Kenneth L. Ho

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Academic and Employment History

07/2021 –	Technical Manager, Optimal Pattern Correction, TSMC, San Jose, CA
06/2019 – 12/2020	Visiting Scholar/Consultant, CCM, Flatiron Institute, New York, NY
08/2017 – 06/2021	Principal Engineer, Optimal Pattern Correction, TSMC, San Jose, CA
08/2015 – 08/2017	Sr. Engineer, Optimal Pattern Correction, TSMC, San Jose, CA
01/2013 – 07/2015	NSF Postdoctoral Fellow, Mathematics, Stanford
09/2012 – 12/2012	Visiting Scholar, Courant Institute, NYU
08/2012	Visiting Scholar, Theoretical Systems Biology, Imperial College London
06/2012 – 08/2012	Assistant Research Scientist, Courant Institute, NYU
06/2010 – 02/2012	Intern/Consultant, Schrödinger, New York, NY
09/2007 – 05/2012	Ph.D., Computational Biology (Mathematics), Courant Institute, NYU
09/2006 – 12/2006	Affiliate Student, Mathematics, University College London
09/2003 – 06/2007	B.S. (with honor), Applied and Computational Mathematics, Caltech

Technical Summary

- Applied mathematics Ph.D. with broad training in computer science, statistics, biology, and chemistry
- Roughly three-stage career so far across both academia (3 years postdoc) and industry (10+ years)
- First, as an early graduate student, I started in mathematical biology and computational chemistry. Research highlights: mechanistic modeling of apoptosis and "trimer" theory for bistability[2]; automated all-atom protein crystal structure refinement[3]; algebraic methods for model selection of chemical reaction networks[5,13].
- Then during later graduate studies (with Leslie Greengard) and continuing through my postdoc (with Lexing Ying), I moved into scientific computing and numerical linear algebra, specifically fast direct solvers and other generalizations of the fast multipole method: $O(N)$ generalized LU decomposition for hierarchical matrices, e.g., for solving integral equations[4,11,14] and PDEs[12,18]; applications to chemistry[6], physics[7], and statistics[16]; open-source MATLAB software[22]; $O(N \log N)$ butterfly factorization[9,19] for high-frequency scattering and Fourier integral operators.
- Now I work in computational lithography and software engineering as a lead developer on TSMC's in-house simulator for OPC/ILT/SMO: numerical methods, computational infrastructure, software design; optics theory[24,25] and fast TCC[23]; high-performance computing, CPU/GPU acceleration; computational electromagnetics, inverse problems, numerical optimization, machine learning.
- *Computing*: C, C++, CUDA, Fortran, Julia, LaTeX, MATLAB, MPI, Octave, OpenMP, Python
- *Awards*: NSF graduate and postdoctoral fellowships, NYU dissertation award, Caltech merit award and research fellowship
- 20 peer-reviewed publications, 10 patents, 48 conference/seminar presentations, 8 open-source codes
- Google Scholar: `6gr2NYwAAAAJ` (1250+ citations); ORCID: `0000-0001-5450-4966`; GitHub: `klho`

Publications and Patents

25. K.L.K. Ho, C.-J. Lai, K. Yamazoe, X. Zhou, D. Peng. Multi-component kernels for vector optical image simulation. U.S. patents 11,435,670, 2022; 11,754,930, 2023; 12,153,349, 2024. Google: `US11435670`.
24. K.L.K. Ho. Litho-aware source sampling and resampling. U.S. patent 11,256,176, 2022. Google: `US11256176`.
23. K.L.K. Ho. Method and apparatus for computing feature kernels for optical model simulation. U.S. patents 10,809,629, 2020; 11,003,092, 2021. Google: `US10809629`.

