Randall Balestriero, Ph.D.

Meta/Facebook AI Research

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Linkedin
Twitter
Github
Google Scholar

I am in the pursuit of useful *theoretical results* to build-up our *understanding*, guide practitioners, and ease the *deployment* of deep networks based AI in the wild... *we can not cross-validate everything...*

Education

2021– **Postdoc with Prof. Y. LeCun**, "Bridging the gap between practices and theories in AI"
Meta/Facebook AI Research, NYC, USA

2016–2021 **PhD with Prof. R. Baraniuk**, "A spline theory of Deep Learning"
ECE Department, Rice University, Houston, USA

2014–2016 **Master with Prof. F. Bach**, "Optimization of Decision Trees via Differentiable Partitions"
Applied Mathematics, MVA, Ecole Normale Superieure, Paris, France
Applied Mathematics, Pierre et Marie Curie University, Paris, France

2011–2014 **Bachelor with Prof. H. Glotin**, "Learnable Signal Processing for Audio and Bioacoustics"
Applied Mathematics, Economics and Computer Science, Toulon University, La Garde, France

Conferences/Journals

2022

NeurIPS *Contrastive and Non-Contrastive Self-Supervised Learning Recover Global and Local Spectral Embedding Methods* (pdf)
Randall Balestriero and Yann LeCun

NeurIPS *The Effects of Regularization and Data Augmentation are Class Dependent* (pdf)
Randall Balestriero, Leon Bottou and Yann LeCun

NeurIPS *A Data-Augmentation Is Worth A Thousand Samples* (pdf)
Randall Balestriero, Ishan Misra and Yann LeCun

NeurIPS *projUNN: Efficient Method for Training Deep Networks with Unitary Matrices* (pdf)
Bobak Kiani, **Randall Balestriero**, Yann LeCun and Seth Lloyd

CVPR *Polarity Sampling: Quality and Diversity Control of Pre-Trained Generative Networks* (pdf)
Ahmed Imtiaz Humayun, **Randall Balestriero** and Richard Baraniuk

ICLR *MaGNET:Uniform Sampling from Deep Generative Network Manifolds Without Retraining* (pdf)
Ahmed Imtiaz Humayun, **Randall Balestriero** and Richard Baraniuk

TMLR *High Fidelity Visualization of What Your Self-Supervised Representation Knows About* (pdf)
Florian Bordes, **Randall Balestriero**, Pascal Vincent

TMLR *Max-Affine Spline Insights Into Deep Network Pruning* (pdf)
Randall Balestriero*, Haoran You* (co-first author),[...] , Richard Baraniuk

IEEE ICASSP *DeepHull: Fast Convex Hull Approximation in High Dimensions* (pdf)
Randall Balestriero, Zichao Wang (co-first author) and Richard Baraniuk

IEEE ICASSP *No More Than 6ft. Apart: Robust K-Means Via Radius Upper Bound* (pdf)
Ahmed Imtiaz Humayun, **Randall Balestriero**, Anastasios Kyrillidis and Richard Baraniuk

ASILOMAR *Interpretable Image Clustering via Diffeomorphism-Aware K-Means* (pdf)
Romain Cosentino, **Randall Balestriero**, Yanis Bahroun, Anirvan Sengupta, Richard Baraniuk and Behnaam Aazhang

2021

IEEE TGRS — *Recurrent Scattering Network Detects Metastable Behavior in Polyphonic Seismo-Volcanic Signals for Volcano Eruption Forecasting* (pdf)
Angel Bueno, **Randall Balestriero** et al.

BSSA — *Anatomy of Continuous Mars SEIS and Pressure Data From Unsupervised Learning* (pdf)
[...], **Randall Balestriero**, [...]

MSML — *Interpretable and Learnable Super-Resolution Time-Frequency Representation* (pdf)
Randall Balestriero, Herve Glotin and Richard Baraniuk

MSML — *Deep Autoencoders: From Understanding to Generalization Guarantees* (pdf)
Romain Cosentino, **Randall Balestriero**, Richard Baraniuk and Behnaam Aazhang

ICLR — *The Recurrent Neural Tangent Kernel* (pdf)
Sina Alemohammad, Zichao Wang, **Randall Balestriero** and Richard Baraniuk

EGU — *Observing Seismic Signatures of Slow Slip Events with Unsupervised Learning* (pdf)
Leonard Seydoux, Michel Campillo, Rene Steinmann, **Randall Balestriero** and Maarten de Hoop

IEEE ICASSP — *Wearing a MASK: Compressed Representations of Variable-Length Sequences Using Recurrent Neural Tangent Kernels* (pdf)
Sina Alemohammad, Hossein Babaei, **Randall Balestriero** et al.

