Irina Tolkova

https://avokloti.github.io/
itolkova@g.harvard.edu

Education

Harvard University (Cambridge, MA)   2017-
PhD Candidate in Applied Mathematics
MS in Applied Mathematics   2017-2019

University of Washington (Seattle, WA)   2012-2017
BS in Applied and Computational Mathematical Sciences
BS in Computer Science with Honors

Work Experience

Software Engineering Intern at MathWorks   Summer 2021
- Working with the Control Design and Reinforcement Learning teams, prototyped data-driven learning of Koopman embeddings for simulation and control of nonlinear dynamical systems (*MATLAB Deep Learning Toolbox, LQR, Model Predictive Control*).

Research Intern at the Honda Research Institute   Summer 2020
- As part of HRI's Curious Minded Machines program, designed and evaluated structured latent representations of high-dimensional environments. Then, formalized and implemented curious exploration for RL agents (*disentangled VAEs, contrastive learning, OpenAI Gym, PyTorch, Stable Baselines*).

Graduate Research

Soft Math Laboratory   2019-
- Advised by Prof. L Mahadevan.
- In collaboration with Prof. Holger Klinck (Cornell), utilizing co-located microphone array for sound source localization and separation to assist passive acoustic biodiversity monitoring (*acoustic vector-sensor, beamforming, spectral analysis*).
- Employing techniques in elastic functional data analysis for characterizing the response of post-stroke participants to rehabilitative training with a soft exosuit (*curve and image registration, optimal transport, dynamic programming*).
- Extended analysis of normalized contour curvature as a quantitative model for underlying neural processing of natural images, showing discrimination between cognitive categories such as animacy, size, and type.
- Applied pre-trained audio embeddings (*Wavegram-Logmel-CNN*) to understand latent structure and clustering (*k-means*) within large datasets of birdsong recordings.

Agile Robotics Laboratory   2017-2019
- Advised by Prof. Scott Kuindersma.
- Developed novel non-convex trajectory optimization algorithm (*ADMM, augmented Lagrangian methods*), benchmarked in simulation for multiple robot platforms (*quadrotor, Kuka Arm, RoboBee*) against commonly used solvers (*SNOPT, IPOPT*), and integrated with the Drake robotics toolbox (*C++*). [link]
- Implemented hybrid control algorithm for fixed-wing UAVs in simulation.

Other Graduate Projects   2017-
- Trained a convolutional denoising autoencoder for signal enhancement of birdsong within outdoor recordings (*PyTorch, Librosa*). [link]
- Demonstrated high classification accuracy in training a multilayer perceptron to detect adversarial noise (*Fast Gradient Sign, DeepFool*). [link]

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Undergraduate Research

Computer Science Senior Thesis   2016-2017
- Co-advised by Prof. Dieter Fox and Prof. Behcet Acikmese.
- Adapted and demonstrated successive convexification algorithm for real-time trajectory planning for quadrotor drones. Constructed data collection framework including point cloud processing and segmentation (*ROS, PCL*) for graph-based inverse optimal control for learning manipulation tasks from demonstration on the Baxter robot. [link]

NSF REU: University of California San Diego   Summer 2016
- Devised and completed a pipeline for automatic classification of humpback whale calls for large-scale acoustic data, de-noising signals, and applying machine learning techniques (*spectrogram analysis, PCA, SVM, HMM*). [link]

NSF REU: Hatfield Marine Science Center   Summer 2015
- Developed a new method for behavioral segmentation of GPS tracking data (*R, C*). [link]

NSF REU: Oregon State University   Summer 2014
- Performed statistical analysis and modeling over fisheries datasets (*R, GAMMs*). [link]

Publications

* indicates equal contribution

Swaminathan S*, **Tolkova I***, Baker L, Revi DA, Awad L, Walsh C, Mahadevan L (in press). "A Continuous and Semi-Automated Framework for Gait Characterization and Analysis in People Post-Stroke." *Journal of the Royal Society Interface.*

Tolkova I, Klinck H (2022). "Source Separation with an Acoustic Vector-Sensor for Terrestrial Bioacoustics." *The Journal of the Acoustical Society of America*, 152(2), 1123-1134.

Marantan A*, **Tolkova I***, Mahadevan L. (2022). "Image Classification and Cognition Using Contour Curvature Statistics." *bioRxiv.*

Cram DL, van der Wal J, Uomini N, …. **Tolkova I** (co-author 37/42)… (2022). "The Ecology and Evolution of Human-Wildlife Cooperation". *People and Nature.*

van der Wal J, Spottiswoode C, Uomini N, …. **Tolkova I** (co-author 38/43)… (2022). "Safeguarding Human-Wildlife Cooperation". *Conservation Letters.*

Chandra J*, Muthupalaniappan S*, Shang Z*, Deng R*, Lin R, **Tolkova I**, Butts D, Sul D, Marzouk S, Bose S, Chen A (2021). "Screening of Parkinson's Disease Using Geometric Features Extracted from Spiral Drawings". *Brain Sciences.*

Tolkova I*, Chu B*, Hedman M*, Kahl S, Klinck H (2021). "Parsing Birdsong with Deep Audio Embeddings." AI for Social Good Workshop, *IJCAI 2021*.