22. K.L. Ho. FLAM: Fast linear algebra in MATLAB – Algorithms for hierarchical matrices. J. Open Source Softw. 5 (51): 1906, 2020. doi:10.21105/joss.01906.
21. D. Beylkin, K.L. Ho, S.V. Trivedi, F. Xu, J. Lei, D. Peng. Synchronized parallel tile computation for large area lithography simulation. U.S. patents 10,671,052, 2020; 10,915,090, 2021; 11,340,584, 2022; 11,747,786, 2023. Google: US10671052.
20. Z. Chen, J. Zhang, K.L. Ho, H. Yang. Multidimensional phase recovery and interpolative decomposition butterfly factorization. J. Comput. Phys. 412: 109427, 2020. doi:10.1016/j.jcp.2020.109427.
19. Q. Pang, K.L. Ho, H. Yang. Interpolative decomposition butterfly factorization. SIAM J. Sci. Comput. 42 (2): A1097–A1115, 2020. doi:10.1137/19M1294873.
18. J. Feliu-Fabà, K.L. Ho, L. Ying. Recursively preconditioned hierarchical interpolative factorization for elliptic partial differential equations. Commun. Math. Sci. 18 (1): 91–108, 2020. doi:10.4310/CMS.2020.v18.n1.a4.
17. H.A. Harrington, K.L. Ho, N. Meshkat. A parameter-free model comparison test using differential algebra. Complexity 2019: 6041981, 2019. doi:10.1155/2019/6041981.
16. V. Minden, A. Damle, K.L. Ho, L. Ying. Fast spatial Gaussian process maximum likelihood estimation via skeletonization factorizations. Multiscale Model. Simul. 15 (4): 1584–1611, 2017. doi:10.1137/17M1116477.
15. F. Fang, K.L. Ho, L. Ristroph, M.J. Shelley. A computational model of the flight dynamics and aerodynamics of a jellyfish-like flying machine. J. Fluid Mech. 819: 621–655, 2017. doi:10.1017/jfm.2017.150.
14. V. Minden, K.L. Ho, A. Damle, L. Ying. A recursive skeletonization factorization based on strong admissibility. Multiscale Model. Simul. 15 (2): 768–796, 2017. doi:10.1137/16M1095949.
13. E. Gross, B. Davis, K.L. Ho, D.J. Bates, H.A. Harrington. Numerical algebraic geometry for model selection and its application to the life sciences. J. R. Soc. Interface 13 (123): 20160256, 2016. doi:10.1098/rsif.2016.0256. PMID:27733697.
12. K.L. Ho, L. Ying. Hierarchical interpolative factorization for elliptic operators: differential equations. Comm. Pure Appl. Math. 69 (8): 1415–1451, 2016. doi:10.1002/cpa.21582.
11. K.L. Ho, L. Ying. Hierarchical interpolative factorization for elliptic operators: integral equations. Comm. Pure Appl. Math. 69 (7): 1314–1353, 2016. doi:10.1002/cpa.21577.
10. V. Minden, A. Damle, K.L. Ho, L. Ying. A technique for updating hierarchical skeletonization-based factorizations of integral operators. Multiscale Model. Simul. 14 (1): 42–64, 2016. doi:10.1137/15M1024500.
9. Y. Li, H. Yang, E.R. Martin, K.L. Ho, L. Ying. Butterfly factorization. Multiscale Model. Simul. 13 (2): 714–732, 2015. doi:10.1137/15M1007173.
8. K.L. Ho, L. Greengard. A fast semidirect least squares algorithm for hierarchically block separable matrices. SIAM J. Matrix Anal. Appl. 35 (2): 725–748, 2014. doi:10.1137/120902677.
7. L. Greengard, K.L. Ho, J.-Y. Lee. A fast direct solver for scattering from periodic structures with multiple material interfaces in two dimensions. J. Comput. Phys. 258: 738–751, 2014. doi:10.1016/j.jcp.2013.11.011.
6. K.L. Ho. Fast direct methods for molecular electrostatics. Ph.D. thesis, New York Univ., 2012. UMI:3524158.
5. H.A. Harrington, K.L. Ho, T. Thorne, M.P.H. Stumpf. Parameter-free model discrimination criterion based on steady-state coplanarity. Proc. Natl. Acad. Sci. U.S.A. 109 (39): 15746–15751, 2012. doi:10.1073/pnas.1117073109. PMID:22967512.
4. K.L. Ho, L. Greengard. A fast direct solver for structured linear systems by recursive skeletonization. SIAM J. Sci. Comput. 34 (5): A2507–A2532, 2012. doi:10.1137/120866683.
3. J.A. Bell, K.L. Ho, R. Farid. Significant reduction in errors associated with nonbonded contacts in protein crystal structures: automated all-atom refinement with *PrimeX*. Acta Cryst. D68 (8): 935–952, 2012. doi:10.1107/S0907444912017453. PMID:22868759.

2. K.L. Ho, H.A. Harrington. Bistability in apoptosis by receptor clustering. PLoS Comput. Biol. 6 (10): e1000956, 2010. doi:10.1371/journal.pcbi.1000956. PMID:20976242.
1. H.A. Harrington, K.L. Ho, S. Ghosh, KC Tung. Construction and analysis of a modular model of caspase activation in apoptosis. Theor. Biol. Med. Model. 5: 26, 2008. doi:10.1186/1742-4682-5-26. PMID:19077196.

Presentations

- *Conferences and workshops*: SPIE Adv. Litho. Patt. 2023; NVIDIA GTC 2020; SIAM AN18; SIAM CSE15; MBI WYRMB 2014; SIAM AN14; FACM 2014; SIAM UQ14; BIRS Worksh. Integral Equations, 2013; SIAM CSE13; NYU/Columbia RTG Symp., 2012; SIAM LS12; SIAM AN12; SIAM ALA12; CJR, Yale, 2012; DOE Appl. Math. Prog. Meet., 2011; NYU Courant 75th Anniv., 2011; NYU COB Day 2009; NSF IGERT PI Meet., 2009
- *Seminars, colloquiua, and other*: Argonne Natl. Lab., CMU (2), Caltech (3), Colorado State, Imperial Coll. London (2), IPAM, JPL, LBNL, MBI, NCSU, NJIT, NYU (4), Stanford, Theranos, TSMC (3), U. Minnesota, U. Wisconsin-Madison, UC Irvine (2), UC Riverside

Codes

8. `mortgage.py`: a simple state-based mortgage calculator
7. `f2mkl`: adapter for preloading Intel MKL in applications linked against Fortran BLAS
6. `lpscheduler`: a simple linear-programming-based scheduling utility
5. `SparseFFT.jl`: sparse fast Fourier transforms in Julia
4. `LowRankApprox.jl`: fast low-rank matrix approximation in Julia (`doi:10.5281/zenodo.1254147`)
    - original developer; now maintained by JuliaLinearAlgebra
3. `FLAM`: fast linear algebra in MATLAB (`doi:10.5281/zenodo.1253581`)
2. `PyMatrixID`: fast interpolative decompositions in Python
    - contributed to SciPy 0.13 as `scipy.linalg.interpolative`
1. `hypoct`: hyperoctree construction and manipulation

Other project contributions: OpenBLAS, SciPy.