

LEK-HENG LIM

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Permanent Residence: United States; Citizenship: Singapore

EMPLOYMENT

University of Chicago

Professor, Computational and Applied Mathematics Initiative, Department of Statistics
(since Jul 2020)

Associate Professor, Computational and Applied Mathematics Initiative, Department of Statistics
(Jul 2017–Jun 2020; with tenure)

Assistant Professor, Computational and Applied Mathematics Initiative, Department of Statistics
(Jul 2010–Jun 2017; tenure track)

University of California, Berkeley

Charles B. Morrey Assistant Professor, Department of Mathematics
(Jul 2007–Jun 2010; mentors: Ming Gu and Bernd Sturmfels)

EDUCATION

Stanford University

Ph.D. in Computational and Mathematical Engineering
(Sep 2001–Jun 2007; principal advisors: Gene Golub and Gunnar Carlsson)

Cambridge University

Cornell University's 2000/01 Clare Hall Fellow
(Sep 2000–Aug 2001; matriculated Ph.D. student; transferred to Stanford in 2001)

Cornell University

M.S. in Mathematics
(Aug 1998–Aug 2000; Ph.D. candidate; won fellowship to Cambridge in 2000)

National University of Singapore

B.Sc. (Honors) in Mathematics
(Aug 1993–May 1996; direct honors program)

