Justo E. Karell

(203) 524-2311 | justokarell@gmail.com
justokarell.today | Google Scholar | github.com/justokarell | linkedin.com/in/justokarell

RESEARCH STATEMENT

I develop and improve numerical methods for phenomena that are hard to simulate, including ion engines, plasmas, and turbulence, with two goals, making those simulations stable enough to run and making them faster and more accurate. I work with optimization algorithms, numerical analysis, PDE theory, and machine learning, and I am interested in extending these methods to higher dimensions. My recent interest is in using neural networks to learn the relationships that govern how a scheme extends to higher dimensions, alongside more fundamental analytical work on the same methods.

RESEARCH INTERESTS

Numerical analysis; spectral stability of PDE discretizations; computational fluid dynamics; cut-cell finite-volume methods; state redistribution; high-speed compressible flow; rarefied gas dynamics and DSMC; kinetic and plasma simulation; MHD; scientific machine learning; PDE-constrained optimization.

EDUCATION

Case Western Reserve University 2018
M.S., Operations Research, Cleveland, Ohio

Case Western Reserve University 2017
B.S.E., Engineering Physics, Cleveland, Ohio

Concentration: Diffusive Processes

PUBLICATIONS AND PREPRINTS

Karell, J. E. (2026). "Spectral Analysis and Redistribution Thresholds for Cut-Cell Finite-Volume Methods." arXiv:2607.28808. Submitted to Applied Numerical Mathematics.

Karell, J. E. (2026). "Update-Magnitude State Redistribution (UM-SRD): A Shut-off Extension of Weighted State Redistribution for Cut-Cell Finite-Volume Methods." arXiv:2605.04863 [math.NA]. Submitted to Communications in Applied Mathematics and Computational Science.

Karell, J. E. (2025). "The Chapman-Enskog Divergence Problem in Plasma Transport: Structural Limitations and a Practical Regularization Approach." arXiv:2508.12390 [physics.plasm-ph].

Karell, J. E. (2026). "Economic Viability of Food Rescue Under Enhanced Tax Deductions: A General Threshold Formula, Failure Conditions, and Urban Simulation." SSRN preprint.

WORKING PAPERS

Karell, J. E. "Optimal Stabilization Strength in Cut-Cell State Redistribution."

Karell, J. E. "Weak Parameter Derivatives for Discontinuous DSMC Boundary Kernels."

Karell, J. E. "Leverage Constraints and Reversal Dynamics in Margin Debt: A Second-Order Markov Framework with Funding-Stress Covariates and Decision-Theoretic Validation."

RESEARCH EXPERIENCE

Stevens Institute of Technology Summer 2025
Research Assistant, advised by Prof. Jia Xu, Hoboken, New Jersey

- Wrote and tested code for Reinforcement Learning from supervised Alignment (RLA), a reward-model training method evaluated on MS MARCO against RLAIF and supervised fine-tuning baselines.

Independent Researcher Dec 2024–Present
Numerical Methods and Computational Physics | Full-time since July 2026

- Independent research in numerical stability and computational physics spanning finite-volume, DSMC, MHD, and lattice-Boltzmann methods; develop analysis and simulation code in Python and Fortran and run numerical experiments on HPC systems.
- Additional quantitative modeling includes food-rescue decision thresholds under tax incentives and path-dependent margin-debt dynamics using second-order Markov models and funding-stress covariates.

TEACHING EXPERIENCE

Stevens Institute of Technology, Department of Computer Science 2022–Present
Adjunct Lecturer, Hoboken, New Jersey

- Teach graduate Deep Learning (CS 583) and Natural Language Processing (CS 584), covering neural networks, optimization, CNNs, recurrent models, attention, transformers, language modeling, question answering, retrieval-augmented generation, and reinforcement learning from human feedback.

- Design syllabi, lectures, assessments, and implementation-based projects in Python, PyTorch, and TensorFlow; supervised independent graduate research through CS 800.

Case Western Reserve University Fall 2018
Teaching Assistant, Business Statistics, Cleveland, Ohio

PROFESSIONAL EXPERIENCE

GridX Apr 2025–Jul 2026
Senior Technical Support Manager, Data, Remote

- Investigated production failures in utility billing and data pipelines using SQL across MySQL/Aurora, Athena, and S3.
- Developed a Python diagnostic tool that reduced billing reconciliation from a manual engineering process to a 1.6-minute workflow across 131 records and identified incorrect tariff charges across 11 accounts.
- Prototyped an LLM-based ticket-classification system using the Anthropic API to categorize billing exceptions and support triage routing.

Independent Consulting Aug 2021–Jan 2025
Data Scientist and Technical Product Consultant, Remote

- Bonsai Data Solutions: implemented a Gurobi mixed-integer program for marketing-mix allocation on Google Cloud and contributed to product definition for MMM, attribution, and incrementality.
- Enchanted Rock and Massaro: developed power-outage, market-analysis, and decision-support models for energy-sector strategic planning.
- Scroobious: developed a content-recommendation system for a pitch-coaching platform using speech-pattern and profile features.
- DataDistillr: built customer-requested features and resolved data-platform issues as a solutions engineer.

Liftango Aug 2020–Jul 2021
Data Scientist, Remote

- Developed demand-responsive transit feasibility simulations used in customer engagements across the Americas, supporting more than $200,000 in annual contracts.
- Built and productized a customer-facing transit-service visualization tool with automated reporting workflows in Python.

Pratt & Whitney Jan 2019–Aug 2020
Data Scientist, East Hartford, Connecticut

- Implemented a Python genetic algorithm for spare-engine allocation and demand forecasting that replaced a legacy system, improved forecast accuracy by 34%, and reduced costs by approximately $200,000 per customer annually.
- Automated forecast reporting and mentored an intern conducting an analytics study on engine-repair metrics.

SERVICE AND COMMUNITY INVOLVEMENT

WellFed 2023–2025
Co-Founder and Engineer

- Built a web platform connecting food businesses with nonprofit recipients, including an activity-prediction model for donor-recipient matching.
- Formulated an expected-value model for food-donation economics under uncertainty in tax rates, food margins, distance, and transportation costs.

TECHNICAL SKILLS

Programming and numerical computing: Python, Fortran, SQL, Scala, JavaScript; finite-volume methods; numerical linear algebra and spectral analysis; numerical simulation; optimization; deep learning; NLP; time-series analysis; genetic algorithms; MILP/Gurobi.

Scientific and infrastructure: NumPy, SciPy, Pandas, PyTorch, TensorFlow, Spark, Git, Linux, high-performance computing (HPC), AWS, GCP, Athena, MySQL, BigQuery, S3, Airflow.

CFD / computational physics: compressible-flow simulation, embedded-boundary and cut-cell methods, state redistribution, DSMC, ideal MHD, lattice-Boltzmann stability analysis.