

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, data science, and machine learning
- **General interest:** Emergent properties of spatial processes; convergence of online/distributed algorithms; MCMC sampling; Online learning algorithms and inference

PUBLICATIONS

Journal Publications

- [1] S. Dittmer, H. Lyu, and I. Pak, "Phase transition in random contingency tables with non-uniform margins." To appear in Transactions of the AMS. [Preprint](#) (2019)
- [2] 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](#))
- [3] 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](#))
- [4] 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](#))
- [5] 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](#))
- [6] 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](#))
- [7] H. Lyu, "Global synchronization of pulse-coupled oscillators on trees." SIAM Journal on Applied Dynamical Systems (2018), Vol. 17, No. 2. ([Journal](#), [Preprint](#))
- [8] 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](#))
- [9] H. Lyu, "Synchronization of finite-state pulse-coupled oscillators.", Physica D: Nonlinear Phenomena 303 (2015): 28-38. ([Journal](#), [Preprint](#))

Preprints

- [10] 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](#) (2019)

- [11] J. Lewis, H. Lyu, P. Pylyavskyy, and A. Sen, "Scaling limit of soliton lengths in a multicolor box-ball system." [Preprint](#) (2019)
- [12] H. Lyu, D. Needell, and L. Balzano, "Online matrix factorization for Markovian data and applications to Network Dictionary Learning." [Preprint](#) (2019)
- [13] H. Lyu, F. Memoli, and D. Sivakoff, "Sampling random graph homomorphisms and applications to network data analysis." [Preprint](#) (2019)
- [14] M. Junge and H. Lyu, "The phase structure in asymmetric ballistic annihilation" Submitted. [Preprint](#) (2018)
- [15] L. Levine, H. Lyu, and J. Pike, "Double jump phase transition in a soliton cellular automaton." Submitted. [Preprint](#) (2017)
- [16] H. Lyu and D. Sivakoff "Synchronization of finite-state pulse-coupled oscillators on \mathbb{Z} ." [Preprint](#) (2017)
- [17] H. Lyu, "Phase transition in firefly cellular automata on finite trees." [Preprint](#) (2017)
- [18] H. Lyu, "Chromatic number, cycles, and non-separating cycles." Submitted. [Preprint](#) (2016)

In preparation

- [19] Hanbaek Lyu, Georg Menz, Deanna Needell, and Christopher Strohmeier, "Applications of Online Nonnegative Matrix Factorization to Image and Time-Series Data."
- [20] Hanqin Cai, Hanbaek Lyu, and Deanna Needell, "Online robust matrix factorization for markovian data", In preparation
- [21] Hanbaek Lyu, Deanna Needell, and Chris Strohmeier "Online tensor factorization for markovian data", In preparation
- [22] Michael Damron, Tobias Johnson, Matthew Junge, Hanbaek Lyu, and David Sivakoff, "Particle density in diffusion-limited annihilating systems." In preparation.
- [23] Sungwon Ahn, Jacob Richey, Lily Wang, Matthew Junge, Hanbaek Lyu, and David Sivakoff, "Phase transition in parking process with coalescing cars", In preparation

Unpublished notes

- [24] H. Lyu, "A Note on Graph Characteristics and Hadwiger's Conjecture." [Preprint](#) (2012)
- [25] H. Lyu and P. Jablonski, "Four-Dimensional Discrete-time Lotka-Volterra Models with an Application to Ecology." [Preprint](#) (2012)

REFEREED JOURNALS

Journal of American Mathematical Society (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

INVITED TALKS

"Learning parts of networks by motif sampling and online matrix factorization", Information Theory and Applications, SD, Feb 6, 2020

"Large deviations and one-sided scaling limit of randomized box-ball system", AMS Special Session on Random Matrices and Integrable Systems, I., JMM 2020, Jan 18, 2020

"Online matrix factorization for Markovian data", AMS Special Session on Iterative Methods for Large-Scale Data Analysis, JMM 2020, Jan 16, 2020

"Learning parts of networks by motif sampling and online matrix factorization", UCLA Applied Math Colloquium, Jan 8, 2020

"Online matrix factorization for Markovian data and applications to Network Dictionary Learning", Probability seminar, Seoul National University, Nov. 27, 2019

"Sampling random graph homomorphisms and applications to network data analysis", Austin - TAMU Probability and Related Fields, TAMU, Oct. 25, 2019

"Sampling random graph homomorphisms and applications to network data analysis", Austin - TAMU Probability and Related Fields, TAMU, Oct. 25, 2019

"Stability inequalities of some probabilistic network observables", TDA seminar, UCLA, Oct. 17, 2019

"Online nonnegative matrix factorization for Markovian data", Random matrix seminar, UCLA, Oct. 9, 2019

"Phase transition in random contingency tables with non-uniform margins", Combinatorics Seminar, University of Michigan, Sep. 27, 2019

"Stable network observables via dynamic embedding of motifs", Probability seminar, CUNY, May. 7, 2019

"Phase transition in random contingency table with non-uniform margins", Probability seminar, OSU, Apr. 11, 2019

