DENIZ AKKAYA

Bilkent University, 06800, Ankara, Turkey
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Ph.D. Candidate and Research Associate in Industrial Engineering specializing in sparse optimization, robust regression, and mathematical programming. Seeking academic opportunities in applied mathematics, operations research, or related quantitative disciplines.

ACADEMIC POSITIONS

Research Associate, Bilkent University *September 2024 - Present*
Industrial Engineering Department *Ankara, Turkey*

- Conducting research on sparse optimization, mathematical programming, and robust regression as part of funded academic projects.
- Collaborating with graduate students and faculty on theoretical and computational aspects of optimization.
- Supporting departmental teaching and mentoring activities.

EDUCATION

Ph.D. Candidate in Industrial Engineering *September 2021 - Present*
Bilkent University
Research Area: Sparse Optimization and Algorithms
Overal CGPA: 3.29

M.Sc. in Industrial Engineering *February 2019 - June 2021*
Bilkent University
Research Area: Continuous and Combinatorial Optimization
Overall CGPA: 3.39

B.Sc. in Mathematics *September 2014 - January 2019*
Bilkent University
Comprehensive Scholar
Overall GPA: 3.40

BOOKS

M. Ç. Pınar, D. Akkaya. Problems and Solutions for Integer and Combinatorial Optimization: Building Skills in Discrete Optimization, Philadelphia: SIAM. (2023) DOI

JOURNAL ARTICLES

D. Akkaya, M. Ç. Pınar, Minimizers of Sparsity Regularized Huber Loss Function. Journal of Optimization Theory and Applications, 187, 205–233 (2020). DOI

Ö. Ekmekcioglu, D. Akkaya, M. Ç. Pınar, Subset Based Error Recovery. Signal Processing, 191, 108361. (2022). DOI

B. Şen, D. Akkaya, M. Ç. Pınar, Sparsity Penalized Mean–Variance Portfolio Selection: Analysis and Computation. Mathematical Programming. 211, 281–318 (2025). DOI

D. Akkaya, M. Ç. Pınar, Minimizers of Sparsity Regularized Least Absolute Deviations. Journal of Global Optimization. Accepted.

B. Çetin, D. Akkaya, M. Ç. Pınar, Sparsity Constrained Minimax Optimization with Applications to Sparse Boosting and Game Theory. Mathematical Programming Computation. Submitted.

D. Akkaya, M. Ç. Pınar, Critical Point Theory for Sparse Huber Recovery. Optimization. Submitted.

D. Akkaya, M. Ç. Pınar, Hidden Conic Quadratic Representation in Some Generalized Nash Equilibrium Problems. Journal of Optimization Theory and Applications, Submitted

THESES

Minimizers of Sparsity Regularized Robust Loss Functions M.Sc. Thesis
Industrial Engineering *Bilkent University*

· **Abstract:** We study the structure of the local and global minimizers of the Huber loss and the sum of absolute deviations functions regularized with a sparsity penalty L0 norm term. We char-acterize local minimizers for both loss functions, and establish conditions that are necessary and sufficient for local minimizers to be strict. A necessary condition is established for global minimizers, as well as non-emptiness of the set of global minimizers. The sparsity of minimizers is also studied by giving bounds on a regularization parameter controlling sparsity. Results are illustrated in numerical examples. Link

CONFERENCE PROCEEDINGS

D. Akkaya, M. Ç. Pınar, Minimizers in Robust Regression Adjusted for Sparsity, in ICCOPT Berlin, 2019.

WORKSHOPS & SUMMER SCHOOLS

CO@Work 2020 Germany
September 14-25, 2020

· **Abstract:** This block course addressed master students (in their final year), PhD students, post-docs, and everyone else interested in the use of combinatorial optimization and mathematical programming in concrete applications from practice. The course schedule covered two weeks with lectures and exercises. We had lectures by more than 30 distinguished researchers from all over the world, including developers and managers of seven leading companies in the field of mathematical optimization.

MACIS 2019 Turkey
November 13-15, 2019

· **Abstract:** MACIS is a series of biennial conferences focusing on research in mathematical and computational aspects of computing and information science. It is broadly concerned with algorithms, their complexity and their embedding in larger logical systems. At the algorithmic level, there is the rich interplay along the Numerical/Algebraic/Geometric/Topological axes. At the logical level, there are issues of data organization, interpretation and associated tools. These issues often arise in scientific and engineering computation where we need experimental and case studies to validate or enrich the theory. MACIS is interested in outstanding and emerging problems in all these areas.

