

Barak Sober - Curriculum Vitae

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Personal Details

Date of Birth	March 27, 1980	Email	barakino@math.duke.edu
Country of Birth	Israel	Phone	+1 (919) 450-5645
ID number	0402145808	Website	https://barakino.wixsite.com/academics
Nationality	Israeli	Address	3 Creekview Lane, Durham, NC, 27705, USA.
Family Status	Married	Military	Captain (reserves) HR officer (4 years of service)

Research Interests

Approximation theory, Moving Least-Squares, manifold estimation, computational geometry, local polynomial regression, mathematical statistics, computer vision, machine learning, and their applications in the Humanities.

Higher Education

2003-2007	B.Sc in Mathematics & Philosophy Tel-Aviv University, Israel Graduated Magna Cum Laude
2009-2013	M.Sc in Applied Mathematics Tel-Aviv University, Israel Advised by Prof. David Levin (Mathematics) and Prof. Israel Finkelstein (Archaeology) Graduated Summa Cum Laude
2013-2018	Ph.D in Applied Mathematics Tel-Aviv University, Israel Advised by Prof. David Levin Dissertation Title: Structuring High Dimensional Data: A Moving Least-Squares Projective Approach to Analyze Manifold Data Approval Date: December 2019
2018- Present	Postdoctoral fellow Department of Mathematics Duke University, USA Hosted by Prof. Ingrid Daubechies

Academic Appointments

2010-2018	Teaching Assistant School of Mathematical Sciences Tel-Aviv University, Israel
2013-2018	Lecturer Faculty of Engineering Tel-Aviv University, Israel

2017-2018	Lecturer Faculty of Engineering Afeka Engineering College, Israel
2018- Present	Phillip Griffiths Assistant Research Professor Information Initiative at Duke Department of Mathematics Duke University, USA

Other Activity

Honors & Awards

2020	Dan-David Scholarship
2020	American Mathematical Society (AMS) and Simons Foundation Travel Grant
2016	Outstanding Ph.D student of the School of Mathematical Sciences – Tel Aviv University
2016	Excellence Scholarship of the Faculty of Exact Sciences – Tel Aviv University
2016	Minerva short term visiting scholar to Freie Universitat, Berlin
2014	Outstanding lecturer at the Faculty of Engineering – Tel Aviv University

Teaching at Academic institution

Courses Taught by Candidate (in the last three years):

Duke University	Multivariate Calculus for Engineering (undergraduate level)
Duke University	Math Everywhere: Mathematical Concepts and Reasoning in our Modern World for general audience (undergraduate level)
Duke University	Mentoring Independent Study in Math Education (graduate level)
Tel-Aviv University	Numerical Analysis for Math (undergraduate level)
Tel-Aviv University	Ordinary Differential Equations for Mechanical Engineering (undergraduate level)
Tel-Aviv University	Harmonic Analysis in English for Engineering (undergraduate level)
Afeka College	Calculus I (undergraduate level)

Publications

The papers where my contribution was equal to the first author are marked with *

Articles

- [1] *Sober, B., Aizenbud, Y., Levin, D. *Approximation of Functions over Manifolds: A Moving Least-Squares Approach*. Journal of Computational and Applied Mathematics 2020.
- [2] *Shaus A., Gerber, Y., Faigenbaum-Golovin, S., Sober, B., Turkel, E., Piasetzky, E., Finkelstein, I., *Forensic document examination and algorithmic handwriting analysis of Judahite biblical period inscriptions reveal significant literacy level*. PLOS ONE 2020.
- [3] *Dym N., Sober, B., Daubechies, I., *Expression of Fractals Through Neural Network Functions*. IEEE Journal on Selected Areas in Information Theory (JSAIT) 2020.
- [4] *Faigenbaum, S., Sober, B., Shaus, A., Turkel, E., Piasetzky, E., Finkelstein, I., *Algorithmic handwriting analysis of the Samaria inscriptions illuminates bureaucratic apparatus in biblical Israel*. PLOS ONE, 2020.
- [5] Pu, W., Sober, B., Daly, N., Higgitt, C., Daubechies, I., Rodrigues, M.R.D., *A connected auto-encoders based approach for image separation with side information: with applications to art investigation*. Proceedings of the 45th International Conference on Acoustics, Speech, and Signal Processing (ICASSP) 2020.

