

# Oscar Mickelin

## Employment

- 2025 – **Tsinghua University, Yau Mathematical Sciences Center.**  
Assistant Professor
- 2021 – 2025 **Princeton University, Applied and Computational Mathematics.**  
Postdoctoral Research Associate

## Education

- Ph.D. Massachusetts Institute of Technology, Applied Mathematics.**  
2016 – 2021 Affiliated with the department of mathematics and the Laboratory for Information and Decision Systems.  
**Advisor:** Sertac Karaman
- M.Sc. California Institute of Technology, Mathematics.**  
2015 – 2016 Transferred to MIT for PhD studies
- M.Sc. Royal Institute of Technology and Stockholm University, Mathematics.**  
2013 – 2015 **Advisor:** Ari Laptev
- M.Sc. Royal Institute of Technology, Engineering Physics.**  
2010 – 2015
- B.Sc. Royal Institute of Technology, Engineering Physics.**  
2010 – 2013

## Publications

### Journal articles

The listed publications below are from different subfields, with different author ordering conventions. Articles marked by  $(\alpha\beta)$  indicate alphabetical authorship attribution.

- [18]  $(\alpha\beta)$  J. Kileel, **O. Mickelin**, A. Singer, and S. Xu, “Two Datasets Are Better Than One: Method of Double Moments for 3-D Reconstruction in Cryo-EM”. Preprint: [arXiv: 2511.07438](https://arxiv.org/abs/2511.07438).
- [17] L. Zhang, **O. Mickelin**, S. Xu, A. Singer, “Diagonally-Weighted Generalized Method of Moments Estimation for Gaussian Mixture Modeling”. Preprint: [arXiv:2507.20459](https://arxiv.org/abs/2507.20459)
- [16]  $(\alpha\beta)$  J. Hoskins, Y. Khoo, **O. Mickelin**, A. Singer, Y. Wang, “Subspace method of moments for ab initio 3-D single-particle Cryo-EM reconstruction”. To appear in SIAM Journal on Imaging Science. Preprint: [arXiv:2410.06889](https://arxiv.org/abs/2410.06889)
- [15]  $(\alpha\beta)$  J. Kileel, N. F. Marshall, **O. Mickelin**, A. Singer, “Fast expansion into harmonics on the ball”. *SIAM Journal on Scientific Computing* 47.2 (2025): A1117-A1144. Preprint: [arXiv:2406.05922](https://arxiv.org/abs/2406.05922)
- [14]  $(\alpha\beta)$  T. Bendory, D. Edidin, **O. Mickelin**, “The beltway problem over orthogonal groups”. *Applied and Computational Harmonic Analysis* 74 (2025): 101723. Preprint: [arXiv:2402.03787](https://arxiv.org/abs/2402.03787)
- [13] A. Adler, **O. Mickelin**, R. K. Ramachandran, G. S. Sukhatme, S. Karaman, “The Role of Heterogeneity in Autonomous Perimeter Defense Problems”. *The International Journal of Robotics Research*. 2024;43(9):1363-1381. Invited journal version of conference paper below.
- [12] A. Zhang, **O. Mickelin**, J. Kileel, E. Verbeke, N. Marshall, M.A. Gilles, A. Singer, “Moment-based metrics for molecules computable from cryo-EM images”. *Biological Imaging* 4 (2024): e3. Preprint: [arXiv:2401.15183](https://arxiv.org/abs/2401.15183)
- [11]  $(\alpha\beta)$  N. F. Marshall, **O. Mickelin**, Y. Shi, A. Singer, “Fast principal component analysis for cryo-electron microscopy images.” *Biological Imaging* 3 (2023): e2. Preprint: [arXiv:2210.17501](https://arxiv.org/abs/2210.17501)
- [10]  $(\alpha\beta)$  T. Bendory, Y. Khoo, J. Kileel, **O. Mickelin**, A. Singer, “Autocorrelation analysis for cryo-EM with sparsity constraints: Improved sample complexity and projection-based algorithms”. *Proceedings of the National Academy of Sciences* 120.18 (2023): e2216507120. Preprint: [arXiv:2209.10531](https://arxiv.org/abs/2209.10531)

