Behrooz Moosavi Ramezanzadeh

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Research Interests

- **Calculus of Variations:** $\mathcal{A}$-quasiconvexity, lower semicontinuity, relaxation, regularity theory.
- **Partial Differential Equations:** nonlinear elliptic equations, viscosity solutions, tug-of-war games.

Education

University of Pittsburgh — Pittsburgh, PA, USA

- *M.S. in Mathematics* **Advisor:** Juan J. Manfredi **Math GPA:** 3.96/4.00 *Expected May 2027*
  Thesis: *Partial Differential Equations and Stochastic Tug-of-War Games*.
  Committee: Juan J. Manfredi, Armin Schikorra, and Piotr Hajłasz.
  Mathematics Ph.D. preliminary examinations:
  Analysis 60/60; Linear Algebra 57.7/60; both passed on the first attempt (pass mark 40/60).
- *Ph.D. student in Economics* *August 2023 – present*
  Advisors: Jordan Awan and Arie Beresteanu **GPA:** 3.84/4.00
- *M.A. in Economics* *August 2025*

Sharif University of Technology — Tehran, Iran

- *B.S. in Mathematical Sciences* *August 2016 – July 2021*
  GPA: 3.68/4.00 **Class rank:** 4/80 Degree conferred January 2022

Research Experience

Lower Semicontinuity under Variable-Coefficient Differential Constraints *Spring 2026 – present*

Carnegie Mellon University. Research advisor: Irene Fonseca.

- Characterizing weak lower semicontinuity under linear differential constraints with variable coefficients via frozen $\mathcal{A}$-quasiconvexity, beyond setting of smooth coefficients with uniform constant rank.
- Proved sufficiency for Lipschitz coefficients under a pointwise constant-rank condition, allowing the rank to vary with x, via blow-up and projections onto the kernels of the frozen operators.
- Proved necessity at every point near which, for each lattice direction ξ, the rank of the symbol $\mathbb{A}(x, \xi)$ is locally constant in x, adapting the Davoli–Fonseca moving-kernel construction in place of pseudodifferential calculus.

Tug-of-War Games and the Regularized p-Laplacian *Fall 2025 – present*

M.S. thesis research, University of Pittsburgh. Advisor: Juan J. Manfredi.

- Observed that the regularized p-Laplacian of u is the ordinary p-Laplacian of the affine lift of $u(x)$ in one more dimension, and computed the projected noise kernel and tilted extremal terms.
- Proved existence, uniqueness, and Borel measurability for the projected dynamic programming principle with boundary-strip data, via monotone iteration and an adapted comparison principle.
- Showed that the solution is the value of an explicit projected tug-of-war game on an augmented state space, using super- and submartingale arguments and measurable almost-optimal strategies.
- Proved convergence to the viscosity solution as the step size $\varepsilon \to 0$ for $p \geq 2$, and a pointwise asymptotic mean value characterization of C^2 solutions for every $p \in (1, \infty)$, which a counterexample shows fails at the formal endpoint $p = \infty$.

Publications and Preprints

Published and Accepted

A Projected Tug-of-War Game for the Regularized p-Laplacian *2026*
Journal of Elliptic and Parabolic Equations. [DOI] [arXiv:2605.01218]

Extended Set Difference: Inverse Operation of Minkowski Summation *To appear*
With Arie Beresteanu. *Journal of Convex Analysis*. [arXiv:2412.19779]

Preprints in Mathematics

A Formally Verified Convergence Theorem for the Tug-of-War Scheme of p-Laplacian *2026*
With Juan J. Manfredi. [arXiv:2611.20169]

An Asymptotic Mean Value Characterization for the Regularized p-Laplacian *2026*
[arXiv:2607.02910]

Optimal Control of an Epidemic with Intervention Design *2025*
[arXiv:2503.22928]

Other Research: Econometrics and Statistics

Partial Identification with Auxiliary Moment Restrictions *2026*
With Arie Beresteanu. [arXiv:2607.21807]

Public Good Provision under Locally Private Signals *2026*
With Jordan Awan. [arXiv:2606.24013]

Bounds for Restricted Selections of Random Sets *2025*
With Arie Beresteanu. [arXiv:2512.04539]

Honors and Awards

Iranian National University Entrance Examination *2016*
Ranked 48th nationally in the Mathematics and Physics track.

