

# Stanford

---



## Aaron Sidford

Associate Professor of Management Science and Engineering and of Computer Science

### CONTACT INFORMATION

- **Administrative Contact**

Jackie Nguyen - Administrative Associate

**Email** Jackie.nguyen@stanford.edu

### Bio

---

### ACADEMIC APPOINTMENTS

- Associate Professor, Management Science and Engineering
- Associate Professor, Computer Science
- Member, Institute for Computational and Mathematical Engineering (ICME)

### LINKS

- Personal Website: <http://web.stanford.edu/~sidford/>

### Research & Scholarship

---

### CURRENT RESEARCH AND SCHOLARLY INTERESTS

My research interests lie broadly in the optimization, the theory of computation, and the design and analysis of algorithms. I am particularly interested in work at the intersection of continuous optimization, graph theory, numerical linear algebra, and data structures.

### Teaching

---

### COURSES

#### 2025-26

- Combinatorial Optimization: CME 310, CS 261, MS&E 315 (Win)
- Introduction to Optimization (Accelerated): MS&E 111X, MS&E 211X (Spr)

#### 2024-25

- Combinatorial Optimization: CME 310, CS 261, MS&E 315 (Win)
- Introduction to Optimization (Accelerated): MS&E 111X, MS&E 211X (Spr)
- Optimization Algorithms: CME 334, CS 369O, MS&E 312 (Aut)

#### 2023-24

- Introduction to Optimization (Accelerated): MS&E 111X, MS&E 211X (Spr)
- Optimization Algorithms: CME 334, CS 369O, MS&E 312 (Win)

## 2022-23

- Introduction to Optimization (Accelerated): ENGR 62X, MS&E 111X, MS&E 211X (Spr)
- Optimization Algorithms: CME 334, CS 369O, MS&E 312 (Aut)
- Optimization and Algorithmic Paradigms: CS 261 (Win)

## STANFORD ADVISEES

### Doctoral Dissertation Reader (AC)

Xiao Mao

### Doctoral Dissertation Advisor (AC)

Jiale Chen, Andrei Graur

### Orals Evaluator

Xiao Mao

### Master's Program Advisor

Eric He, JC Hu, Eric Kuang, Isabella Lee, Neil Parasher, Giselle Rivera, Schwinn Saereesitthipitak, Yuxin Wu

### Doctoral Dissertation Co-Advisor (AC)

Ishani Karmarkar, Chenyi Zhang

### Doctoral (Program)

Liam O'Carroll, Ta-Wei Tu

## Publications

---

### PUBLICATIONS

- **Ultrasparse Ultrasparsifiers and Faster Laplacian System Solvers** *ACM TRANSACTIONS ON ALGORITHMS*  
Jambulapati, A., Sidford, A.  
2025; 21 (3)
- **Extracting Dual Solutions via Primal Optimizers**  
Carmon, Y., Jambulapati, A., O'Carroll, L., Sidford, A.  
edited by Meka, R.  
SCHLOSS DAGSTUHL, LEIBNIZ CENTER INFORMATICS.2025
- **Accelerated Approximate Optimization of Multi-commodity Flows on Directed Graphs**  
Chen, L., Graur, A., Sidford, A.  
edited by Koucky, M., Bansal, N.  
ASSOC COMPUTING MACHINERY.2025: 2203-2212
- **Solving Zero-Sum Games with Fewer Matrix-Vector Products**  
Karmarkar, I., O'Carroll, L., Sidford, A., IEEE COMPUTER SOC  
IEEE COMPUTER SOC.2025: 2381-2391
- **Generalized Flow in Nearly-linear Time on Moderately Dense Graphs**  
Jiang, S., Kapralov, M., Li, L., Sidford, A., IEEE COMPUTER SOC  
IEEE COMPUTER SOC.2025: 1091-1099
- **Efficient Convex Optimization Requires Superlinear Memory** *JOURNAL OF THE ACM*  
Marsden, A., Sharan, V., Sidford, A., Valiant, G.  
2024; 71 (6)

