

Tolga Ergen

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Research Interests

Machine learning, deep learning, optimization

Education

Stanford University

PH.D. IN ELECTRICAL ENGINEERING, CGPA: **4.11 / 4.00**

- Advisor: Mert Pilanci
- Thesis: Convex optimization for neural networks

Stanford, CA

Sep 2018 – June 2023

Bilkent University

M.S. IN ELECTRICAL AND ELECTRONICS ENGINEERING, CGPA: **4.00 / 4.00**

- Advisor: Suleyman Serdar Kozat
- Thesis: Online learning with recurrent neural networks

Ankara, Turkey

Sep 2016 – July 2018

Bilkent University

B.S. IN ELECTRICAL AND ELECTRONICS ENGINEERING, CGPA: **3.97 / 4.00**

- Graduated as the **3rd** in class

Ankara, Turkey

Sep 2011 – July 2016

Industrial & Academic Experience

LG AI Research

AI RESEARCH SCIENTIST

- Improving optimization, efficiency, and understanding of Large Language Models

Ann Arbor, MI

July 2023 – Present

Google Research

RESEARCH INTERN

- Hosts: Harsh Mehta and Behnam Neyshabur
- Improving optimization and understanding of transformer networks through convex optimization theory

Mountain View, CA

Jun 2022 – Sep 2022

Salesforce Research

RESEARCH INTERN

- Host: Yu Bai
- Gradient based methods for uncertainty quantification under unknown distribution shift

Palo Alto, CA

Jun 2021 – Sep 2021

Stanford University

TEACHING ASSISTANT

- EE-269: Signal Processing for Machine Learning
- EE-270: Large Scale Matrix Computation, Optimization and Learning
- EE-364B: Convex Optimization II
- EE-269: Signal Processing for Machine Learning
- EE-270: Large Scale Matrix Computation, Optimization and Learning
- EE-364B: Convex Optimization II
- EE-364B: Convex Optimization II

Stanford, CA

2018-Present

Sep 2019 – Dec 2019

Jan 2020- Mar 2020

Apr 2020 – Jun 2020

Sep 2020 – Dec 2020

Jan 2021 – Mar 2021

Mar 2021 – Jun 2021

Mar 2022 – Jun 2022

Bilkent University

TEACHING ASSISTANT

- EEE-424: Digital Signal Processing
- EEE-102: Introduction to Digital Circuit Design
- EEE-424: Digital Signal Processing
- EEE-424: Digital Signal Processing

Ankara, Turkey

2016-2018

Sep 2016 – Jan 2017

Feb 2017 – Jun 2017

Sep 2017 – Jan 2018

Feb 2018 – Jun 2018

Academic Service

REVIEWER

- NeurIPS, ICML, ICLR, IEEE Transactions on Neural Networks and Learning Systems (TNNLS) and IEEE Signal Processing Letters (SPL)

Havelsan Inc., CCCS

UNDERGRADUATE INTERN

- Modelling sound propagation and design of a wireless communication system using Snap modules

Ankara, Turkey

Aug 2015 – Sep 2015

- Design and implementation of an audio radar warning system based on Virtex-5 FPGA

Honors & Awards

2022	Awarded Adobe Research Fellowship	Stanford, CA
2021	Received NeurIPS 2021 Outstanding Reviewer Award given to the top 8% of reviewers	Stanford, CA
2021	International Conference on Acoustics, Speech, & Signal Processing (ICASSP), best paper award	Stanford, CA
2020	Conference on the Mathematical Theory of Deep Neural Networks (DeepMath), best poster award	Stanford, CA
2018	Stanford University Departmental Fellowship: Full tuition waiver & stipend during the first year of PhD	Stanford, CA
2017	Bilkent University Graduate Research Conference (GRC), best oral presentation award in signal processing	Ankara, Turkey
2016	TUBITAK Scholarship for the M.S. studies based on a weighted ALES (National GRE) and GPA score list	Ankara, Turkey
2016	Full Scholarship from Bilkent University during M.S. Studies	Ankara, Turkey
2016	Bilkent University Academic Excellence Award	Ankara, Turkey
2016	Bilkent University High Honor Student during B.S. Studies	Ankara, Turkey
2015	Received the 13th rank among 0.2M university graduates in ALES (National GRE)	Ankara, Turkey
2011	Bilkent University Full Scholarship for the B.S. degree in the EEE Department	Ankara, Turkey
2011	Received the 178th rank among 2M high school graduates in University Entrance Examinations	Ankara, Turkey