RESEARCH EXPERIENCE

Graduate Research, Bilkent University May 2018 - Present
Research Assistant

· Under supervision of Prof. Mustafa Çelebi Pınar, conducting research on continuous optimization using robust loss functions.

- Analyzing behavior of non-differentiable or non-strictly convex functions under sparsity regularizations.
- Established theory and created exact algorithms for minimizer computation.

Undergraduate Research, Bilkent University September 2017 - May 2018
Senior Project

- Under the supervision of Prof. Aurelian Gheondea, conducting research on Perron-Frobenius Theorem and applications.
- Studied the applications of the Perron–Frobenius theorem in ranking systems (e.g., PageRank) and operator theory (e.g., shifts on infinite strings over finite alphabets).

PROJECTS & TALKS

Hidden Conic Quadratic Representation in Some Generalized Nash Equilibrium Problems
November 7, 2025
Bilkent University Industrial Engineering Seminars *Turkey*

- **Abstract:** A class of generalized Nash equilibrium (GNE) problems inspired by multi-investor Markowitz portfolio models and strategic portfolio efficiency games is investigated. These settings are formulated as quadratic matrix optimization problems that capture strategic interactions through shared matrix decisions. Building on the hidden conic quadratic representation results of Ben-Tal and den Hertog, it is shown that, under simultaneous diagonalizability, a broad class of such matrix problems admits tractable conic quadratic reformulations. New structural insights are revealed, and computational advantages for analyzing equilibrium behavior in matrix-valued optimization frameworks are obtained.

Critical Point Theory for Sparse Huber Recovery
June 30, 2025
EUROPT25, Southampton *United Kingdom*

- **Abstract:** Sparse recovery in linear systems is studied with a focus on minimizing the sensing error using solutions with a fixed number of nonzero entries. Robustness to outliers is enhanced through the use of the Huber loss, which limits the influence of large deviations while maintaining sensitivity to small errors. The extension of classical results from the smooth least squares case to the non-smooth Huber setting is examined, and associated analytical challenges are addressed.

Minimizers of Least Absolute Deviations for Sparse Regularization
April 9, 2024
NOPTA 24, Antwerp *Belgium*

- **Abstract:** Sparse solutions to linear systems of equations affected by noise or modeling errors are considered. A sparse solution to the system that minimizes the ℓ_1-norm of the residual error is sought. Sparsity is controlled using a ℓ_0-norm term weighted by a positive parameter. A detailed study of the local and global minimizers is given as well as conditions for monitoring the sparsity level of the minimizers.

Sparsity Penalized Mean-Variance Portfolio Selection: Analysis and Computation
September 8, 2022
HUGO22, Sziget *Hungary*

- **Abstract:** Mean-variance portfolio selection problems regularized with an ℓ_0-penalty are studied to promote sparse solutions. Structural properties of local and global minimizers are analyzed and used in the development of a Branch-and-Bound algorithm with a tailored initialization heuristic. Extensive computational experiments on real datasets are conducted, including comparisons with a state-of-the-art MIQP solver.

Hill-Cipher Decryption using Mixed Integer Programming
February 5, 2021
Bilkent University Industrial Engineering Seminars *Turkey*

· **Abstract:** Equivalences between existing methods for Hill cipher decryption and mixed-integer programming formulations incorporating various penalty functions are investigated. Probabilistic bounds on the quality of linear relaxations for the resulting formulations are also provided.

A Proof of Johnson Linderstrauss Lemma and Comparison of Random Projection and Singular Value Decomposition Performances on Image Retrieval Tasks
2020
Bilkent University, Ankara *Turkey*

· **Abstract:** A detailed proof of the Johnson–Lindenstrauss Lemma is presented along with its application to the Random Projection method. Two image reconstruction approaches based on Random Projection and Singular Value Decomposition are briefly introduced. A computational experiment on image retrieval is conducted to compare the performance of the proposed methods, and numerical results are reported.

Minimizers in Robust Regression Adjusted for Sparsity
August 8, 2019
ICCOPT2019, Berlin *Germany*

· **Abstract:** Robust regression analysis using Huber's linear-quadratic loss function has been studied in the context of numerical optimization since the 1980s. Its statistical properties under deviations from normality are well-known. We couple the Huber loss function with a L0 -norm term to induce sparsity, and study the local and global minimizers of the resulting non-convex function inspired from results of Nikolova on the least squares regression adjusted for sparsity.