Gold Medal, Iranian National Mathematical Olympiad *2014*
National competition, Iran.

Talks

Contributed talk, CFE–CMStatistics 2026 *December 2026 (scheduled)*
HTW Berlin, Germany. *Asymptotically Optimal Test Statistics for Simulation-Based Finite-Sample Inference*.

Contributed talks, Midwest Econometrics Group Annual Meeting *October 2026, October 2025*
University of Cincinnati (2026). [Slides 2026] University of Illinois Urbana–Champaign (2025). [Slides 2025]

Conferences, Workshops, and Summer Schools

Working Group on the De Giorgi Conjecture *Fall 2026*
Participant, Center for Nonlinear Analysis, Carnegie Mellon University. Organizer: Robin Neumayer.

Frontiers of Mathematical and Computational Aspects of Materials Science *October 2026*
Conference participant, Carnegie Mellon University.

Topics at the Interface of Partial Differential Equations and Probability *June 2026*
Summer school participant, Department of Mathematical Sciences, Carnegie Mellon University.

Teaching and Research Appointments

University of Pittsburgh *2022 – 2026*

Teaching Assistant: Graduate Stochastic Processes (Industrial Engineering, Fall 2022); Probability & Statistics I (Industrial Engineering, Summer 2023); Intermediate Microeconomics (Economics, Fall 2024); Applied Econometrics I and II (Economics, Spring and Fall 2025); Introduction to Microeconomic Theory (Economics, Spring 2026).

Graduate Research Assistant: Department of Industrial Engineering (Fall 2022 – Summer 2023) — implemented first-order splitting methods (projected gradient, ADMM) and numerical routines for constrained optimization in Julia and Python.

Sharif University of Technology *2017 – 2022*

Instructor (as an undergraduate): Introduction to Linear Algebra for Engineers (Spring 2019) — sole responsibility for lectures, problem sets, and assessment.
Teaching Assistant (spring semesters): Elementary Measure Theory, 2022; Topology I, 2021; Abstract Algebra I, 2020.

Volunteer Tutor: Yarigaran Center, tutoring child laborers (2017–2018).

Expository Lecture Notes

Causal Inference *2026*

Lecture notes for a Ph.D.-level course. [GitHub]

Topology *2021*

Lecture series written as a teaching assistant. [GitHub]

Linear Algebra *2019*

Lecture notes for the course taught in Spring 2019. [GitHub]

An Advanced Introduction to Mathematical Logic and Set Theory *2019*

Expository notes on first-order logic and axiomatic set theory. [GitHub]

Selected Advanced Coursework

Carnegie Mellon Univ.[†]	**Univ. of Pittsburgh**	**Sharif Univ. of Technology**
Calculus of Variations	PDE I	Real Analysis I
Functional Analysis	PDE II[‡]	Real Analysis II
Measure and Integration	Analysis II	Complex Analysis
Advanced Optimal Transport	Analysis III	Topology
Statistical Optimal Transport I	Analysis IV[‡]	Abstract Algebra I
Statistical Optimal Transport II	Differential Geometry I	Dynamical Systems
	Differential Geometry II[‡]	

[†] PCHE cross-registration.
[‡] Enrolled for Spring 2027.

Technical Skills and Languages

- **Scientific computing:** MATLAB, Python, Julia, R, C++.
- **Mathematical software and typesetting:** Lean 4, LaTeX.
- **Software:** Author of `LangevinFlow`, an R package with a C++ backend published on CRAN.
- **Languages:** Persian (native), English (fluent).