Publications

JOURNAL ARTICLES [7]

Convex Geometry and Duality of Over-parameterized Neural Networks

T. Ergen, M. Pilanci
Journal of Machine Learning Research (JMLR) (2021)

A Novel Distributed Anomaly Detection Algorithm based on Support Vector Machines

T. Ergen, S. S. Kozat
Elsevier Digital Signal Processing (2020)

Unsupervised Anomaly Detection with LSTM Neural Networks

T. Ergen, S. S. Kozat
IEEE Transactions on Neural Networks and Learning Systems (2019)

Energy-Efficient LSTM Networks for Online Learning

T. Ergen, Ali H Mirza, S. S. Kozat
IEEE Transactions on Neural Networks and Learning Systems (2019)

Team-optimal Online Estimation of Dynamic Parameters over Distributed Tree Networks

O. F. Kilic, T. Ergen, M. Sayin, S. S. Kozat
Elsevier Signal Processing (2019)

Online Training of LSTM Networks in Distributed Systems for Variable Length Data Sequences

T. Ergen, S. S. Kozat
IEEE Transactions on Neural Networks and Learning Systems (2017)

Efficient Online Learning Algorithms based on LSTM Neural Networks

T. Ergen, S. S. Kozat
IEEE Transactions on Neural Networks and Learning Systems (2017)

PREPRINTS [4]

A Library of Mirrors: Deep Neural Nets in Low Dimensions are Convex Lasso Models with Reflection Features

E. Zeger, Y. Wang, A. Mishkin, T. Ergen, E. Candès, M. Pilanci
Under Review (2024)

MASSW: A New Dataset and Benchmark Tasks for AI-Assisted Scientific Workflows

X. Zhang, Y. Xie, J. Huang, J. Ma, Z. Pan, Q. Liu, Z. Xiong, T. Ergen, D. Shim, H. Lee, Q. Mei
Under Review (2024)

The Convex Landscape of Neural Networks: Characterizing Global Optima and Stationary Points via Lasso Models

T. Ergen, M. Pilanci
Under Review (2023)

Convexifying Transformers: Improving optimization and understanding of transformer networks

T. Ergen, B. Neyshabur, H. Mehta
Under Review (2022)

CONFERENCE & WORKSHOP PAPERS [27]

Scaling Convex Neural Networks with Burer-Monteiro Factorization

A. Sahiner, T. Ergen, B. Ozturkler, J. Pauly, M. Mardani, M. Pilanci
International Conference on Learning Representations (ICLR) (2024)

Path Regularization: A Convexity and Sparsity Inducing Regularization for Parallel ReLU Networks

T. Ergen, M. Pilanci
Neural Information Processing Systems (NeurIPS) (2023)

Fixing the NTK: From Neural Network Linearizations to Exact Convex Programs

R. Dwaraknath, T. Ergen, M. Pilanci
Neural Information Processing Systems (NeurIPS) (2023)

Globally Optimal Training of Neural Networks with Threshold Activation Functions

T. Ergen, H. Gulluk, J. Lacotte, M. Pilanci
International Conference on Learning Representations (ICLR) (2023)

Parallel Deep Neural Networks Have Zero Duality Gap

Y. Wang, T. Ergen, M. Pilanci
International Conference on Learning Representations (ICLR) (2023)

Unraveling Attention via Convex Duality: Analysis and Interpretations of Vision Transformers

A. Sahiner, T. Ergen, B. Ozturk, J. Pauly, M. Mardani, M. Pilanci
International Conference on Machine Learning (ICML) (2022)

Demystifying Batch Normalization in ReLU Networks: Equivalent Convex Optimization Models and Implicit Regularization

T. Ergen*, A. Sahiner*, B. Ozturk, J. Pauly, M. Mardani, M. Pilanci
International Conference on Learning Representations (ICLR) (2022)

Hidden Convexity of Wasserstein GANs: Interpretable Generative Models with Closed-Form Solutions

