Zois Boukouvalas — Curriculum Vitae

Contact Information

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Academic Appointments

American University, Washington, DC USA
Assistant Professor **August 2019 - Present**

Education

University of Maryland Baltimore County, Baltimore, Maryland USA
Ph.D., Applied Mathematics, May 2017
- Dissertation Topic: "*Development of ICA and IVA Algorithms with Application to Medical Image Analysis*"
- Advisor: Dr. Tülay Adalı

M.S., Applied Mathematics, January 2013

Rochester Institute of Technology, Rochester, New York USA
M.S., Applied and Computational Mathematics, August 2011
- Master Thesis: "*Distance Metric Learning for Medical Image Registration*"
- Advisor: Dr. Nathan Cahill

University of Patras, Patras, Greece
B.S., Mathematics, September 2008
- Degree Thesis: "*Matrix Groups and Topology*"
- Advisor: Dr. Andreas Arvanitoyeorgos

Research Interests

Machine learning, Differential Geometry, Statistical Signal Processing, Numerical Optimization, Big Data and Social Science.

Research Experience

Department of Computer Science and Electrical Engineering, University of Maryland Baltimore County, Baltimore, Maryland USA
Visiting Assistant Professor **October 2018 - October 2019**
Collaboration with Dr. Tülay Adalı on grant proposals. Close research interaction with other Machine Learning for Signal Processing Laboratory (MLSP-Lab) members.

The IDEAL Lab, University of Maryland, College Park, College Park, Maryland USA
Postdoctoral Research Associate **September 2017 - July 2019**
Development of machine learning models and algorithms for big data, by combining aspects from information geometry, mathematical statistics, and numerical optimization.
- Support: Office of Naval Research, *Machine Learning for Energetic Materials.*
- Written or provided technical support of research proposals submitted to: NSF, DARPA, US Army, AWS Amazon.
- Mentoring undergraduate students.

Machine Learning for Signal Processing Laboratory (MLSP-Lab), University of Maryland Baltimore County, Baltimore, Maryland USA
Research Assistant **October 2013 - May 2017**
Development of blind source separation algorithms and study of their application to functional magnetic resonance imaging (fMRI) data.
- Provided technical supported in successful research proposal submitted to NIH "A Unified Framework for Flexible Brain Image Analysis".
- Team leader for multiple collaborative research projects.

Advanced Document Imaging (ADI) LLC, Rochester, New York USA

Research Assistant **November 2010 - March, 2011**

Development of text segmentation algorithms for the separation between text and images in a given document.

Publications

Journal articles

1. D. C. Elton, **Z. Boukouvalas**, M. D. Fuge, and P. W. Chung, "Deep learning for molecular design-a review of the state of the art", *Molecular Systems Design & Engineering, Royal Society of Chemistry*, vol. 4, pp. 828-849, 2019.
2. A. von Lühmann, **Z. Boukouvalas**, T. Adalı, and K. R. Müller, "A new blind source separation framework for signal analysis and artifact rejection in functional Near-Infrared Spectroscopy", *NeuroImage*, Elsevier, 2019.
3. **Z. Boukouvalas**, Y. Levin-Schwartz, V. D. Calhoun, and T. Adalı, "Sparsity and Independence: Balancing of two Objectives in Optimization for Source Separation with Application to fMRI Analysis," *Elsevier, Journal of the Franklin Institute (JFI)*, 355, no. 4, 2018: 1873-1887.
4. D. C. Elton, **Z. Boukouvalas**, M. S. Butrico, M. D. Fuge, and P. W. Chung, "Applying machine learning techniques to predict the properties of energetic materials", *Nature Scientific reports*, vol. 8, no. 1, (2018): 9059.
5. R. Mowakeaa, Q. Long, **Z. Boukouvalas**, and T. Adalı, "IVA Using Complex Multivariate GGD: Application to fMRI Analysis", *Multidimensional Systems and Signal Processing, Springer*, pp. 1-20, 2018.
6. Q. Long, S. Bhinge, Y. Levin-Schwartz, **Z. Boukouvalas**, V. D. Calhoun, and T. Adalı, "The Role of Diversity in Data-driven Analyses of Multi-subject fMRI Data: Comparison of Approaches Based on Independence and Sparsity Using Global Performance Metrics", *Human Brain Mapping*, no. 2, pp. 489-504, 2018.
7. D. Emge, , Y. Levin-Schwartz, **Z. Boukouvalas**, and T. Adalı, "Power Spectra Constrained IVA for SSVEP Detection," *Biomedical Physics & Engineering Express*, 5(1), 015008, 2018.
8. **Z. Boukouvalas**, S. Said, L. Bombrun, Y. Berthoumieu and T. Adalı, "A New Riemannian Averaged Fixed-Point Algorithm for MGGD Parameter Estimation," *IEEE Signal Proc. Letts.*, vol. 22, no. 12, pp. 2314–2318, Dec. 2015.
9. **Z. Boukouvalas**, A. Arvanitoyeorgos, "A coordinate system for the three-sphere in the Euclidean four space," *Mathematical Review of the Greek Mathematical Society*, (2006) 65.