- [9] ( $\alpha\beta$ ) N. F. Marshall, **O. Mickelin**, A. Singer, "Fast expansion into harmonics on the disk: a steerable basis with fast radial convolutions". *SIAM Journal on Scientific Computing*, 45.5 (2023): A2431-A2457. Preprint: [arXiv:2207.13674](https://arxiv.org/abs/2207.13674)
- [8] ( $\alpha\beta$ ) N. F. Marshall, **O. Mickelin**, "An optimal scheduled learning rate for a randomized Kaczmarz algorithm". *SIAM Journal on Matrix Analysis and Applications* 44 (1), 312-330. Preprint: [arXiv:2202.12224](https://arxiv.org/abs/2202.12224)
- [7] **O. Mickelin**, S. Karaman, "Recovering orthogonal tensors under arbitrarily strong, but locally correlated, noise". *Numerical Linear Algebra with Applications*, 2022;e2479. Preprint: [arxiv:2102.09661](https://arxiv.org/abs/2102.09661)
- [6] **O. Mickelin**, S. Karaman, "Multiresolution Low-rank Tensor Formats". *SIAM Journal on Matrix Analysis and Applications*, 41(3), 1086-1114. Preprint: [arxiv:1908.11413](https://arxiv.org/abs/1908.11413)
- [5] **O. Mickelin**, S. Karaman, "On Algorithms for and Computing with the Tensor Ring Decomposition". *Numerical Linear Algebra with Applications* 27.3 (2020): e2289. Preprint: [arxiv:1807.02513](https://arxiv.org/abs/1807.02513)
- [4] L. Yang, **O. Mickelin**, N. Ozay, "On sufficient conditions for mixed monotonicity". *IEEE Transactions on Automatic Control*, 64 (12), 2019. Preprint: [arxiv:1803.04528](https://arxiv.org/abs/1803.04528)
- [3] **O. Mickelin\***, J. Słomka\*, K. J. Burns, D. Lecoanet, G. M. Vasil, L. Faria, and J. Dunkel, "Anomalous chained turbulence in actively driven flows on spheres". *Phys. Rev. Lett.*, 120: 164503, 2018. Preprint: [arxiv:1710.05525](https://arxiv.org/abs/1710.05525) \*: authors contributed equally.
- [2] **O. Mickelin**, "Lieb-Thirring inequalities for generalized magnetic fields". *Bulletin of Mathematical Sciences*, (2015), pp. 1–14.
- [1] P.E. Olofsson, E. Forslund, B. Vanherberghen, K. Chechet, **O. Mickelin**, A. Rivera Ahlin, T. Everhorn and B. Önfelt, "Distinct migration and contact dynamics of resting and IL-2-activated human natural killer cells." *Frontiers in Immunology* 5 (2014).

### Peer-reviewed conference proceedings

- [4] M. Fraiman, P. Hoyos, T. Bendory, J. Kileel, **O. Mickelin**, N. Sharon, A. Singer, "SO(3)-invariant PCA with application to molecular data". To appear in the 2026 IEEE International Symposium on Biomedical Imaging. Preprint: [arXiv:2510.18827](https://arxiv.org/abs/2510.18827)
- [3] A. Adler, **O. Mickelin**, R. K. Ramachandran, G. S. Sukhatme, S. Karaman, "The Role of Heterogeneity in Autonomous Perimeter Defense Problems". *Algorithmic Foundations of Robotics XV WAFR 2022. Springer Proceedings in Advanced Robotics*, vol 25. Preprint: [arXiv:2202.10433](https://arxiv.org/abs/2202.10433). **Invited to submit an extended journal version to the International Journal of Robotics Research.**
- [2] T. Bendory, **O. Mickelin**, A. Singer, "Sparse multi-reference alignment: sample complexity and computational hardness". In *Proc. IEEE ICASSP 2022*, pp. 8977–8981. Preprint: [arxiv:2109.11656](https://arxiv.org/abs/2109.11656)
- [1] **O. Mickelin**, N. Ozay and R.M. Murray, "Synthesis of Correct-by-construction Control Protocols for Hybrid Systems Using Partial State Information". In *Proc. of American Control Conference (ACC)*, 2014. **Best presentation award in its session.**

### Talks

- July 2025 SIAM Conference on Applied Algebraic Geometry, **invited talk**.
- June 2025 CAMERA seminar, Lawrence Berkeley National Lab.
- March 2025 SIAM Conference on Computational Science and Engineering, **invited talk**.
- October 2024 Math & Data Seminar, University of Missouri, **invited talk**.
- September 2024 Computational Harmonic Analysis in Data Science and Machine Learning, Casa Matematica Oaxaca, **invited talk**.
- May 2024 SIAM Conference on Applied Linear Algebra, **invited talk**.
- January 2024 Codes and Expansions (CodEx) Seminar, **invited talk**.
- September 2023 AIP2023, 11th Applied Inverse Problems Conference, **invited talk**.
- August 2023 ICIAM2023, 10th International Congress on Industrial and Applied Mathematics, **invited talk**.