A. Sahiner*, T. Ergen*, B. Ozturk, B. Bartan, J. Pauly, M. Mardani, M. Pilanci
International Conference on Learning Representations (ICLR) (2022)

Revealing the Structure of Deep Neural Networks via Convex Duality

T. Ergen, M. Pilanci
International Conference on Machine Learning (ICML) (2021)

Global Optimality Beyond Two Layers: Training Deep ReLU Networks via Convex Programs

T. Ergen, M. Pilanci
International Conference on Machine Learning (ICML) (2021)

Implicit Convex Regularizers of CNN Architectures: Convex Optimization of Two- and Three-Layer Networks in Polynomial Time

T. Ergen, M. Pilanci
International Conference on Learning Representations (ICLR)-(Spotlight Presentation) (2021)

Vector-output ReLU Neural Network Problems are Copositive Programs: Convex Analysis of Two Layer Networks and Polynomial-time Algorithms

A. Sahiner, T. Ergen, J. Pauly, M. Pilanci
International Conference on Learning Representations (ICLR) (2021)

Exact and Relaxed Convex Formulations for Shallow Neural Autoregressive Models

V. Gupta, B. Bartan, T. Ergen, M. Pilanci
IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)-(Outstanding Paper Award) (2021)

Greedy learning for large-scale neural MRI reconstruction

B. Ozturkler, A. Sahiner, T. Ergen, A. D. Desai, J. M. Pauly, S. Vasanawala, M. Mardani, M. Pilanci
NeurIPS 2021 Workshop on Deep Learning and Inverse Problems (2021)

Neural Networks are Convex Regularizers: Exact Polynomial-time Convex Optimization Formulations for Two-layer Networks

M. Pilanci, T. Ergen
International Conference on Machine Learning (ICML) (2020)

Convex Geometry of Two-Layer ReLU Networks: Implicit Autoencoding and Interpretable Models

T. Ergen, M. Pilanci

International Conference on Artificial Intelligence and Statistics (*AISTATS*) (2020)

Convex Programs for Global Optimization of Convolutional Neural Networks in Polynomial-Time

T. Ergen, M. Pilanci

NeurIPS Workshop on Optimization for Machine Learning (*OPTML*) - **(Oral Presentation)** (2020)

Random Projections for Learning Non-convex Models

T. Ergen, M. Pilanci

NeurIPS Workshop on Beyond First Order Methods in Machine Learning (2019)

Convex Duality and Cutting Plane Methods for Over-parameterized Neural Networks

T. Ergen, M. Pilanci

NeurIPS Workshop on Optimization for Machine Learning (*OPTML*) (2019)

Convex Optimization for Shallow Neural Networks

T. Ergen, M. Pilanci

Annual Allerton Conference on Communication, Control, and Computing (*Allerton*) (2019)

Recurrent neural networks based online learning algorithms for distributed systems

T. Ergen, S. O. Sahin, S. S. Kozat

IEEE Signal Processing and Communications Applications Conference (*SIU*) (2018)

A Highly Efficient Recurrent Neural Network Architecture for Data Regression

T. Ergen, E. Ceyani

IEEE Signal Processing and Communications Applications Conference (*SIU*) (2018)

A Novel Anomaly Detection Approach Based on Neural Networks

T. Ergen, M. Kerpici

IEEE Signal Processing and Communications Applications Conference (*SIU*) (2018)

An Efficient Bandit Algorithm for General Weight Assignments

K. Gokcesu, T. Ergen, S. Ciftci, S. S. Kozat

IEEE Signal Processing and Communications Applications Conference (*SIU*) (2017)

Neural Networks Based Online Learning

T. Ergen, S. S. Kozat

IEEE Signal Processing and Communications Applications Conference (*SIU*) (2017)

Novelty Detection Using Soft Partitioning and Hierarchical Models

T. Ergen, K. Gokcesu, M. Simsek, S. S. Kozat

IEEE Signal Processing and Communications Applications Conference (*SIU*) (2017)

Online Distributed Nonlinear Regression via Neural Networks

T. Ergen, S. S. Kozat

IEEE Signal Processing and Communications Applications Conference (*SIU*) (2017)

Skills

Programming Languages Python, Matlab, LaTeX, VHDL
English, Turkish