Existence and Simplicity of a Maximal Eigenvalue for Ruelle-Perron-Frobenius Operators
May 8, 2018
Bilkent University Analysis Seminars *Turkey*

· **Abstract:** Hölder continuous function spaces associated with certain dynamical systems are considered, where the existence and simplicity of a maximal eigenvalue, analogous to the classical Perron–Frobenius Theorem, is established. Ruelle's Theorem has significant implications for the thermodynamical formalism, including the existence and uniqueness of the Gibbs measure for one-sided finite-type subshifts with Hölder continuous potentials. Following Jiang (1999), a detailed proof of Ruelle's Theorem is provided along with an application to shift spaces over finite symbol sets.

The Perron-Frobenius Theorem and an Application to Web Page Ranking
December 5, 2017
Bilkent University Analysis Seminars *Turkey*

· **Abstract:** An elementary and concise proof of the Perron–Frobenius Theorem for square matrices with nonnegative entries is provided, following the approach of Cairns (2014) based on spectral theory in Banach algebras. The required background, including the Spectral Mapping Theorem and Gelfand's Theorem on the spectral radius, is reviewed. As an application, the web page ranking algorithm employed by the Google search engine is presented, together with the necessary graph-theoretic preliminaries on primitive adjacency matrices.

TEACHING EXPERIENCE

IE342 Engineering Economic Analysis (Instructor) Analysis of engineering decisions; principles and methodology of comparing decision alternatives, such as various engineering designs, manufacturing

equipment, or industrial projects. Dealing with uncertainty and risk; rational decision making when future outcomes are uncertain. Concepts of time value of money. Effects of depreciation, inflation, and taxation on economic decisions. Cost-benefit analysis of public projects. Replacement analysis. Introduction to financial engineering.

• Fall 24 - Fall 25

IE400 Principles of Engineering Management (Instructor) Introduction to management analysis such as management layers, network analysis, project management via CPM/PERT networks, optimization concepts, linear programming, integer programming, and decision analysis; and economic concepts such as cash flow, interest rates, rate of return, demand supply relations, product pricing, taxes, inflation, and related subjects.

• Spring 24 - Summer 24

IE 505 Mathematical Programming (Teaching Assistant): Fermat rule, Lagrange multipliers, duality theory, Karush-Kuhn-Tucker conditions, convexity, conic optimization, linear optimization, networks, integer programming.

• Fall 23

IE 586 Computational Optimization (Teaching Assistant): Strong models and valid inequalities. Extended formulations. Cutting plane and column generation algorithms. Decomposition approaches in deterministic and stochastic optimization. Applications in production planning, network design and logistics.

• Spring 23

IE 411 Introduction to Nonlinear Optimization (Teaching Assistant): Nonlinear optimization, optimality conditions for unconstrained optimization, line search, convex sets and functions, convex optimization, constrained optimization, Karush-Kuhn-Tucker conditions, duality.

• Fall 22

IE 500 Mathematics of Operations Research (Teaching Assistant): Introduction to methods of proof, sets and functions, metric spaces, functions on metric spaces, differential and integral equations, fundamentals of linear algebra.

• Fall 21 – Fall 23

IE 303 Modeling and Methods in Optimization (Teaching Assistant): Extension of linear programming to different methodologies including network models, integer programming and dynamic programming. Discrete optimization: local search heuristics.

• Spring 19 – Spring 22

HONORS & AWARDS

Ranked 49th in the National Graduate Education Entrance Exam (ALES)

· Ranked 49th in National Graduate Education Entrance Exam (ALES) among university students in Turkey (99+ percentile).

Scientific and Technological Research Council of Turkey Scholar

· Received undergraduate scholarship from Scientific and Technological Research Council of Turkey (TUBITAK).

99+ Percentile in the National University Entrance Exam (LYS)

· Got 99.65th percentile in National University Entrance Exam (LYS) among 2 million students in Turkey.

PROGRAMMING SKILLS

Languages	MATLAB, Python, Java, R
Modeling Environments	GAMS, AMPL, Xpress

LANGUAGES

English	Full Working Proficiency, C2
Turkish	Native

PROFESSIONAL ACTIVITIES

Reviewer

· IEEE Conference on Signal Processing and Communication Applications (SIU)

Reviewer

· Springer Optimization and Engineering Journal (OPTE)