- [6] Shaus A., **Sober, B.**, Tzang, O., Ioffe, Z., Cheshnovsky, O., Finkelstein, I., Piasetzky, E. *Raman Binary Mapping of Iron Age Ostrakon in an Unknown Material Composition and High-Fluorescence Setting - A Proof of Concept*. Archaeometry 2019.
- [7] ***Sober, B.**, Levin, D. *Manifold Approximation by Moving Least-Squares Projection (MMLS)*. Constructive Approximations 2019.
- [8] *Sabetsarvestani, Z. **Sober, B.**, Higgit, C., Daubechies, I., Rodrigues, M.R.D. *Artificial Intelligence for Art Investigation: Meeting the Challenge of Separating X-ray Images of the Ghent Altarpiece*. Science Advances 2019.
- [9] Mendel-Geberovich A., Faigenbaum-Golovin S., Shaus A., **Sober, B.**, Cordonsky, M., Piasetzky, E., Finkelstein I., Milevsky, I. *A Renewed Reading of Hebrew Ostraca from Cave A-2 at Ramat Beit Shemesh (Nahal Yarmut), Based on Multispectral Imaging*. Vetus Testamentum 2019.
- [10] Shaus A., Faigenbaum-Golovin S., **Sober, B.**, Piasetzky, E., Turkel E., 2017, *Potential Contrast - A New Image Quality Measure*. Proceedings of the Image Quality and System Performance, 2017.
- [11] *Mendel-Geberovich A., Faigenbaum-Golovin S., Shaus A., **Sober, B.**, Piasetzky, E., Finkelstein I., *A Brand New Old Inscription: Arad Ostrakon 16 Rediscovered Via Multispectral Imaging*. Bulletin of the American Schools of Oriental Research 2017.
- [12] ***Sober, B.**, Levin, D., *Computer aided restoration of handwritten character strokes*. Journal of Computer Aided Design, 2017.
- [13] *Faigenbaum-Golovin S., Mendel-Geberovich A., Shaus A., **Sober, B.**, Cordonsky M., Levin D., Moinester M., Sass B., Turkel E., Piasetzky, E., Finkelstein I., *Multispectral Imaging Reveals Unnoticed Biblical-Period Inscription*. PLOS ONE, 2017.
- [14] *Faigenbaum-Golovin S., Shaus A., **Sober, B.**, Levin D., Naaman, N., Sass, B., Turkel, E., Piasetzky, E., Finkelstein, I., *Algorithmic handwriting analysis of Judah's military correspondence sheds light on composition of biblical texts*. Proceedings of the National Academy of Sciences (PNAS), 2016.
- [15] *Shaus, A., **Sober, B.**, Turkel, E., Piasetzky, E., *Beyond the ground truth: Alternative quality measures of document binarizations*. Proceedings of the 15th International Conference on Frontiers in Handwriting Recognition, 2016.
- [16] *Faigenbaum-Golovin, S., Shaus, A., **Sober, B.**, Finkelstein, I., Levin, D., Moinester, M., Piasetzky, E., Turkel, E., *Computerized Paleographic Investigation of Hebrew Iron Age Ostraca*, (invited review). Radiocarbon, 2015.
- [17] Faigenbaum-Golovin, S., Rollston, C. A., Piasetzky, E., **Sober, B.**, Finkelstein, I., *The Ophel (Jerusalem) Ostrakon in Light of New Multispectral Images*. Semitica, 2015.
- [18] ***Sober, B.**, Faigenbaum, S., Beit-Arieh, I., Finkelstein, I., Moinester, M., Piasetzky, E., Shaus, A., *Multispectral Imaging as a Tool to Enhance the Reading of Ostraca*. Palestine Exploration Quarterly, 2014.
- [19] *Faigenbaum, S., **Sober, B.**, Finkelstein, I., Moinester, M., Piasetzky, E., Shaus, A., Cordonsky, M., *Multispectral Imaging of two Hieratic Inscriptions from Qubur el- Walaydah. Egypt and the Levant*, 2014
- [20] *Faigenbaum, S., Shaus, A., **Sober, B.**, Turkel, E., Piasetzky, E., *Evaluating Glyph Binarizations Based on Their Properties*. 13th ACM Symposium on Document Engineering 2013.
- [21] *Shaus, A., **Sober, B.**, Turkel, E., Piasetzky, E. *Improving binarization via sparse methods*. Proceedings of 16th International Graphonomics Society Conference (IGS), 2013.
- [22] *Faigenbaum, S., **Sober, B.**, Shaus, A., Moinester, M., Piasetzky, E., Bearman, G., Cordonsky, M., Finkelstein, I. *Multispectral Images of Ostraca: Acquisition and Analysis*. Journal of Archaeological Science, 2012.

