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Oscar Mickelin

Skills

I am an applied mathematician with experience in a wide domain of research topics, mentoring and teaching. My research has focused on fast algorithms to compute with big data, with applications in scientific computing and signal processing, as well as problems in control theory.

Research domains

- dimensionality reduction
- low-rank tensor algorithms for compression of large-scale and high-dimensional data, tensor completion
- statistical identifiability properties of tensor decompositions
- inverse problems
- signal processing problems
- control theory and robotics

Research applications

- autonomous systems, heterogeneous team selection problems
- cyberphysical systems, correct-by-construction control protocols
- compressing and computing with hyperspectral images and large-scale PDE
- phase retrieval problems
- algorithms for cryo-electron microscopy

Employment

July 2021 – present **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

The listed publications below are from different subfields, with different author ordering conventions. Articles marked by † indicate alphabetical authorship attribution.

[15] † 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

[14] † 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". To appear in the Proceedings of the National Academy of Sciences. Preprint: arXiv:2209.10531

[13] † N. F. Marshall, **O. Mickelin**, A. Singer, "Fast expansion into harmonics on the disk: a steerable basis with fast radial convolutions". Preprint: arXiv:2207.13674

[12] † 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

[11] 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.

[10] T. Bendory, **O. Mickelin**, A. Singer, "Sparse multi-reference alignment: sample complexity and computational hardness". In Proc. IEEE ICASSP 2022, pp. 8977–8981.

[9] **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

[8] **O. Mickelin**, S. Karaman, "Optimal orthogonal approximations to symmetric tensors cannot always be chosen symmetric". Preprint: arXiv:1906.06407

[7] **O. Mickelin**, S. Karaman, "Multiresolution Low-rank Tensor Formats". SIAM Journal on Matrix Analysis and Applications, 41(3), 1086-1114.

[6] **O. Mickelin**, S. Karaman, "Algorithms for and Computing with the Tensor Ring Decomposition". Numerical Linear Algebra with Applications 27.3 (2020): e2289.

[5] L. Yang, **O. Mickelin**, N. Ozay, "On sufficient conditions for mixed monotonicity". IEEE Transactions on Automatic Control, 64 (12), 2019.

[4] **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. *: authors contributed equally.

[3] **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.**

[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).*

Talks

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.

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

January 2020 Einat Gavish, Directed Reading Program, January 2020. One month mentoring in game theory.

Summer 2017 Silvia Casacuberta, Research Science Institute. **RSI Student Award for Best Presentation**.

Teaching Experience

2023 – **Instructor**, *Princeton University*.
Spring 2023 MAT 199/APC 199.

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 the
  - SIAM Journal on Matrix Analysis and Applications
  - Journal of Machine Learning Research (JMLR)
  - BIT Numerical Mathematics
  - IEEE Transactions on Automatic Control
  - IEEE Journal of Selected Topics in Signal Processing
  - IEEE Signal Processing Letters
  - IEEE Control Systems Letters
  - Neural Computing and Applications
  - IEEE International Symposium on Information Theory
  - American Control Conference (ACC)
  - IEEE Conference on Decision and Control (CDC)

  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 alumn at MIT.

Spring 2017 MIT Graduate School Leadership Institute alumn.

Spring 2015 Recipient of the Stockholm Mathematics Centre Prize for Excellent Master Thesis the year 2014-2015.

Summer 2014 Recipient of "Best Presentation award" during the 2014 American Control Conference.