Peer-reviewed conference publications

1. SK. Popuri, **Z. Boukouvalas**, "Efficient Parameter Estimation for Semi-Continuous Data: An Application to Independent Component Analysis," *IEEE Machine Learning for Signal Processing Workshop (MLSP)*, October 2019, (In Press)
2. **Z. Boukouvalas**, D. C. Elton, P. W. Chung, and M. D. Fuge, "Independent Vector Analysis for Data Fusion Prior to Molecular Property Prediction with Machine Learning", *Machine Learning for Molecules and Materials NIPS 2018*. (Accepted)
3. **Z. Boukouvalas**, Y. Levin-Schwartz, R. Mowakeaa, G.-S. Fu, and T. Adalı, "Independent Component Analysis Using Semi-Parametric Density Estimation via Entropy Maximization," *IEEE Statistical Signal Processing Workshop*, June 2018, pp. 403-407.
4. D. C. Elton, D. Turakhia, N. Reddy, J. Tan, **Z. Boukouvalas**, P. W. Chung, and M. D. Fuge, "Using natural language processing techniques to extract information on the properties and functionalities of energetic materials from large text corpora", *22nd International Seminar in New Trends in Research of Energetic Materials, NTREM 2019*. (In Press)
6. B. C. Barnes, D. C. Elton, **Z. Boukouvalas**, D. E. Taylor, W. D. Mattson, M. D. Fuge, and P. W. Chung, "Machine Learning and Discovery for Energetic Materials", *16th International Detonation Symposium*, Cambridge MD, USA, July 2018.
7. Q. Long, C. Jia, **Z. Boukouvalas**, B. Gabrielson, D. Emge, V. D. Calhoun, and T. Adalı,

"Consistent Run Selection for Independent Component Analysis: Application to fMRI Analysis", *Proc. IEEE Int. Conf. Acoust., Speech, Signal Processing (ICASSP)*, Calgary, Alberta, Canada, April 2018, pp. 2581–2585.

8. D. Emge, **Z. Boukouvalas**, Y. Levin-Schwartz, S. Bhinge, Q. Long, and T. Adalı, "Power Spectra Constrained IVA for Enhanced Detection of SSVEP Content," *Proc. Conf. on Info. Sciences and Systems (CISS)*, Baltimore, USA, March 2017, pp. 1–5.
9. **Z. Boukouvalas**, Y. Levin-Schwartz, and T. Adalı, "Enhancing ICA performance by exploiting sparsity: Application to fMRI Analysis." *IEEE Int. Conf. Acoust., Speech, Signal Processing (ICASSP)*, New Orleans, USA, March 2017, pp. 2532–2536.
10. S. Bhinge, Q. Long , Y. Levin-Schwartz, **Z. Boukouvalas**, and T. Adalı, "Non-orthogonal constrained independent vector analysis: Application to data fusion." *Proc. IEEE Int. Conf. Acoust., Speech, Signal Processing (ICASSP)*, New Orleans, USA, March 2017, pp. 2666–2670.
11. R. Mowakeaa, **Z. Boukouvalas**, and T. Adalı, "On the Characterization, Generalization, and Efficient Estimation of the Complex Multivariate Generalized Gaussian Distribution," in *Proc. IEEE Sensor Array and Multichannel Signal Processing Workshop (SAM)*, Rio de Janeiro, Brazil, July 2016, pp. 1–5.
12. S. Bhinge, **Z. Boukouvalas**, Y. Levin-Schwartz, and T. Adalı, "IVA for Abandoned Object Detection: Exploiting Dependence Across Color Channels," in *Proc. IEEE Int. Conf. Acoust., Speech, Signal Processing (ICASSP)*, Shanghai, China, March 2016, pp. 2494–2498.
13. G.-S. Fu, **Z. Boukouvalas**, and T. Adalı, "Density estimation by entropy maximization with kernels," in *Proc. IEEE Int. Conf. Acoust., Speech, Signal Processing (ICASSP)*, Brisbane, Australia, April 2015, pp. 1896–1900.
14. **Z. Boukouvalas**, G.-S. Fu, and T. Adalı, "An Efficient Multivariate Generalized Gaussian Distribution Estimator: Application to IVA," in *Proc. Conf. on Info. Sciences and Systems (CISS)*, Baltimore, MD, March 2015, pp. 1–4.