2020

IEEE Proc. — *Mad Max: Affine Spline Insights Into Deep Learning* (pdf)
Randall Balestriero and Richard Baraniuk

NeurIPS — *Analytical Probability Distributions and Expectation-Maximization Learning for Deep Generative Networks* (pdf)
Randall Balestriero, Sebastien Paris and Richard Baraniuk

Nature Comm. — *Clustering Earthquake Signals and Background Noises in Continuous Seismic Data with Unsupervised Deep Learning* (pdf)
Leonard Seydoux, **Randall Balestriero**, Piero Poli, Maarten de Hoop, Michel Campillo, Richard Baraniuk

IEEE SP Letters — *Universal Frame Thresholding* (pdf)
Romain Cosentino, **Randall Balestriero**, Richard Baraniuk and Behnaam Aazhang

2019

NeurIPS — *The Geometry of Deep Networks: Power Diagram Subdivision* (pdf)
Randall Balestriero, Romain Cosentino, Behnaam Aazhang and Richard Baraniuk

ICLR — *From Hard to Soft: Understanding Deep Network Nonlinearities via Vector Quantization and Statistical Inference* (pdf)
Randall Balestriero and Richard Baraniuk

ICLR — *A Max-Affine Spline Perspective of Recurrent Neural Networks* (pdf)
Zichao Wang, **Randall Balestriero** and Richard Baraniuk

AGU — *Seismic Signals and Noises Clustering with Unsupervised Deep Representation Learning* (pdf)
Leonard Seydoux, **Randall Balestriero**, Pierro Poli, Maarten de Hoop, Richard Baraniuk, Michelle Campillo

IEEE Oceans — *Wavelet Learning by Adaptive Hermite Cubic Splines applied to Bioacoustic Chirps* (pdf)
Randall Balestriero and Herve Glotin

2018

ICML — *A Spline Theory of Deep Networks* (pdf)
Randall Balestriero and Richard Baraniuk

ICML — *Spline Filters For End-to-End Deep Learning* (pdf)
Randall Balestriero, Romain Cosentino, Herve Glotin and Richard Baraniuk

2014-2017

ICLRW — *Fast Chirplet Transform to Enhance CNN Machine Listening-Validation on Animal Calls and Speech* (pdf)
Herve Glotin, Julien Ricard and **Randall Balestriero**

IEEE GlobalSIP — *Best Basis Selection Using Sparsity Driven Multi-Family Wavelet Transform* (pdf)
Romain Cosentino, **Randall Balestriero** and Behnaam Aazhang

ICDMW *Scattering Decomposition for Massive Signal Classification: From Theory to Fast Algorithm and Implementation with Validation on International Bioacoustic Benchmark* (pdf)
Randall Balestriero and Herve Glotin

ASA *Enhanced Feature Extraction using the Morlet Transform on 1 MHz Recordings Reveals the Complex Nature of Amazon River Dolphin (Inia Geoffrensis) Clicks* (pdf)
Marie Trone, Herve Glotin, **Randall Balestriero** et al.

ASA *All Clicks are not Created Equally: Variations in High-Frequency Acoustic Signal Parameters of the Amazon River Dolphin (Inia Geoffrensis)* (pdf)
Marie Trone, **Randall Balestriero** et al.

ASA *Heterogeneity of Amazon River Dolphin High-Frequency Clicks: Current Odontoceti Bioacoustic Terminology in Need of Standardization* (pdf)
Marie Trone, Herve Glotin, **Randall Balestriero** et al.

Relevant Preprints and Projects

2022 *Joint Embedding Self-Supervised Learning in the Kernel Regime* (pdf)
Bobak Kiani, **Randall Balestriero**, Yubei Chen, Yann LeCun and Seth Lloyd

2022 *RankMe: Assessing the Downstream Performance of Pretrained Self-Supervised Representations by their Rank* (pdf)
Quentin Garrido, **Randall Balestriero**, Laurent Najman and Yann LeCun

2022 *Batch Normalization Explained* (pdf)
Randall Balestriero and Richard Baraniuk

2021 *Learning in High Dimension Always Amounts to Extrapolation* (pdf)
Randall Balestriero, Jerome Pesenti and Yann LeCun

2020 *Ensembles of Generative Adversarial Networks for Disconnected Data* (pdf)
Lorenzo Luzi, **Randall Balestriero** and Richard Baraniuk

2020 *Max-Affine Spline Insights into Deep Generative Networks* (pdf)
Randall Balestriero, Sebastien Paris and Richard Baraniuk