SELECTED HONORS

American Mathematical Society

Fellow, Class of 2020

International Linear Algebra Society

Hans Schneider Prize, 2019

Society for Industrial and Applied Mathematics

James H. Wilkinson Prize in Numerical Analysis and Scientific Computing, 2017

Foundations of Computational Mathematics

Stephen Smale Prize, 2017

Defense Advanced Research Projects Agency

Director's Fellowship, 2017–2018

Young Faculty Award, 2015–2017

Air Force Office of Scientific Research

Young Investigator Award, 2013–2016

National Science Foundation

Faculty Early Career Development Award, 2011–2016

SPECIAL LECTURES

International Linear Algebra Society

Hans Schneider Prize Lecture, 2021

LAA Lecture, 2010

Massachusetts Institute of Technology

Distinguished Seminar Series in Computational Science and Engineering, Spr 2019

Duke University–North Carolina State University–University of North Carolina

Triangle Lectures in Combinatorics, Fall 2018

Foundations of Computational Mathematics

Smale Prize Lecture, 2017

Society for Industrial and Applied Mathematics

James H. Wilkinson Prize Lecture, 2017

Pacific Institute for the Mathematical Sciences

PIMS–CSC Distinguished Lecture, 2016

Rice University

Peaceman Lecture on Numerical Mathematics, 2014

PUBLICATIONS

- [1] B. St. Thomas, K. You, L. Lin, L.-H. Lim, S. Mukherjee, “Learning subspaces of different dimensions,” *J. Comput. Graph. Stat.*, (2021), to appear.
- [2] J. Rodriguez, J.-H. Du, Y. You, L.-H. Lim, “Fiber product homotopy method for multiparameter eigenvalue problems,” *Numer. Math.*, (2021), to appear.
- [3] K. Ye, K. Wong, L.-H. Lim, “Optimization on flag manifolds,” *Math. Program.*, (2021), to appear.
- [4] L.-H. Lim, M. Michałek, Y. Qi, “Best k -layer neural network approximations,” *Constr. Approx.*, (2021), to appear.
- [5] L.-H. Lim, “Tensors in computations,” *Acta Numer.*, **30** (2021), pp. 555–764.
- [6] L.-H. Lim, K. Wong, K. Ye, “The Grassmannian of affine subspaces,” *Found. Comput. Math.*, **21** (2021), pp. 537–574.
- [7] G. Naitzat, A. Zhitnikov, L.-H. Lim, “Topology of deep neural networks,” *J. Mach. Learn. Res.*, **21** (2020), no. 184, pp. 1–40.
- [8] Z. Lai, L.-H. Lim, “Recht–Ré noncommutative arithmetic-geometric mean conjecture is false,” *Proc. Int. Conf. Mach. Learn.* (ICML), PMLR **119**, (2020), pp. 5608–5617.
- [9] L.-H. Lim, “Hodge Laplacians on graphs,” *SIAM Rev.*, **62** (2020), no. 3, pp. 685–715.
- [10] P. Comon, L.-H. Lim, Y. Qi, K. Ye, “Topology of tensor ranks,” *Adv. Math.*, **367** (2020), no. 107128, 46 pp.
- [11] Y. Qi, M. Michałek, L.-H. Lim, “Complex best r -term approximations almost always exist in finite dimensions,” *Appl. Comput. Harmon. Anal.*, **49** (2020), no. 1, pp. 180–207.
- [12] S. Friedland, L.-H. Lim, J. Zhang, “Grothendieck constant is norm of Strassen matrix multiplication tensor,” *Numer. Math.*, **143** (2019), no. 4, pp. 905–922.
- [13] L.-H. Lim, K. Wong, K. Ye, “Numerical algorithms on the affine Grassmannian,” *SIAM J. Matrix Anal. Appl.*, **40** (2019), no. 2, pp. 371–393.
- [14] L.-H. Lim, R. Sepulchre, K. Ye, “Geometric distance between positive definite matrices of different dimensions,” *IEEE Trans. Inform. Theory*, **65** (2019), no. 9, pp. 5401–5405.
- [15] S. Friedland, L.-H. Lim, J. Zhang, “An elementary and unified proof of Grothendieck’s inequality,” *Enseign. Math.*, **64** (2018), no. 3/4, pp. 327–351.
- [16] L. Zhang, G. Naitzat, L.-H. Lim, “Tropical geometry of deep neural networks,” *Proc. Int. Conf. Mach. Learn.* (ICML), PMLR **80** (2018), pp. 5824–5832.
- [17] S. Friedland, L.-H. Lim, “Nuclear norm of higher-order tensors,” *Math. Comp.*, **87** (2018), no. 311, pp. 1255–1281.
- [18] K. Ye, L.-H. Lim, “Fast structured matrix computations: tensor rank and Cohn–Umans method,” *Found. Comput. Math.*, **18** (2018), no. 1, pp. 45–95.
- [19] K. Ye, L.-H. Lim, “Cohomology of cryo-electron microscopy,” *SIAM J. Appl. Algebra Geometry*, **1** (2017), no. 1, pp. 507–535.
- [20] M. Ankele, L.-H. Lim, S. Groeschel, T. Schultz, “Versatile, robust, and efficient tractography with constrained higher-order tensor fODFs,” *Int. J. Comput. Assist. Radiol. Surg.*, **12** (2017), no. 8, pp. 1257–1270.