- **Incremental Approximate Maximum Flow on Undirected Graphs in Subpolynomial Update Time**  
van den Brand, J., Chen, L., Kyng, R., Liu, Y. P., Peng, R., Gutenberg, M., Sachdeva, S., Sidford, A.  
edited by Woodruff, D. P.  
SIAM.2024: 2980-2998
- **UNIT CAPACITY MAXFLOW IN ALMOST  $m^4$  / TIME** *SIAM JOURNAL ON COMPUTING*  
Kathuria, T., Liu, Y. P., Sidford, A.  
2024; 53 (6): OCS20175-OCS20204
- **Near-Optimal Dynamic Rounding of Fractional Matchings in Bipartite Graphs**  
Bhattacharya, S., Kiss, P., Sidford, A., Wajc, D.  
edited by Mohar, B., Shinkar, O'Donnell, R.  
ASSOC COMPUTING MACHINERY.2024: 59-70
- **Sparsifying Generalized Linear Models**  
Jambulapati, A., Lee, J. R., Liu, Y. P., Sidford, A.  
edited by Mohar, B., Shinkar, O'Donnell, R.  
ASSOC COMPUTING MACHINERY.2024: 1665-1675
- **A Whole New Ball Game: A Primal Accelerated Method for Matrix Games and Minimizing the Maximum of Smooth Functions**  
Carmon, Y., Jambulapati, A., Jin, Y., Sidford, A.  
edited by Woodruff, D. P.  
SIAM.2024: 3685-3723
- **Towards optimal running times for optimal transport** *OPERATIONS RESEARCH LETTERS*  
Blanchet, J., Jambulapati, A., Kent, C., Sidford, A.  
2024; 52
- **Sparsifying Sums of Norms**  
Jambulapati, A., Lee, J. R., Liu, Y. P., Sidford, A., IEEE  
IEEE COMPUTER SOC.2023: 1953-1962
- **Structured Semidefinite Programming for Recovering Structured Preconditioners**  
Jambulapati, A., Musco, C., Li, J., Shiragur, K., Sidford, A., Tian, K.  
edited by Oh, A., Neumann, T., Globerson, A., Saenko, K., Hardt, M., Levine, S.  
NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2023
- **Towards Optimal Effective Resistance Estimation**  
Dwaraknath, R., Karmarkar, I., Sidford, A.  
edited by Oh, A., Neumann, T., Globerson, A., Saenko, K., Hardt, M., Levine, S.  
NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2023
- **Quantum Speedups for Zero-Sum Games via Improved Dynamic Gibbs Sampling**  
Boulund, A., Getachew, Y., Jin, Y., Sidford, A., Tian, K.  
edited by Krause, A., Brunskill, E., Cho, K., Engelhardt, B., Sabato, S., Scarlett, J.  
JMLR-JOURNAL MACHINE LEARNING RESEARCH.2023
- **Moments, Random Walks, and Limits for Spectrum Approximation**  
Jin, Y., Musco, C., Sidford, A., Singh, A.  
edited by Neu, G., Rosasco, L.  
JMLR-JOURNAL MACHINE LEARNING RESEARCH.2023
- **Semi-Random Sparse Recovery in Nearly-Linear Time**  
Kelner, J. A., Li, J., Liu, A., Sidford, A., Tian, K.  
edited by Neu, G., Rosasco, L.  
JMLR-JOURNAL MACHINE LEARNING RESEARCH.2023
- **Improved girth approximation in weighted undirected graphs**  
Kadria, A., Roditty, L., Sidford, A., Williams, V., Zwick, U.

