Atharva Awari

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Research Identity

My research focuses on the development of optimisation algorithms and machine learning methods for high-dimensional data, with particular emphasis on nonlinear matrix and tensor decompositions and their applications to data science, image and signal processing and biomedical analysis. During my visiting research at Simula Metropolitan Center for Digital Engineering, I extended this work to tensor decomposition models for biomedical data, developing scalable, interpretable methods for uncovering latent structure in complex multi-modal datasets. My work lies at the intersection of optimisation, numerical linear algebra, and data-driven machine learning, with a strong focus on reproducible, open-source software.

Research Interests

- Nonlinear Matrix and Tensor decompositions for biomedical and multimodal data.
- Optimisation algorithms, numerical methods and scalable algorithm design.
- Unsupervised and interpretable machine learning, representation learning.
- Data-driven modelling and knowledge discovery from high-dimensional data.

Experience

Visiting Researcher
Simula Metropolitan Center for Digital Engineering Oslo, Norway *March-June 2026*
Supervisor: Prof. Evrim Acar

- Developed nonlinear tensor decomposition models for biomedical data analysis, focusing on interpretable latent representations and scalable optimisation methods.
- Extended ADMM-based algorithmic frameworks from matrix to tensor settings, with applications to multi-modal, high-dimensional data problems.
- Collaborated with the DataSci group on extracting meaningful and actionable insights from complex datasets, bridging mathematical methodology and applied data science.

Education

PhD in Applied Mathematics, Université de Mons, Belgium *2023–expected Fall 2026*
Supervisor: Prof. Nicolas Gillis
Thesis: Non-linear Matrix and Tensor Decompositions: Theory, Algorithms and Applications.

MSc in Applied Mathematics, Indian Institute of Technology Delhi, India *2020–2022*
Supervisor: Prof. Punit Sharma
Thesis: Linear and Non-linear Eigenvalue Problems
CGPA: 8.20

BSc in Mathematics, Fergusson College, Pune University, India *2016–2019*
CGPA: 9.07

Selected Publications

Published / Accepted

- *A Simple and Flexible ADMM-Based Framework for Tensor Decompositions*, accepted at European Signal Processing Conference (EUSIPCO), 2026. [preprint] [code]
- *Nonlinear Matrix Decompositions with Sigmoid Function*, IEEE Machine Learning for Signal Processing (MLSP), 2025. [paper]
- *Coordinate Descent Algorithm for Nonlinear Matrix Decomposition with ReLU*, European Signal Processing Conference (EUSIPCO), 2024. [paper] [code]
- *Accelerated Algorithms for Nonlinear Matrix Decomposition with ReLU*, IEEE Machine Learning for Signal Processing (MLSP), 2023. [paper]

Under Review (Preprints available online)

- *Nonlinear Tensor Decomposition for Pattern Discovery*, submitted to IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP) 2027. [preprint] [code]
- *Alternating Direction Method of Multipliers for Nonlinear Matrix Decompositions*, submitted to IEEE Transactions on Signal Processing. [preprint] [code]

Software and Reproducible Research

- **Nonlinear Tensor Decomposition Library for Pattern Discovery**
  ADMM-based framework for nonlinear CP decompositions, where an element-wise nonlinearity models clipped or censored data, e.g., values below a limit of detection in metabolomics or saturated audio recordings. [GitHub]
- **Tensor Decomposition Library**
  A flexible and extensible framework for generalized tensor decomposition models supporting multiple loss functions. [GitLab]
- **Nonlinear Matrix Decompositions Library**
  Implementation of an ADMM-based framework for a wide range of nonlinear matrix decomposition models with different activation functions and loss formulations. [GitLab]
- **ReLU-based Nonlinear Decomposition Library**
  Implementation of a coordinate descent algorithm for nonlinear matrix decomposition models with ReLU activations, focusing on accuracy and efficiency. [GitLab]

Research Talks and Conferences

- EUSIPCO Low-rank Matrix and Tensor Decompositions session - Bruges, Belgium 2026
- EUROPT Advances in Continuous Optimization — Southampton,(2025); Lund, Sweden (2024)
- Biennial Numerical Analysis Conference — Glasgow, UK (2025)
- SIAM Conference on Applied Linear Algebra — Paris, France (2024)
- Belgian Mathematical Optimization Workshop — La Roche, Belgium (2024)
- Foundations of Computational Mathematics (FoCM) — Paris, France (2023)

Technical Skills

Languages: Python, MATLAB, Julia, C, C++
Tools: GitLab, LaTeX, MS Office
Areas: Tensor decompositions, Optimisation, Machine learning, data analysis, Scientific computing

Leadership & Activities

President, Erasmus Student Network Mons (2023–2024): Organized international events and networking activities.
Interests: Cricket (university team), hiking

Languages

English (Professional), French (Basic), Hindi (Native), Marathi (Native)