- [21] A. Benson, D. Gleich, L.-H. Lim, "The spacey random walk: a stochastic process for higher-order data," *SIAM Rev.*, **59** (2017), no. 2, pp. 321–345.
- [22] L.-H. Lim, "Self-concordance is NP-hard," *J. Global Optim.*, **68** (2017), no. 2, pp. 357–366.
- [23] L.-H. Lim, J. Weare, "Fast randomized iteration: diffusion Monte Carlo through the lens of numerical linear algebra," *SIAM Rev.*, **59** (2017), no. 3, pp. 547–587.
- [24] S. Friedland, L.-H. Lim, "The computational complexity of duality," *SIAM J. Optim.*, **26** (2016), no. 4, pp. 2378–2393.
- [25] K. Ye, L.-H. Lim, "Algorithms for structured matrix-vector product of optimal bilinear complexity," *Proc. IEEE Inform. Theory Workshop (ITW)*, **16** (2016), pp. 310–314.
- [26] M. Ankele, L.-H. Lim, S. Groeschel, T. Schultz, "Fast and accurate multi-tissue deconvolution using SHORE and H-PSD tensors," pp. 502–510, S. Ourselin et al. (Eds.), *Medical Image Computing and Computer-Assisted Intervention (MICCAI)*, **III**, Springer International, Cham, 2016.
- [27] Y. Qi, P. Comon, L.-H. Lim, "Semialgebraic geometry of nonnegative tensor rank," *SIAM J. Matrix Anal. Appl.*, **37** (2016), no. 4, pp. 1556–1580.
- [28] K. Ye, L.-H. Lim, "Schubert varieties and distances between subspaces of different dimensions," *SIAM J. Matrix Anal. Appl.*, **37** (2016), no. 3, pp. 1176–1197.
- [29] K. Ye, L.-H. Lim, "Every matrix is a product of Toeplitz matrices," *Found. Comput. Math.*, **16** (2016), no. 3, pp. 577–598.
- [30] Y. Qi, P. Comon, L.-H. Lim, "Uniqueness of nonnegative tensor approximations," *IEEE Trans. Inform. Theory*, **62** (2016), no. 4, pp. 2170–2183.
- [31] D. Gleich, L.-H. Lim, Y. Yu, "Multilinear PageRank," *SIAM J. Matrix Anal. Appl.*, **36** (2015), no. 4, pp. 1507–1541.
- [32] A. Rajkumar, S. Ghoshal, L.-H. Lim, S. Agarwal, "Ranking from stochastic pairwise preferences: recovering Condorcet winners and tournament solution sets at the top," *Proc. Int. Conf. Mach. Learn. (ICML)*, **37** (2015), pp. 665–673.
- [33] L.-H. Lim, P. Comon, "Blind multilinear identification," *IEEE Trans. Inform. Theory*, **60** (2014), no. 2, pp. 1260–1280.
- [34] T. Schultz, A. Fuster, A. Ghosh, L. Florack, R. Deriche, L.-H. Lim, "Higher-order tensors in diffusion imaging," pp. 129–161, C.-F. Westin et al. (Eds.), *Visualization and Processing of Tensors and Higher Order Descriptors for Multi-Valued Data*, Springer-Verlag, Berlin Heidelberg, 2014.
- [35] C. J. Hillar, L.-H. Lim, "Most tensor problems are NP-hard," *J. ACM*, **60** (2013), no. 6, Art. 45, 39 pp.
- [36] L.-H. Lim, "Tensors and hypermatrices," Art. 15, 30 pp., in L. Hogben (Ed.), *Handbook of Linear Algebra*, 2nd Ed., CRC Press, Boca Raton, FL, 2013.
- [37] M. Gu, L.-H. Lim, C. Wu, "PARNES: A rapidly convergent algorithm for accurate recovery of sparse and approximately sparse signals," *Numer. Algorithms*, **64** (2013), no. 2, pp. 321–347.
- [38] D. Gleich, L.-H. Lim, "Rank aggregation via nuclear norm minimization," *Proc. ACM SIGKDD Conf. Knowledge Discovery and Data Mining (KDD)*, **17** (2011), pp. 60–68.
- [39] X. Jiang, L.-H. Lim, Y. Yao, Y. Ye, "Statistical ranking with combinatorial Hodge theory," *Math. Program.*, **127** (2011), no. 1, pp. 203–244.
- [40] B. Savas, L.-H. Lim, "Quasi-Newton methods on Grassmannians and multilinear approximations of tensors and symmetric tensors," *SIAM J. Sci. Comput.*, **32** (2010), no. 6, pp. 3352–3393.
- [41] L.-H. Lim, P. Comon, "Multisensor signal processing: tensor decomposition meets compressed sensing," *C. R. Acad. Sci. Paris, Series IIB – Mechanics*, **338** (2010), no. 6, pp. 311–320.
- [42] L.-H. Lim, P. Comon, "Nonnegative approximations of nonnegative tensors," *J. Chemometrics*, **23** (2009), no. 7–8, pp. 432–441.
- [43] M. Mørup, L. Hansen, S. Arnfred, L.-H. Lim, K. Madsen, "Shift-invariant multilinear decomposition of neuroimaging data," *NeuroImage*, **42** (2008), no. 4, pp. 1439–1450.
- [44] P. Comon, G. Golub, L.-H. Lim, B. Mourrain, "Symmetric tensor and symmetric tensor rank," *SIAM J. Matrix Anal. Appl.*, **30** (2008), no. 3, pp. 1254–1279.
- [45] V. De Silva, L.-H. Lim, "Tensor rank and the ill-posedness of the best low-rank approximation problem," *SIAM J. Matrix Anal. Appl.*, **30** (2008), no. 3, pp. 1084–1127.
- [46] P. Comon, G. Golub, L.-H. Lim, B. Mourrain, "Genericity and rank deficiency of high order symmetric tensors," *Proc. IEEE Int. Conference on Acoustics, Speech, and Signal Process. (ICASSP)*, **31** (2006), no. 3, pp. 125–128.
- [47] L.-H. Lim, "Singular values and eigenvalues of tensors: a variational approach," *Proc. IEEE Int. Workshop on Computational Advances in Multi-Sensor Adaptive Process. (CAMSAP)*, **1** (2005), pp. 129–132.
- [48] L.-H. Lim, J. Packer, K. Taylor, "Direct integral decomposition of the wavelet representation," *Proc. Amer. Math. Soc.*, **129** (2001), no. 10, pp. 3057–3067.
- [49] L.-H. Lim, "Security of the Cao–Li public key cryptosystem," *Electron. Lett.*, **34** (1998), no. 2, pp. 170–172.