- [23] Finkelstein, I., Boaretto, E., Ben Dor Evian, S., Cabanes, D., Cabanes, M., Eliyahu, A., Faigenbaum, S., Gadot, Y., Langgut, D., Martin, M., Meiri, M., Namdar, D., Sapir-Hen, L., Shahack-Gross, R., Shaus, A., **Sober, B.**, Tofollo, M., Yahalom-Mack, N., Zapassky, L., Weiner, S., *Reconstructing Ancient Israel: Integrating Macro- and Micro-archaeology*, (invited review). Hebrew Bible and Ancient Israel, 2012.

Submitted Articles & Preprints

- [24] Pu, W., **Sober, B.**, Daly, N., Sabetsarvestani, Z., Higgitt, C., Daubechies, I., Rodrigues, M.R.D., *Image separation with side information: A Connected Auto-Encoders Based Approach*. Submitted.
- [25] *Aizenbud, Y., **Sober, B.** *Approximating the span of principal components via iterative least-squares*. Submitted. arXiv preprint arXiv:1907.12159.
- [26] ***Sober, B.**, Ravier R., Daubechies I. *Approximating the Riemannian Metric from Point Clouds via Manifold Moving Least-Squares*. Submitted. arXiv preprint arXiv:2007.09885.
- [27] *Aizenbud, Y., **Sober, B.** *Non-Parametric Estimation of Manifolds from Noisy Data*. In Preparation.
- [28] *Aizenbud, Y., **Sober, B.** *Vector-Valued Local Polynomial Regression - Convergence Rates*. In Preparation.

Chapters in Collections

- [29] *Shaus, A., **Sober, B.**, Faigenbaum-Golovin, S., Mendel-Geberovich, A., Levin, D., Piasetzky, E., Turkel, E., *Statistical Inference in Archaeology: Are We Confident?*, in: O. Lipschits, Y. Gadot, M. J. Adams eds., Rethinking Israel: Studies in the History and Archaeology of Ancient Israel in Honor of Israel Finkelstein, Eisenbrauns, Winona Lake, 2017.
- [30] *Shaus, A., **Sober, B.**, Faigenbaum-Golovin, S., Mendel-Geberovich, A., Piasetzky, E., Turkel, E., *Facsimile creation: Review of algorithmic approaches*, in: I. Finkelstein, C. Robin, T. Romer eds., Alphabets, Texts and Artefacts in the Ancient Near East, Studies Presented to Benjamin Sass, 2016.
- [31] *Faigenbaum, S., **Sober, B.**, Moinester, M., Piasetzky, E., Bearman, G., *Multispectral Imaging of Tel Malhata Ostraca*, in Tel Malhata: A Central City in the Biblical Negev, Itzhaq Beit-Arieh (ed), Tel Aviv, Tel Aviv University Monograph Series 32, 2015.
- [32] Nir-El, Y., Goren, Y., Piasetzky, E., Moinester, M., **Sober, B.**, *X-ray fluorescence (XRF) measurements of red ink on a Tel Malhata ostrakon*, *Tel Malhata a Central City in the Biblical Negev*, Itzhaq Beit-Arieh (ed), Tel Aviv, Tel Aviv University Monograph Series 32. 2015.

Doctoral Dissertation

- [33] Structuring High Dimensional Data: A Moving Least-Squares Projective Approach to Analyze Manifold Data, Supervised by Prof. David Levin.
Publications resulting from the dissertation: [\[7\]](#),[\[1\]](#)

Participation in Scientific Conferences and Invited Talks

- [1] 2020. Approximating the Riemannian Metric from Discrete Samples. ACM Seminar University of South Carolina, USA.
- [2] 2020. Expression of Fractals Through Deep Neural Networks, The Second Symposium on Machine Learning and Dynamical Systems, Fields Institute, Canada.
- [3] 2020. The Manifold Moving Least-Squares Framework, DataShape seminar, INRIA, France.