Non peer-reviewed publications

1. **Z. Boukouvalas**, J. Zhou, M. D. Fuge, and S. Said, "MGGD Parameter Estimation on the Space of SPD Matrices," *International Conference on Machine Learning (ICML), Geometry in Machine Learning (GiMLi)*, Stockholm International Fairs, Stockholm, Sweden, July 2018.
2. **Z. Boukouvalas**, R. Mowakeaa, G.-S. Fu, and T. Adalı, "Independent Component Analysis by Entropy Maximization with Kernels," arXiv:1610.07104 (2016).

Honors and Awards

Third place in the Best Paper Competition, 22nd "New Trends in Research of Energetic Materials" (NTREM) Conference, April 2019

Outstanding Graduate Researcher in the Field of Mathematics, UMBC, 2017.

Outstanding Graduate Teaching Assistant in the Field of Mathematics, UMBC, 2012.

Invited Talks

Data Fusion in the Age of Data: Recent Theoretical Advances and Applications, Math/Stat Department Colloquia, American University, Washington DC, September 2019.

Machine Learning Applications in Energetics, U.S. Army Research Laboratory, Aberdeen Proving Ground, MD, April 2018.

Independent Component Analysis: Algorithms and Applications to Medical Imaging and Video Surveillance, Math/Stat Department Colloquia, American University, Washington DC, February 2017.

A New Riemannian Averaged Fixed-Point Algorithm for MGGD Parameter Estimation: Application to IVA, UMBC Graduate Student Seminar, Baltimore MD, March 2016.

Multivariate Generalized Gaussian Distribution Estimation Algorithms for Independent Vector Analysis, UMBC Graduate Student Seminar, Baltimore MD, March 2015.

Introduction to Independent Component Analysis, UMBC Graduate Student Seminar, Baltimore

MD, April 2014.

Image Deblurring, Spectra and Filtering, UMBC Graduate Student Seminar, Baltimore MD, April 2013.

Medical Image Registration, UMBC Graduate Student Seminar, Baltimore MD, April 2012.

Text Segmentation, RIT Summer Mathematics Institute Teachers' Workshop, Rochester NY, June 2011.

Conference Presentations

Using Natural Language Processing Techniques to Extract Information on the Properties and Functionalities of Energetic Materials from Large Text Corpora, 22nd International Seminar in New Trends in Research of Energetic Materials, NTREM 2019, Czech Republic, April 2019.

Independent Vector Analysis for Data Fusion Prior to Molecular Property Prediction with Machine Learning, Conference on Neural Information Processing Systems (NIPS) 2018, Machine Learning for Molecules and Materials, Montreal, Canada, December 2018.

MGGD Parameter Estimation on the Space of SPD Matrices, International Conference on Machine Learning (ICML), Geometry in Machine Learning (GiMLi), Stockholm International Fairs, Stockholm, Sweden, July 2018.

Independent Component Analysis Using Semi-Parametric Density Estimation via Entropy Maximization, IEEE Statistical Signal Processing Workshop, Freiburg, Germany, June 2018.

Sparsity and Independence: Balancing Two Objectives in Optimization for Source Separation, 12th Annual Machine Learning Symp., The New York Academy of Sciences, New York, March 2018.

Sparsity and Independence: Balancing Two Objectives in Optimization for Source Separation, Machine Learning for Materials Science (MLMR), College Park, USA, June 2017.

Development of ICA and IVA Algorithms with Application to Medical Image Analysis, IEEE Int. Conf. Acoust., Speech, Signal Processing (ICASSP), New Orleans, USA, March 2017.

Enhancing ICA performance by exploiting sparsity: Application to fMRI Analysis, IEEE Int. Conf. Acoust., Speech, Signal Processing (ICASSP), New Orleans, USA, March 2017.

IVA for Abandoned Object Detection: Exploiting Dependence Across Color Channels, Research Presentation, UMBC, Baltimore MD, November 2016.

An Efficient Multivariate Generalized Gaussian Distribution Estimator: Application to IVA, Conference on Information Sciences and Systems (CISS), Johns Hopkins University, Baltimore MD, March 2015.

Classification Algorithms for Medical Image Registration, Graduate Research Conference, UMBC, Baltimore MD, February 2013.

Medical Image Registration using Distance Metric Learning, RIT Graduate Research Symposium, Rochester NY, July 2011.