EDITORIAL SERVICES

Forum of Mathematics, Pi

Editor, since 2019

Forum of Mathematics, Sigma

Editor (Computational Mathematics), since 2019

Linear Algebra and its Applications

Associate Editor, since 2012

Linear and Multilinear Algebra

Editor, since 2013

Mathematical Programming B

Guest Editor (with S. Friedland, J.-B. Lasserre, J. Nie), Special issue on *Tensor and Polynomial Optimization*, Dec 2018–

Numerical Algorithms

Associate Editor, since 2018

Numerical Linear Algebra and its Applications

Guest Editor (with M. K.-P. Ng, L. Qi), Special issue on *Spectral Theory of Tensors*, Mar 2011–Dec 2012

GRANTS

Defense Advanced Research Projects Agency

Time-Aware Machine Learning Program: Topological Control for Time Aware Machine Intelligence

(HR00112190040; \$550,000; 2021–2022; co-PI)

Young Faculty Award Program: Statistical Inference on Grassmannians

(D15AP00109; \$750,000; 2015–2019; PI)

National Science Foundation

Collaborative Research: Geometric Harmonic Analysis in Learning and Inference

(DMS-11854831; \$110,000; with T. Gao; 2019–2022; PI)

RTG: Computational and Applied Mathematics in Statistical Science

(DMS-1547396; \$1,750,000; with M. Anitescu, R. Barber, C. Gao, D. Sanz-Alonso; 2016–2021; PI)

BIGDATA:F: Big Data, It's Not So Big — Exploiting Low-Dimensional Geometry for Learning and Inference

(IIS-1546413; \$1,000,000; with L. Lin, S. Mukherjee; 2015–2019; PI)

IMA Summer School Supplementary Funding

(DMS-1417916; \$40,000; with R. Kondor, J. Morton; 2014–2016; co-PI)

Collaborative Research: Numerical Algebra and Statistical Inference

(DMS-1209136; \$300,000; with S. Mukherjee; 2012–2015; PI)

CAREER: Numerical Multilinear Algebra and its Applications — From Matrices to Tensors

(DMS-1057064; \$550,000; 2011–2016; PI)

Air Force Office of Scientific Research

Young Investigator Research Program: Multilinear Computing and Multilinear Algebraic Geometry

(FA9550-13-1-0133; \$400,000; 2013–2016; PI)