBAEK LYU

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EMPLOYMENT

University of California, Los Angeles Hedrick Assistant Professor (Mentor: Marek Biskup) *Jul. 2018 - Jun. 2021*

EDUCATION

The Ohio State University Ph.D in Mathematics (Advised by David Sivakoff) *Aug. 2013 - Apr. 2018*

Thesis: *Combinatorial and probabilistic aspects of coupled oscillators*

Seoul National University B.S. in Mathematics *Mar. 2008 - Feb. 2013*

RESEARCH INTEREST

- **Fields of research:** Probability, combinatorics, dynamical systems, optimization, and machine learning
- **General interest:** Emergent properties of spatial processes; convergence of online/distributed algorithms; MCMC sampling; Online learning algorithms and inference

RESEARCH GRANTS

NSF **DMS-2010035:** *Combinatorial and probabilistic approaches to oscillator and clock synchronization. 2020-2023*
Award amount: \$146,953

PUBLICATIONS

Publications

- [1] H. Lyu, C. Strohmeier, G. Menz, and D. Needell, "Applications of Online Nonnegative Matrix Factorization to Image and Time-Series Data" 2020 Information Theory and Applications Workshop (ITA) [Preprint](#)
- [2] H. Lyu, D. Needell, and L. Balzano, "Online matrix factorization for Markovian data and applications to Network Dictionary Learning." Revision under review in Journal of Machine Learning Research. ([Preprint](#), [GitHub](#)) (2019)
- [3] L. Levine, H. Lyu, and J. Pike, "Double jump phase transition in a soliton cellular automaton." To appear in International Mathematics Research Notices. [Preprint](#) (2020)
- [4] H. Lyu, "Chromatic number, cycles, and non-separating cycles." Graphs and Combinatorics. 36, 1297–1310 (2020) ([Journal](#), [Preprint](#))
- [5] S. Dittmer, H. Lyu, and I. Pak, "Phase transition in random contingency tables with non-uniform margins." Trans. Amer. Math. Soc. 373 (2020), pp. 8313-8338. ([Journal](#), [Preprint](#))
- [6] A. Kuniba and H. Lyu, "Large deviations and one-sided scaling limit of random multicolor box-ball system" Journal of Statistical Physics, 178(1), 38-74 (2019) ([Journal](#), [Preprint](#))
- [7] A. Kuniba, H. Lyu, and M. Okado, "Randomized box-ball systems, limit shape of rigged configurations, and thermodynamic Bethe ansatz" Nuclear Physics B (2018), Vol. 937, 240-271. ([Journal](#), [Preprint](#))
- [8] M. Damron, J. Gravner, M. Junge, H. Lyu, and D. Sivakoff, "Parking on transitive unimodular graphs." Annals of Applied Probability, Volume 29, Number 4 (2019), 2089-2113 ([Journal](#), [Preprint](#))

- [9] H. Lyu and D. Sivakoff “*Persistence of sums of correlated increments and clustering in cellular automata*” Stochastic Processes and Applications (2018), Vol. 129, Issue 4. ([Journal](#), [Preprint](#))
- [10] E. Foxall and H. Lyu, “*Clustering in three and four color cyclic particle systems in one dimension*” Journal of Statistical Physics (2018), Vol. 171, Issue 3, 470–483. ([Journal](#), [Preprint](#))
- [11] H. Lyu, “*Global synchronization of pulse-coupled oscillators on trees.*” SIAM Journal on Applied Dynamical Systems (2018), Vol. 17, No. 2. ([Journal](#), [Preprint](#))
- [12] J. Gravner, H. Lyu, and D. Sivakoff, “*Limiting behavior of 3-color excitable media on arbitrary graphs.*” Annals of Applied Probability, Vol. 28, Number 6 (2018), 3324–3357. ([Journal](#), [Preprint](#))
- [13] H. Lyu, “*Synchronization of finite-state pulse-coupled oscillators.*”, Physica D: Nonlinear Phenomena 303 (2015): 28–38. ([Journal](#), [Preprint](#))