- [4] 2020. Imaging and Image Processing Techniques in the Service of Historical Investigations, mini-symposium on Cultural Heritage Imaging Science at SIAM Conference on Imaging Science, Toronto Canada (via zoom).
- [5] 2020. The Manifold Moving Least-Squares (Manifold-MLS) Framework: estimating manifolds and reconstructing their atlas from discrete data sets, Program of Applied and Computation Mathematics Princeton University, Princeton, NJ, USA.
- [6] 2020. The Manifold Moving Least-Squares (Manifold-MLS) Framework: estimating manifolds and reconstructing their atlas from discrete data sets, Applied Mathematics Seminar, Columbia University, NYC, NY, USA.
- [7] 2019. Approximation of Manifolds From Scattered Data by Manifold Moving Least-Squares, Applied Mathematics Seminar, University of South Carolina, SC, USA.
- [8] 2019. Approximation of Functions Over Manifolds From Scattered Data by Moving Least-Squares, Approximation Theory, Nashville, TN, USA.
- [9] 2018. Iron Age Hebrew Epigraphy in the Silicon Age, Image Processing for Art Investigation, Ghent, Belgium.
- [10] 2018. Approximation of Functions Over Manifolds by Moving Least Squares, The 9th International Conference on Curves and Surfaces, Arcachon, France.
- [11] 2018. Iron Age Hebrew Epigraphy in the Silicon Age - An Algorithmic Approach to Study Paleo-Hebrew Inscriptions, Computer Science Colloquium, Tel Aviv University, Tel Aviv, Israel.
- [12] 2017. Approximation of Functions Over Manifolds by Moving Least Squares, Applied Mathematics Seminar, Yale University, New Haven, Connecticut, USA.
- [13] 2017. Approximation of Functions Over Manifolds by Moving Least Squares, Google Research, NYC, NY, USA.
- [14] 2017. Approximation of Functions Over Manifolds by Moving Least Squares, Applied and Computational Mathematics Seminar, Georgia Tech, Atlanta, GA, USA.
- [15] 2017. Approximation of Functions Over Manifolds by Moving Least Squares, MIC Seminar at the Mathematics and Data, New York University, NY, USA.
- [16] 2017. An Algorithmic Approach To Study Paleo-Hebrew Inscriptions, CRCS Lunch Seminar, Harvard, Boston, MA, USA.
- [17] 2017. An Algorithmic Approach To Study Paleo-Hebrew Inscriptions, Machine Learning Seminar of the Information Initiative, Duke, Durham, NC, USA.
- [18] 2017. An Algorithmic Approach To Study Paleo-Hebrew Inscriptions, Microsoft Research, NYC, NY, USA.
- [19] 2017. An Algorithmic Approach To Study Paleo-Hebrew Inscriptions, Program of Applied and Computation Mathematics Princeton University, Princeton, NJ, USA.
- [20] 2017. Least-Squares Between Approximation & Regression. Applied Math Student Seminar, Tel Aviv University, Tel Aviv, Israel.
- [21] 2016. Algorithmic Handwriting Analysis of Judah's Military Correspondence, Freie Universität, Berlin, Germany.
- [22] 2016. Approximation of Manifolds Using Moving Least-Squares (MMLS), Freie Universität, Berlin, Germany.
- [23] 2016. Approximation of Manifolds Using Moving Least-Squares (MMLS), 9th International Conference on Mathematical Methods for Curves and Surfaces, Tønsberg, Norway.
- [24] 2016. Epigraphy in the Silicon Age – Imaging and Analysis of Iron Age Hebrew Ostraca, The 42nd Archaeological Conference in Israel, Tel Aviv, Israel.

- [25] 2016. Algorithmic Handwriting Analysis of Judah's Military Correspondence, Applied Math Seminar, Tel Aviv University, Tel Aviv, Israel.
- [26] 2013. Computerized Character Reconstruction and Comparison Techniques, American School of Oriental Research Annual Meeting (ASOR) , Baltimore, USA.
- [27] 2012. Binarization of First Temple Period inscriptions - performance of existing algorithms and a new registration based scheme. The 13th International Conference on Frontiers in Handwriting Recognition (ICFHR), Bari, Italy.
- [28] 2012. Multispectral Imaging as a Tool to Enhance Reading of Ostraca, SOMA 16, Florence, Italy.