---

edited by Bansal, N., Nagarajan  
SIAM.2023: 2242-2255

- **Parallel Submodular Function Minimization**  
Chakrabarty, D., Graur, A., Jiang, H., Sidford, A.  
edited by Oh, A., Neumann, T., Globerson, A., Saenko, K., Hardt, M., Levine, S.  
NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2023
- **Dynamic Maxflow via Dynamic Interior Point Methods**  
van den Brand, J., Liu, Y. P., Sidford, A.  
edited by Servedio, R. A., Saha, B.  
ASSOC COMPUTING MACHINERY.2023: 1215-1228
- **Chaining, Group Leverage Score Overestimates, and Fast Spectral Hypergraph Sparsification**  
Jambulapati, A., Liu, Y. P., Sidford, A.  
edited by Servedio, R. A., Saha, B.  
ASSOC COMPUTING MACHINERY.2023: 196-206
- **A Deterministic Almost-Linear Time Algorithm for Minimum-Cost Flow**  
van den Brand, J., Chen, L., Peng, R., Kyng, R., Liu, Y. P., Gutenberg, M., Sachdeva, S., Sidford, A., IEEE  
IEEE COMPUTER SOC.2023: 503-514
- **Sparse Submodular Function Minimization**  
Graur, A., Jiang, H., Sidford, A., IEEE  
IEEE COMPUTER SOC.2023: 2071-2080
- **Matrix Completion in Almost-Verification Time**  
Kelner, J. A., Li, J., Liu, A., Sidford, A., Tian, K., IEEE  
IEEE COMPUTER SOC.2023: 2102-2128
- **Singular Value Approximation and Sparsifying Random Walks on Directed Graphs**  
Ahmadinejad, A., Peebles, J., Pyne, E., Sidford, A., Vadhan, S., IEEE  
IEEE COMPUTER SOC.2023: 846-854
- **ReSQueing Parallel and Private Stochastic Convex Optimization**  
Carmon, Y., Jambulapati, A., Jin, Y., Lee, Y., Liu, D., Sidford, A., Tian, K., IEEE  
IEEE COMPUTER SOC.2023: 2031-2058
- **Improved Iteration Complexities for Overconstrained p-Norm Regression**  
Jambulapati, A., Liu, Y. P., Sidford, A.  
edited by Leonardi, S., Gupta, A.  
ASSOC COMPUTING MACHINERY.2022: 529-542
- **Improved Lower Bounds for Submodular Function Minimization**  
Chakrabarty, D., Graur, A., Jiang, H., Sidford, A., IEEE Comp Soc  
IEEE COMPUTER SOC.2022: 245-254
- **RECAPP: Crafting a More Efficient Catalyst for Convex Optimization**  
Carmon, Y., Jambulapati, A., Jin, Y., Sidford, A.  
edited by Chaudhuri, K., Jegelka, S., Song, L., Szepesvari, C., Niu, G., Sabato, S.  
JMLR-JOURNAL MACHINE LEARNING RESEARCH.2022
- **Faster Maxflow via Improved Dynamic Spectral Vertex Sparsifiers**  
van den Brand, J., Gao, Y., Jambulapati, A., Lee, Y., Liu, Y. P., Peng, R., Sidford, A.  
edited by Leonardi, S., Gupta, A.  
ASSOC COMPUTING MACHINERY.2022: 543-556
- **Deterministic Approximation of Random Walks in Small Space** *THEORY OF COMPUTING*  
Murtagh, J., Reingold, O., Sidford, A., Vadhan, S.

2021; 17

- **Variance reduced value iteration and faster algorithms for solving Markov decision processes** *NAVAL RESEARCH LOGISTICS*  
Sidford, A., Wang, M., Wu, X., Ye, Y.  
2021
- **Lower bounds for finding stationary points II: first-order methods** *MATHEMATICAL PROGRAMMING*  
Carmon, Y., Duchi, J. C., Hinder, O., Sidford, A.  
2021; 185 (1-2): 315–55
- **Minimum Cost Flows, MDPs, and  $l(1)$ -Regression in Nearly Linear Time for Dense Instances**  
van den Brand, J., Lee, Y., Liu, Y. P., Saranurak, T., Sidford, A., Song, Z., Wang, D.  
edited by Khuller, S., Williams, V. V.  
ASSOC COMPUTING MACHINERY.2021: 859-869
- **Towards Tight Bounds on the Sample Complexity of Average-reward MDPs**  
Jin, Y., Sidford, A.  
edited by Meila, M., Zhang, T.  
JMLR-JOURNAL MACHINE LEARNING RESEARCH.2021
- **DERANDOMIZATION BEYOND CONNECTIVITY: UNDIRECTED LAPLACIAN SYSTEMS IN NEARLY LOGARITHMIC SPACE** *SIAM JOURNAL ON COMPUTING*  
Murtagh, J., Reingold, O., Sidford, A., Vadhan, S.  
2021; 50 (6): 1892-1922
- **Lower bounds for finding stationary points I** *MATHEMATICAL PROGRAMMING*  
Carmon, Y., Duchi, J. C., Hinder, O., Sidford, A.  
2020; 184 (1-2): 71–120
- **Solving Discounted Stochastic Two-Player Games with Near-Optimal Time and Sample Complexity**  
Sidford, A., Wang, M., Yang, L. F., Ye, Y.  
edited by Chiappa, S., Calandra, R.  
ADDISON-WESLEY PUBL CO.2020
- **Efficiently Solving MDPs with Stochastic Mirror Descent**  
Jin, Y., Sidford, A.  
edited by Daume, H., Singh, A.  
JMLR-JOURNAL MACHINE LEARNING RESEARCH.2020
- **Bipartite Matching in Nearly-linear Time on Moderately Dense Graphs**  
van den Brand, J., Lee, Y., Nanongkai, D., Peng, R., Saranurak, T., Sidford, A., Song, Z., Wang, D., IEEE  
IEEE.2020: 919-930
- **Coordinate Methods for Matrix Games**  
Carmon, Y., Jin, Y., Sidford, A., Tian, K., IEEE  
IEEE.2020: 283-293
- **High-precision Estimation of Random Walks in Small Space**  
Ahmadinejad, A., Kelner, J., Murtagh, J., Peebles, J., Sidford, A., Vadhan, S., IEEE  
IEEE.2020: 1295-1306
- **Unit Capacity Maxflow in Almost  $O(m^{4/3})$  Time**  
Kathuria, T., Liu, Y. P., Sidford, A., IEEE  
IEEE.2020: 119-130
- **Acceleration with a Ball Optimization Oracle**  
Carmon, Y., Jambulapati, A., Jiang, Q., Jin, Y., Lee, Y., Sidford, A., Tian, K.  
edited by Larochelle, H., Ranzato, M., Hadsell, R., Balcan, M. F., Lin, H.  
NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2020