2017 *Neural Decision Trees* (pdf)
Randall Balestriero

projects

Deep Q-Network extension for sparse reward signals with Prof. Iasonas Kokinos and Alessandro Lazaric.
Deep Scattering Network for large-scale bioacoustic datasets with Prof. Stephane Mallat and Herve Glotin.
Stock market volume prediction, CFM Hedge Fund Challenge, 2nd Place.
Full Stack (React, Python/Node.js/Express) extracting sentiments from users' inputs (url)
Front End (React/Plotly) for real-time visualization of Deep Networks

Leadership/Managerial Experience

Advisor **PhD students Polina Kirichenko and Quentin Garrido**, *during internship at FAIR leading to ongoing work to be submitted in top conference*
FAIR (ongoing)

Co-Advisor **PhD student Ahmed Imtiaz Humayun**, *leading to the publication of* 3 *papers in top conferences (ICLR/CVPR/ICASSP)*
Rice University/FAIR (ongoing)

Project Manager **Beat-to-beat classification of unlabeled ECGs**, *Research project manager of a team of* 4 *with final competition rank #1 among* 12 *teams (youtube presentation)*
Rice University (completed)

Software and Computing Skills

Python3 **Numpy-datasets**, *Machine learning/deep learning dataset in Python3 with all the utilities needed for research/data science* (Github)

Python3/XLA	**SymJAX**, *Symbolic programming with JAX for fast CPU/GPU/TPU algebra and deep learning applications combining XLA and Autograd* (Github)
C++/OpenGL	**CIGAL**, *GUI for automatic approximation and real time visualization of Partial Differential Equations using Finite Element Method* (Github)
Programming:	Python, C++, OpenGL, Qt, Bash, Tex, Julia
GPU:	PyTorch, TensorFlow1-2, Jax, Theano
Web Dev.:	HTML, CSS, JavaScript, React, NodeJS/Express, Plotly

Invited Talks/Posters

2022

DeepMath	**Talk+Poster**, *Self Supervised Learning in the Kernel Regime* San Diego, CA, USA
DeepMath	**Poster**, *The Loss Landscape of Deep Networks* San Diego, CA, USA
SIAM Data Science	**Talk**, *Interpretable Near-Optimal Piecewise Affine Control with Reinforcement Learning* San Diego, CA, USA

2021

ML Street Talk	**Talk**, *Interpolation and Extrapolation in Deep Learning* Youtube
SIAM Optimization	**Talk**, *Max-Affine Spline Insights into Deep Networks* Washington DC
Joint Math. Meetings	**Talk**, *The Geometry of Deep Networks: Power Diagram Subdivision* Online

2020

DeepMath	**Poster**, *The Recurrent Neural Tangent Kernel* Online
UCLA Seminar	**Talk**, *Max-Affine Spline Insights into Deep Networks,* Mathematical Machine Learning Seminar (invited by Prof. Guido Montufar) Max-Planck Institute + UCLA
MATH+X	**Talk**, *Learnable Spline Wavelets for Geophysical Data Analysis,* Symposium on Inverse Problems and Deep Learning, Mitigating Natural Hazards Las Catalinas, Costa Rica
Info. Theory and App.	**Poster**, *Max-Affine Spline Insights into Deep Learning* San Diego, CA, USA

2019

NAS	**Poster**, *Max-Affine Spline Insights into Deep Learning,* session: The Science of Deep Learning National Academy of Sciences, Washington, D.C., USA
DeepMath	**Poster**, *Max-Affine Spline Insights into Deep Learning* Princeton Club, NYC, USA
Asilomar	**Talk**, *Max-Affine Spline Insights into Deep Learning,* session: Theory of Deep Learning Asilomar, CA, USA
Event	**Poster**, *The Geometry of Deep Networks: Power Diagram Subdivision,* A celebration for Alexandre Grossmann and Yves Meyer Paris, France

Teaching

Guest Lecturer	**ELEC/COMP576**, *Graduate level class at Rice University on Deep Learning; lecture title: "Deep Networks and Splines"*

Guest Lecturer — **Signal Processing and Machine Learning**, *Graduate level class at Toulon University on learnable Time-Frequency representation; lecture title: "From spectrograms to Learnable Wigner-Ville Distributions for Adaptive Time-Frequency Representations"*

Tutor — **ELEC/COMP549**, *Graduate level class at Rice University; tutoring a team of 4 students to solve an applied machine learning problem through the semester. Subject: anomaly detection of abnormal heartbeats in ECG recordings. Our pipeline and results were elected #1 by an external jury among 18 teams*

Reviewing

NeurIPS, ICML, ICLR, CVPR, IEEE Trans. PAMI, IEEE Signal Processing

Languages

French	Native	
English	Fluent	*ESL Program at Rice University, Houston TX, TOEFL (610), GRE*
Spanish	Basic	