Preprints

- [14] H. Lyu, Y. Kureh, J. Vendrow, and M. A. Porter, “*Learning low-rank latent mesoscale structures of networks*” ([Preprint](#), [GitHub](#), [Python package “ndlearn”](#)) (2020)
- [15] H. Lyu and I. Pak, “*On the number of contingency tables and the independence heuristic.*” Submitted. [Preprint](#) (2020)
- [16] L. Kassab, A. Kryshchenk, H. Lyu, D. Molitor, D. Needell, and E. Rebrova, “*On Nonnegative Matrix and Tensor Decompositions for COVID-19 Twitter Dynamics*” Submitted. [Preprint](#) (2020)
- [17] M. Damron, H. Lyu, and D. Sivakoff, “*Stretched exponential decay for subcritical parking times on \mathbb{Z}^d .*” Submitted. [Preprint](#) (2020)
- [18] C. Strohmeier, H. Lyu, and D. Needell, “*Online nonnegative tensor factorization and CP-dictionary Learning for Markovian data*” Submitted. ([Preprint](#), [GitHub](#)) (2020)
- [19] T. Johnson, M. Junge, H. Lyu, and D. Sivakoff, “*Particle density in diffusion-limited annihilating systems*” Submitted. [Preprint](#) (2020)
- [20] H. Lyu, C. Strohmeier, G. Menz, and D. Needell, “*COVID-19 Time-series prediction by joint dictionary learning and online NMF*” Submitted ([Preprint](#), [GitHub](#)) (2020)
- [21] (*From summer REU project*) Y. Guo, N. Hanoian, Z. Lin, N. Liskij, H. Lyu, D. Needell, J. Qu, H. Sojico, Y. Wang, Z. Xiong, and Z. Zou, “*Topic-aware Chatbot Using Recurrent Neural Networks and Nonnegative Matrix Factorization.*” ([Preprint](#), [GitHub](#)) (2019)
- [22] J. Lewis, H. Lyu, P. Pylyavskyy, and A. Sen, “*Scaling limit of soliton lengths in a multicolor box-ball system.*” Submitted. [Preprint](#) (2019)
- [23] H. Lyu, F. Memoli, and D. Sivakoff, “*Sampling random graph homomorphisms and applications to network data analysis.*” Submitted. ([Preprint](#), [GitHub](#)) (2019)
- [24] M. Junge and H. Lyu, “*The phase structure in asymmetric ballistic annihilation*” Submitted. [Preprint](#) (2018)
- [25] H. Lyu and D. Sivakoff “*Synchronization of finite-state pulse-coupled oscillators on \mathbb{Z} .*” [Preprint](#) (2017)
- [26] H. Lyu, “*Phase transition in firefly cellular automata on finite trees.*” [Preprint](#) (2017)

REFEREED JOURNALS

SIAM Journal on Mathematical Analysis, Journal of the AMS (quick opinion) Communications in Mathematical Physics
 Mathematical Reviews, ALEA: Latin American Journal of Probability and Mathematical Statistics
 Electronic Journal of Probability, Linear Algebra and its Applications, Journal of Statistical Physics
 Nonlinear Dynamics, Journal of Nonlinear Science, Automatica, IEEE Transactions in Cybernetics

TEACHING

UCLA

Fall 2020: Math 170S (Intro. to Probability and Statistics II) — Course coordinator

Summer 2020 C: Math 170S (Intro. to Probability and Statistics II), Math 174E (Mathematical Finance)

Spring 2020: Math 170S (Intro. to Probability and Statistics II)

Winter 2020: Math 171 (Stochastic processes), Math 170S (Intro. to Probability and Statistics II)

Summer 2019: Math 170A (Probability theory), Math 170B (Probability theory), Math 174E (Mathematical Finance)

Spring 2019: Math 170B (Probability theory)

Winter 2019: Math 170A (Probability theory), Math 171 (Stochastic Processes)

Fall 2018: Math 170B (Probability theory)

Lecture notes: [Probability Theory A](#), [Probability Theory B](#), [Probability Theory A/B combined](#)
 [Stochastic Processes](#), [Mathematical Finance](#), [Introduction to Statistics II](#)

OSU

Fall 2015: Math 2153 (Calculus 3) ([Notes](#))

Spring 2014: Math 1131 (Calculus for business)

Fall 2014: Fall 2014: Math 1131 (Calculus for business)

Summer 2013: Summer 2013: Math 1152 (Calculus 2)

Spring 2013: Spring 2013: Math 1151 (Calculus 1)

Fall 2013: Math 1151 (Calculus 1)

SUMMER REU MENTORED

Summer 2020: “*Machine Learning approaches to oscillators and clock synchronization*” ([link](#))

PI: Hanbaek Lyu

Team members: Hardeep Bassi, Rohith Kodukula, Josh Vendrow, Richard Yim, and Cherlin Zhu

Summer 2019: “*Sequence learning and building topic-aware chatbot using RNN and NMF*” ([link](#))

PI: Deanna Needell

Mentor: Hanbaek Lyu

Consultant: Blake Hunter

Team members: Henry Sojico, Nicholas Liskij, Nicholas Hanoian, Zhexiao Lin, Jiajao Qu, Yuchen Guo, Yuliang Wang, Xiong Zhe, Zhenhong Zou