- **Fast and Space Efficient Spectral Sparsification in Dynamic Streams**  
Kapralov, M., Mousavifar, A., Musco, C., Musco, C., Nouri, N., Sidford, A., Tardos, J., ACM  
ASSOC COMPUTING MACHINERY.2020: 1814–33
- **Near-optimal Approximate Discrete and Continuous Submodular Function Minimization**  
Axelrod, B., Liu, Y. P., Sidford, A., ACM  
ASSOC COMPUTING MACHINERY.2020: 837–53
- **Solving Tall Dense Linear Programs in Nearly Linear Time**  
van den Brand, J., Lee, Y., Sidford, A., Song, Z.  
edited by Makarychev, K., Makarychev, Y., Tulsiani, M., Kamath, G., Chuzhoy, J.  
ASSOC COMPUTING MACHINERY.2020: 775–88
- **Faster Energy Maximization for Faster Maximum Flow**  
Liu, Y. P., Sidford, A.  
edited by Makarychev, K., Makarychev, Y., Tulsiani, M., Kamath, G., Chuzhoy, J.  
ASSOC COMPUTING MACHINERY.2020: 803–14
- **Constant Girth Approximation for Directed Graphs in Subquadratic Time**  
Chechik, S., Liu, Y. P., Rotem, O., Sidford, A.  
edited by Makarychev, K., Makarychev, Y., Tulsiani, M., Kamath, G., Chuzhoy, J.  
ASSOC COMPUTING MACHINERY.2020: 1010–23
- **A Direct  $O(1)$  Iteration Parallel Algorithm for Optimal Transport**  
Jambulapati, A., Sidford, A., Tian, K.  
edited by Wallach, H., Larochelle, H., Beygelzimer, A., d'Alche-Buc, F., Fox, E., Garnett, R.  
NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2019
- **Efficient Profile Maximum Likelihood for Universal Symmetric Property Estimation**  
Charikar, M., Shiragur, K., Sidford, A.  
edited by Charikar, M., Cohen, E.  
ASSOC COMPUTING MACHINERY.2019: 780–91
- **Memory-Sample Tradeoffs for Linear Regression with Small Error**  
Sharan, V., Sidford, A., Valiant, G.  
edited by Charikar, M., Cohen, E.  
ASSOC COMPUTING MACHINERY.2019: 890–901
- **Faster Matroid Intersection**  
Chakrabarty, D., Lee, Y., Sidford, A., Singla, S., Wong, S., IEEE  
IEEE COMPUTER SOC.2019: 1146–68
- **Parallel Reachability in Almost Linear Work and Square Root Depth**  
Jambulapati, A., Liu, Y. P., Sidford, A., IEEE  
IEEE COMPUTER SOC.2019: 1664–86
- **Principal Component Projection and Regression in Nearly Linear Time through Asymmetric SVRG**  
Jin, Y., Sidford, A.  
edited by Wallach, H., Larochelle, H., Beygelzimer, A., d'Alche-Buc, F., Fox, E., Garnett, R.  
NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2019
- **A General Framework for Symmetric Property Estimation**  
Charikar, M., Shiragur, K., Sidford, A.  
edited by Wallach, H., Larochelle, H., Beygelzimer, A., d'Alche-Buc, F., Fox, E., Garnett, R.  
NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2019
- **Complexity of Highly Parallel Non-Smooth Convex Optimization**  
Bubeck, S., Jiang, Q., Lee, Y., Li, Y., Sidford, A.  
edited by Wallach, H., Larochelle, H., Beygelzimer, A., d'Alche-Buc, F., Fox, E., Garnett, R.