"Stable network observables and dynamic embedding of motifs into networks", TGDA Seminar, OSU, Apr. 9, 2019

"Phase transition in random contingency table with asymmetric margins" Probability Seminar, USC, Apr. 5, 2019

"Synchronization of firefly cellular automata on various graphs", Applied math seminar, University of Alberta, Mar 25, 2019

"Phase transition in random contingency table with asymmetric margins", Interacting Particle Systems Conference, IPAM, Mar. 9, 2019

"Stable network observables and dynamic embedding of motifs into networks", Probability Seminar, UCSD, Feb. 28, 2019

"Dynamic embedding of motifs into networks", Probability Seminar, UCI, Dec 11, 2018

"Phase transition in box-ball system and its spatial generalization", Integrable systems seminar, Tokyo University, June 19, 2018

"Double jump phase transition in soliton cellular automata", Southeastern Probability Conference, Duke University, May 14-15, 2018

"Double jump phase transition in soliton cellular automata", Probability Seminar, University of California, Los Angeles, April 19, 2018

"Double jump phase transition in soliton cellular automata", Probability Seminar, University of Pennsylvania, Mar 27, 2018

"Double jump phase transition in random soliton cellular automaton", Combinatorics seminar, University of Minnesota, March 2, 2018

"Double jump phase transition in random soliton cellular automaton", Combinatorics seminar, University of Michigan, Jan 26, 2018

"Global synchronization of pulse-coupled oscillators on trees", AMS Contributing papers on Applied Mathematics III, Joint Mathematics Meetings 2018, San Diego

"Limiting behavior of 3-color excitable media on arbitrary graphs", AMS Special Session on Emergent Phenomena in discrete models, Joint Mathematics Meetings 2018, San Diego

"Persistence of sums of correlated increments and clustering in cellular automata", AMS Special Session on Markov chains, Markov processes and applications, Joint Mathematics Meetings 2018, San Diego

"Phase transition in a random soliton cellular automaton" Combinatorics and Probability Seminar, OSU, April 12, 2017

"Discrete excitable media on graphs" Probability Seminar, Indiana University, Sep 12, 2016

"Synchronization of finite-state pulse-coupled oscillators and applications to distributed algorithms" 2016 Combinatorics Conference, KAIST, Jul 23, 2016

"Synchronization of finite-state pulse-coupled oscillators on various network topologies" Hayes Graduate Research Forum, OSU, Feb 26, 2016

"Synchronization of finite-state pulse-coupled oscillators on various graphs" Probability Seminar, Cornell University, Feb 22, 2016

"Synchronization of finite-state pulse-coupled oscillators on various graphs" Korea Institute of Advanced Studies, Jan 14, 2016

"Synchronization of finite-state pulse-coupled oscillators" HYKE seminar, Seoul National University, May 14, 2015

"Synchronization of finite-state pulse-coupled oscillators on various network topologies" Combinatorics and Probability seminar, OSU, Oct 1, 2015

"Synchronization of finite-state pulse-coupled oscillators" Graduate Student Seminar, OSU, Sep 22, 2015

AWARDS AND FELLOWSHIPS

The Ohio State University Presidential Fellowship (University research fellowship), Spring 2017 - Fall 2017

Special Graduate Associate (Departmental research fellowship), Fall 2016

Special Graduate Associate (Departmental research fellowship), Spring 2016

National Science & Technology Scholarship, 2008-2012

CONFERENCES ATTENDED

Mathematics Research Community (Stochastic Spatial Models), Jun. 9-15, 2019, West Greenwich, RI

Interacting Particle Systems, Statistical Physics, and Related Topics, Mar. 7-9, 2019, IPAM, Los Angeles, CA

MSRI summer school in Representations of high dimensional data, July 9-20, 2018, MSRI, Berkeley, CA

4th Lake Michigan Workshop on Combinatorics and Graph Theory, April 15-16, 2017, Western Michigan University, Kalamazoo, MI

Dynamics and Geometry from High Dimensional Data, March 14-16, 2017, Carnegie Mellon University, Pittsburgh, PA

38th Midwest Probability Colloquium, October 13-15, 2016, Northwestern University, Evanston, IL

The 28th Fall meeting of the Semi-annual Workshop in Dynamical Systems and Related Topics, October 5 - 8, 2017, Penn State University, State College, PA

2016 Charles River Lectures on Probability Theory and Related Topics, October 27, 2016, Microsoft Research New England

Stochastic Networks Conference, June 20 - July 24, 2016, University of California at San Diego, CA

CRM-PIMS Summer School in Probability, June 15 - July 11, 2015, McGill University, Canada

2015 Charles River Lectures on Probability Theory and Related Topics, October 2, 2015, Microsoft Research New England

37th Midwest Probability Colloquium, October 8-10, 2015, Northwestern University, Evanston, IL

Central Spring Sectional Meeting Michigan State University, East Lansing, MI March 14-15, 2015

TEACHING

UCLA

Winter 2019: 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](#), [Stochastic Processes](#), [Mathematical Finance](#), [Intro to Stat. 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

UCLA

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