- May 2023 13th AIMS Conference on Dynamical Systems, Differential Equations and Applications, **invited talk**.
- November 2022 Analysis seminar, SUNY Binghamton, **invited talk**.
- October 2022 Seminar, University of Texas at Austin, **invited talk**.
- May 2022 2022 IEEE International Conference on Acoustics, Speech and Signal Processing. Recorded talk and poster presentation..
- May 2021 SIAM Conference on Applied Linear Algebra, **invited talk**.
- February 2021 IDeAS Seminar, Princeton University.
- June 2019 Group meeting talk, Sukhatme group, University of Southern California.
- March 2017 70th New England Complex Fluids Workshop, Yale University.
- June 2014 American Control Conference. **Best presentation award in its session, invited talk**.

## Mentoring

- Spring 2025 Diego Rubio Garcia, Junior paper.
- January 2020 Einat Gavish, Directed Reading Program. One month mentoring in game theory.
- Summer 2017 Silvia Casacuberta, Research Science Institute. **RSI Student Award for Best Presentation**.

## Teaching Experience

### 2025 – Instructor, Tsinghua University.

Fall 2025 Introduction to Finite Element Methods. Open course, not for credit.

### 2023 – 2025 Instructor, Princeton University.

- Spring 2025 MAT 322/APC 350, Introduction to Differential Equations.
- Spring 2024 MAT 322/APC 350, Introduction to Differential Equations.
- Spring 2023 MAT 199/APC 199, Math Alive.

### 2017 – 2021 Teaching Assistant, MIT.

- Spring 2021 Grader, 18.367, Waves and Imaging.
- Spring 2021 Grader, 18.085/18.0851, Computational Science and Engineering I.
- January 2020 Head TA, 18.02A, Calculus (multivariable).
- Fall 2019 Head TA, 18.02A, Calculus (multivariable).
- Fall 2019 Head TA, 18.01A, Calculus (single variable).
- Fall 2018 TA, 18.02A, Calculus (multivariable).
- Fall 2018 TA, 18.01A, Calculus (single variable).
- Spring 2018 Beta tester for MITx: 18.033x, Differential Equations: Linear Algebra and  $N \times N$  Systems of DEs.
- Spring 2018 TA, 18.03, Differential Equations.
- Fall 2017 TA, 18.085/18.0851, Computational Science and Engineering I.

### 2015 – 2016 Teaching Assistant, California Institute of Technology.

- Spring 2016 TA, Ma1c analytical, Multivariable calculus.
- Winter 2016 TA, Ma103/3, Introduction to Probability and Statistics.
- Fall 2015 TA, Ma102/2, Differential Equations.

### 2012–2014 Teaching Assistant, Royal Institute of Technology.

- Fall 2014 Grader, SF1628, Complex Analysis.
- Fall 2013 Grader, SF1628, Complex Analysis.
- Spring 2012 Resident tutor, substituting occasionally until Fall 2013.
- Fall 2012 TA, SF1611, Introductory Course in Mathematics I.

## Peer reviewing

I have served as a reviewer for:

Linear Algebra and its Applications, Information and Inference: A Journal of the IMA, SIAM Journal on Matrix Analysis and Applications, Journal of Machine Learning Research (JMLR), BIT Numerical Mathematics, Numerical Linear Algebra with Applications, IEEE Transactions on Automatic Control, IEEE Journal of Selected Topics in Signal Processing, IEEE Signal Processing Letters, IEEE Control Systems

Letters, IEEE International Symposium on Information Theory, American Control Conference (ACC), IEEE Conference on Decision and Control (CDC), Journal of Computational and Applied Mathematics, Neural Computing and Applications.

Additionally, I have written reviews for Mathematical Reviews.

## Honors

- Spring 2020 Charles and Holly Housman Award for Excellence in Teaching, 2020. Awarded for skill and dedication in undergraduate teaching.
- Spring 2017 Kaufman Teaching Certificate Program alum at MIT.
- Spring 2017 MIT Graduate School Leadership Institute alum.
- Spring 2015 Recipient of the Stockholm Mathematics Centre Prize for Excellent Master Thesis the year 2014-2015.
- Summer 2014 Recipient of “Best Presentation award” in my session during the 2014 American Control Conference.