---

NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2019

- **Variance Reduction for Matrix Games**

Carmon, Y., Jin, Y., Sidford, A., Tian, K.  
edited by Wallach, H., Larochelle, H., Beygelzimer, A., d'Alche-Buc, F., Fox, E., Garnett, R.  
NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2019

- **ACCELERATED METHODS FOR NONCONVEX OPTIMIZATION** *SIAM JOURNAL ON OPTIMIZATION*

Carmon, Y., Duchi, J. C., Hinder, O., Sidford, A.  
2018; 28 (2): 1751–72

- **Approximating Cycles in Directed Graphs: Fast Algorithms for Girth and Roundtrip Spanners**

Pachocki, J., Roditty, L., Sidford, A., Tov, R., Williams, V., Assoc Comp Machinery  
ASSOC COMPUTING MACHINERY.2018: 1374–92

- **Stability of the Lanczos Method for Matrix Function Approximation**

Musco, C., Musco, C., Sidford, A., Assoc Comp Machinery  
ASSOC COMPUTING MACHINERY.2018: 1605–24

- **Efficient  $O(\frac{n}{\epsilon})$  Spectral Sketches for the Laplacian and its Pseudoinverse**

Jambulapati, A., Sidford, A., Assoc Comp Machinery  
ASSOC COMPUTING MACHINERY.2018: 2487–2503

- **Variance Reduced Value Iteration and Faster Algorithms for Solving Markov Decision Processes**

Sidford, A., Wang, M., Wu, X., Ye, Y., Assoc Comp Machinery  
ASSOC COMPUTING MACHINERY.2018: 770–87

- **Exploiting Numerical Sparsity for Efficient Learning : Faster Eigenvector Computation and Regression**

Gupta, N., Sidford, A.  
edited by Bengio, S., Wallach, H., Larochelle, H., Grauman, K., CesaBianchi, N., Garnett, R.  
NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2018

- **Near-Optimal Time and Sample Complexities for Solving Markov Decision Processes with a Generative Model**

Sidford, A., Wang, M., Wu, X., Yang, L. F., Ye, Y.  
edited by Bengio, S., Wallach, H., Larochelle, H., Grauman, K., CesaBianchi, N., Garnett, R.  
NEURAL INFORMATION PROCESSING SYSTEMS (NIPS).2018

- **Coordinate Methods for Accelerating  $l(\infty)$  Regression and Faster Approximate Maximum Flow**

Sidford, A., Tian, K.  
edited by Thorup, M.  
IEEE COMPUTER SOC.2018: 922–33

- **Solving Directed Laplacian Systems in Nearly-Linear Time through Sparse LU Factorizations**

Cohen, M. B., Kelner, J., Kyng, R., Peebles, J., Peng, R., Rao, A. B., Sidford, A.  
edited by Thorup, M.  
IEEE COMPUTER SOC.2018: 898–909

- **Parallelizing Stochastic Gradient Descent for Least Squares Regression: Mini-batching, Averaging, and Model Misspecification** *JOURNAL OF MACHINE LEARNING RESEARCH*

Jain, P., Netrapalli, P., Kakade, S. M., Kidambi, R., Sidford, A.  
2018; 18

- **SINGLE PASS SPECTRAL SPARSIFICATION IN DYNAMIC STREAMS** *SIAM JOURNAL ON COMPUTING*

Kapralov, M., Lee, Y. T., Musco, C. N., Musco, C. P., Sidford, A.  
2017; 46 (1): 456–477

- **Derandomization Beyond Connectivity: Undirected Laplacian Systems in Nearly Logarithmic Space**

Murtagh, J., Reingold, O., Sidford, A., Vadhan, S., IEEE  
IEEE.2017: 801–12

- **Subquadratic Submodular Function Minimization**

Chakrabarty, D., Lee, Y., Sidford, A., Wong, S.

edited by Hatami, H., McKenzie, P., King

ASSOC COMPUTING MACHINERY.2017: 1220–31