Tolkova I (2021). "Feature Representations for Conservation Bioacoustics: Review and Discussion." AI for Social Good Workshop, *IJCAI 2021*.

Ciannelli L, **Tolkova I**, Lauth R, Puerta P, Helser T, Gitelman A, Thompson G (2019). "Spatial, Interannual, and Generational Sources of Trait Variability in a Marine Population." *Ecology.*

Torres LG, Orben RA, **Tolkova I**, Thompson DR. (2017) "Classification of Animal Movement Behavior through Residence in Space and Time." *PLOS ONE.*

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Presentations		
IEEE Signal Processing Invited Seminar at the University of Rhode Island	June 2022	

"Spatial Bioacoustics: Soundscape Analysis with a Co-located Microphone Array"

Oral presentation at Northeast Regional Environmental Acoustics Symposium May 2022
"Spatial Bioacoustics: Soundscape Analysis with a Co-located Microphone Array"

Departmental seminar at the Max Planck Institute for Animal Behavior Mar. 2022
"Spatial Bioacoustics: Soundscape Analysis with a Co-located Microphone Array"

Oral presentation at IJCAI 2021 AI for Social Good Workshop Aug. 2021
"Parsing Birdsong with Deep Audio Embeddings"

Oral presentation at UCI CMCF Early Career Researcher Symposium Apr. 2021
"Acoustic Source Separation for Avian Biodiversity Monitoring"

Oral presentation at IJCAI 2021 AI for Social Good Workshop Jan. 2021
"Feature Representations for Conservation Bioacoustics: Review and Discussion"

Oral presentation at Acoustics '17 Boston Jun. 2017
"Automatic classification of humpback whale social calls"

Poster presentation at Annual Science Conference, Copenhagen Sept. 2015
"Spatial and Temporal Variation in the Size-At-Age of Pacific Cod in the Eastern Bering Sea: Implications for Sampling Strategies"

Awards

Quantitative Biology Fellowship (Harvard NSF Simons Center)	2022-2023
Quantitative Biology Fellowship (Harvard NSF Simons Center)	2021-2022
Quantitative Biology Fellowship (Harvard NSF Simons Center)	2020-2021
Certificate of Distinction in Teaching (Harvard Derek Bok Center)	2019-2021
Outstanding Graduating Senior (Applied Math Department, UW)	2017
Paradise Scholarship (Robinson Center for Young Scholars, UW)	2015
Annual Dean's List (UW)	2012-2017

Teaching

Teaching Fellow for APMTH 104: Complex Analysis Fall 2022
Prepared weekly materials, held office hours, graded homework.

Teaching Fellow for GENED 1080: Engineering the Acoustical World Fall 2021
Led laboratory sessions, developed assignments, held office hours, graded homework.

Head Teaching Fellow for APMTH 22a: Solving and Optimizing Fall 2020
Prepared weekly materials, held office hours, graded homework.

Teaching Fellow for ES 159/259: Introduction to Robotics Spring 2020
Led laboratory sessions, developed assignments, held office hours, graded homework.

Head Teaching Fellow for APMTH 22a: Solving and Optimizing Fall 2019
Prepared weekly materials, taught section, held office hours, graded homework.

Teaching Fellow for CS 182: Introduction to Artificial Intelligence Fall 2018
Prepared weekly section materials, taught section, held exam review and office hours.

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Outreach

Mentor for Veritas AI Bootcamp and Fellowship programs.	2022-
Mentor for undergraduate project at the Global Alliance for Medical Innovation.	2020-
CovEd tutor for public school student.	2020-2021
Tutor for APMTH 104: Complex and Fourier Analysis.	2020
Weekly **tutor** at local public school through Cambridge School Volunteers.	2018-2019
Volunteer at math competitions (GEMS, MathDay, Math Hour Olympiad).	2013-2017

Lead Organizer for Quantitative Ecology/Ethology/Evolution Seminars   2020-2022
Coordinated over two dozen virtual talks on a diverse range of topics,
with speakers spanning five continents. [link]

President of the Harvard GSAS Photography Society   2019-2022
Organized trips, photo competitions, guest speakers, and photographed events and
performances for numerous organizations on campus.

Skills

Fluent in English and Russian. **Proficient** in Python, C++, C, MATLAB, Java, R.
Experienced with TensorFlow, PyTorch, Git, ROS, Arduino, Teensy, BeagleBone, OpenMP.