Research Grants and Contracts

Current

Office of Naval Research/Energetics Technology Center
Title: Machine Learning for Energetic Materials
PI: Zois Boukouvalas. $40,000 Start: 10/2019. End: 07/2020
Role: (subcontractor to Energetics Technology Center) Using Machine Learning techniques to accelerate the discovery and design of new energetic materials.

CAS Faculty Mellon Fund (American University)
Title: Data Analysis, Visualization, and Knowledge Discovery for Early Detection of Child Victimization
PI: Zois Boukouvalas. $4,000 Start: 10/2019. End: 10/2020
Role: (Collaborative with faculty from Math & Stat and CS department) Using Machine Learning for knowledge discovery in emergency situations and early detection of child victimization.

Pending

National Science Foundation (NSF)
SaTC: CORE: Small: Collaborative: FullTrust: Fully Multivariate Fusion for Trustworthy Cyberspace with Application to High Impact Events
PI: Zois Boukouvalas. $499,836 (w/ PIs Tülay Adalı, Joshi Anupam, Mittal Sudip)

National Science Foundation (NSF)
Collaborative: A Genome for Manufacturing Science of Solid Mixtures
PI: Zois Boukouvalas. $498,678 (w/ PIs Peter Chung, Ryan Sochol)

Teaching Experience

American University, Washington, DC USA

Assistant Professor **August 2019 - Present**

- STAT 427/627, Statistical Machine Learning, Spring 2020.
- STAT 415/615, Regression, Fall 2019.
- STAT 412/612, Statistical Programming in R, Fall 2019.

Adjunct Professorial Lecturer **January 2018 - May 2018**

- STAT 204, Intro to Business Statistics, Spring 2018.

University of Maryland Baltimore County, Baltimore, Maryland USA

Guest Lecturer **September 2015 - May 2018**

- ENEE 620, Probability and Random Processes, Fall 2015, Fall 2016, Fall 2017.
- ENEE 712, Special Topics in Signal Processing, Spring 2016, Spring 2018.
- ENEE 621, Detection and Estimation Theory, Spring 2017.

Instructor **May 2012 - July 2017**

- MATH 150, Precalculus, Summer 2012, Summer 2015, Summer 2017.
- MATH 151, Calculus I, Summer 2013, Summer 2014.
- MATH 155, Applied Calculus, Summer 2016.

Math Teaching Assistant **August 2011 - May 2016**
Head teaching assistant. Duties included mini lectures and worksheet preparation, shared administrative responsibilities with faculty instructor, fielding of all student inquiries, provide assistance with calculus-related questions, and grade weekly quizzes for over 100 students.
Courses: Precalculus, Applied Calculus, Calculus I, II.

Rochester Institute of Technology, Rochester, New York USA

Math Teaching Assistant **August 2009 - May 2011**
Provide assistance with calculus-related questions and grade homework problems for over 30 students.
Courses: Project Based Calculus I, II, III, Calculus A.

Student Advising

Undergraduate students

Chuanmudi Qin	Mathematics	**Summer 2018 - Spring 2019**
Chuyi Wang	Mathematics	**Fall 2018**
Rohith Venkatesh	Computer Science	**Fall 2018**

Development of complex machine learning algorithms for the generation of features in order to detect semantically anomalous text entries from human authored articles and fake news on social media (e.g., Twitter or text documents).

Austin Kim Computer Science **Spring - Fall 2018**
Implementation of Independent Vector Analysis using Python as the primary platform.

Professional Service

Ph.D. committee member and dissertation reader

Suchita Bhinge UMBC, Dept. of CSEE **Fall 2019**
Adaptive Constrained Independent Vector Analysis: Application to Large-Scale fMRI Analysis

Darren K. Emge UMBC, Dept. of CSEE **Spring 2018**
Independent Vector Analysis for Steady State Visually Evoked Potential Data Analysis.

Conferences Special Sessions Organizer

Co-organizer, Machine Learning for Knowledge Discovery in the Social Sciences, MLSP 2019 (October 2019), Pittsburgh, PA, USA

Journal paper reviewer and conference program committee member

- Journal:
  - Journal of Neuroscience methods (Elsevier) (**Certificate of Reviewing**)
  - Neural Processing Letters (Springer)
  - Transactions on Signal Processing (IEEE)
  - Journal of Machine Learning Research
  - Computational and Mathematical Methods in Medicine (Hindawi)
  - Journal of the Franklin Institute (Elsevier)
- Conference:
  - IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), 2016, 2017, 2018,2019
  - The Ninth IEEE Sensor Array and Multichannel Signal Processing Workshop (SAM),2016
  - Latent Variable Analysis and Signal Separation (LVA/ICA), 2015
  - IEEE International Workshop on Machine Learning for Signal Processing (MLSP), 2015, 2016, 2018