

# Doruk Aksoy

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Scientific Machine Learning | Data Science | Tensor Decompositions | Bayesian Inference | Data Compression

## Summary

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Ph.D. Candidate in Aerospace Engineering and Scientific Computing at the University of Michigan, specializing in tensor decomposition algorithms and scientific machine learning. Expertise in reducing computational costs by up to 95% through algorithm development. Skilled in managing high-dimensional data, solving complex inverse problems, and applying Bayesian approaches in computational science. Proven track record of research publications, international presentations, and team leadership.

## Education

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### University of Michigan

Ann Arbor, MI

Ph.D. in Aerospace Engineering and Scientific Computing

Expected May 2025

- Thesis title: Incremental tensor decompositions for scientific machine learning and Bayesian inference
- Ph.D. advisor: Alex A. Gorodetsky
- Michigan Institute of Computational Discovery and Engineering(MICDE) 2023-2024 fellow

### Bogazici University

Istanbul, TR

B.Sc. in Mechanical Engineering

Sep 2013 - Jun 2018

## Research and Project Management Experience

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### Bayesian Optimal Experimental Design in Tensor-Network Reduced Spaces

Feb 2023 - Present

- Developed a framework for large-scale, high-dimensional data using tensor decompositions
- Enhanced measurement accuracy by up to 18% through optimal sensor placement

### Incremental Hierarchical Tucker Decomposition

Jan 2023 - Sep 2024

- Developed the first incremental algorithm for hierarchical Tucker decomposition in the literature
- Achieved up to 60% reduction in computational cost compared to existing methods
- Authored a manuscript detailing the algorithm for peer-reviewed journal submission
- Implemented the algorithm as high-performance scientific computing software

### Incremental Tensor Train Decomposition

Aug 2021 - Jan 2023

- Developed a state-of-the-art algorithm for converting tensor streams into tensor train format
- Reduced computation time by 95% and increased compression ratio by  $57\times$  compared to existing methods
- Achieved up to 13x speedup in end-to-end training time for deep learning against AE/VAE based architectures
- Released the algorithm as an open-source software package at [github.com/dorukaks/TT-ICE](https://github.com/dorukaks/TT-ICE)

### Neural Network Inverse Design for Self-Oscillating Gels

Jan - Dec 2020

- Designed a neural network to predict physical and motion parameters of a PDE-driven chaotic system
- Achieved over 99% accuracy for discrete parameters and 98% for continuous parameters

### Process Parameter Control for Fused Deposition Modeling

Jan - Sep 2019

- Engineered and built a cost-effective bead height measurement system for Ultimaker 3D printers
- Established a model linking process parameters to bead cross-sectional geometry
- Demonstrated up to 85% reduction in bead height error through experimental testing
- Presented findings at the 2020 American Control Conference

## Skills

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**Programming:** Python, PyTorch, OpenCV, Git, MATLAB, C/C++, Julia

**Soft skills:** Project management, scientific writing, teamwork, communication, problem-solving, adaptability

**Languages:** Turkish (Native), English (Fluent), German (Fluent)

**Relevant coursework:** Large Language Models, Comp. Data Science and Machine Learning, Numerical Linear Algebra

## Select Publications

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### Incremental hierarchical Tucker decomposition

Aksoy, D., Gorodetsky, A. A.

(submitted to) JMLR

### An incremental tensor train decomposition algorithm

Aksoy, D., Gorsich, D. J., Veerapaneni, S., Gorodetsky, A. A.

SIAM Journal on Scientific Computing

[doi.org/10.1137/22M1537734](https://doi.org/10.1137/22M1537734)

### Low-rank tensor-network encodings for video-to-action behavioral cloning

Chen, B.\* , Aksoy, D.\* , Gorsich, D. J., Veerapaneni, S., Gorodetsky, A. A.

TMLR

[openreview.net/forum?id=w4DXLzBPPw](https://openreview.net/forum?id=w4DXLzBPPw)

### Inverse design of self-oscillatory gels through deep learning

Aksoy, D., Alben, S., Deegan, R. D., Gorodetsky, A. A.

Neural Computing and Applications

[doi.org/10.1007/s00521-021-06788-9](https://doi.org/10.1007/s00521-021-06788-9)

## Select Presentations

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Leveraging incremental tensor decompositions in Bayesian inference and machine learning

**ETH Zurich - 2024**

Incremental tensor decompositions for compressing image-based data streams

**SIAM IS - 2024**

Incremental tensor decompositions for building efficient digital twins

**WCCM - 2024**

Enabling Bayesian optimal exp. design for high-dim. systems with incr. tensor dec.

**SIAM UQ - 2024**

## Awards and Honors

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Michigan Institute of Computational Discovery and Engineering (MICDE) Fellowship

2023-2024

2nd Place, MICDE Annual Symposium Poster Competition

2023

Best Reproducibility Award, Michigan Institute of Data Science Annual Symposium Poster Competition

2023

## Relevant Work Experience

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**Graduate Student Research Assistant at University of Michigan (Ann Arbor, MI)** Jan 2020 - Present

- Leading a cross-university research team of graduate and undergraduate students to develop a framework for behavioral cloning using multi-modal data
- Developed and implemented tensor decomposition algorithms for scientific machine learning
- Mentored 2 master's students and 1 undergraduate student in research setting
- Presented research findings at 5+ peer reviewed papers and 10+ international conferences

**Co-op Intern at Mercedes-Benz Turk (Istanbul, TR)**

Jul 2017 - Jun 2018

- Specialized in obtaining ECE-R51 (noise) and ECE-R121 (lighting) approvals, ensuring product compliance
- Automated the preparation for ECE-R51 noise tests, reducing engineering time by 40%
- Facilitated effective communication and teamwork across international and cross-functional teams

**Summer Intern at Turkish Aerospace Industries Inc. (Ankara, TR)**

Jun 2015 - Jul 2015

- Explored aerospace manufacturing techniques and observed composite materials testing
- Gained practical experience in resin transfer molding (RTM) processes
- Designed a mandrel extraction machine for the RTM production line

## Academic Service

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**Reviewer:** Neural Computing and Applications; IEEE Systems, Man and Cybernetics: Systems

**Session chair:** SIAM CSE 2025