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Davood Damircheli

Curriculum Vitae

Research Interests

Numerical analysis and scientific computing for partial differential and integro-differential equations, with a focus on Galerkin, discontinuous Petrov–Galerkin (DPG), and meshfree collocation methods, and their application in two domains: **computational finance** (Lévy and fractional models, obstacle and free-boundary problems, credit risk) and **computational mechanics** (nonlocal fracture, granular and particulate media). Current work also develops **certified neural and reduced-order surrogates** for parabolic and nonlocal problems, and large-scale simulation on high-performance computing systems.

Education

2023 **Ph.D. in Mathematical Sciences (Applied Mathematics)**, *Mississippi State University*, Starkville, MS
Dissertation: *Spectral methods and wavelets in quantitative finance problems*. Advisor: Mohsen Razzaghi.

2022 **Ph.D. in Computational Engineering**, *Mississippi State University*, Starkville, MS
Dissertation: *Stable numerical methodology for variational inequalities with application in quantitative finance and computational mechanics*. Advisor: Shanti Bhushan.

2011 **M.Sc. in Applied and Financial Mathematics**, *Institute for Advanced Studies in Basic Sciences (IASBS)*, Zanjan, Iran
Thesis: *Numerical solution of stochastic boundary value problems*.

2008 **B.Sc. in Mathematics**, *Imam Khomeini International University*, Qazvin, Iran

Academic Positions

2026–present **Lecturer of Actuarial Science**, *Department of Mathematics, Louisiana State University*, Baton Rouge, LA
Chosen with the department chair's support to succeed Dr. Lawrence Smolinsky as Director of Financial Mathematics and Actuarial Science at LSU on his retirement.

2023–2026 **Postdoctoral Researcher**, *Department of Mathematics, Louisiana State University*, Baton Rouge, LA
Mentor: Robert Lipton. Research supported by the DoD Multidisciplinary University Research Initiative (MURI) program: Army Research Office MURI *Predicting and Controlling the Response of Particulate Systems through Grain Scale Engineering* (2019–2024) and DoD MURI *Complexity, Nonlocality, and Uncertainty in Heterogeneous Solids* (2024–2029).
- Large-scale three-dimensional simulation of aggregates of elastic and inelastic particles, including crushing, comminution and fracture
- Nonlocal (peridynamic-type) and blended models for quasi-brittle fracture
- Microstructure and effective behavior of random materials

2016–2023 **Graduate Research Assistant**, *Department of Mathematics and Statistics, Mississippi State University*, Starkville, MS
- Wavelet and spectral collocation methods for fractional and time-fractional PDEs in finance
- Credit risk under regime-switching synchronous-jump tempered stable Lévy processes; credit-rating migration models

2018–2022 **Graduate Research Assistant**, *Bagley College of Engineering, Mississippi State University*, Starkville, MS

- Discontinuous Petrov–Galerkin methods for option pricing and sensitivity analysis
- Variational inequalities and plasticity; semismooth Newton methods
- HPC-enabled machine-learned surrogate models for a fluid–thermal loading database

2012–2014 **Graduate Research Assistant**, *Institute for Advanced Studies in Basic Sciences (IASBS)*, Zanjan, Iran

- Partial integro-differential equations with free boundaries (American options under regime-switching jump diffusion)
- Adaptive numerical integration of stochastic boundary value problems

Publications

Submitted

[S1] **Damircheli, D.**, Razzaghi, M., and Vo, T. N. *Cancellation-preserving closed-form Galerkin assembly for the one-dimensional integral fractional Laplacian.* Submitted to *SIAM Journal on Numerical Analysis*.

[S2] **Damircheli, D.** *A B-spline Galerkin method for option pricing under the CGMY tempered stable process.* Submitted to *SIAM Journal on Financial Mathematics*. arXiv:2610.07554.

[S3] **Damircheli, D.** *Discontinuous Petrov–Galerkin methods for linear Black–Scholes option pricing I: European and multi-asset extensions.* Submitted to *Computers & Mathematics with Applications*.

[S4] **Damircheli, D.** and Kazemi, S.-M.-M. *A semismooth Newton-based non-cardinal MLS collocation method for option pricing and sensitivity analysis under generalized mixed fractional Brownian motion.* Submitted to *Applied Numerical Mathematics*.

[S5] Bhattacharya, D., **Damircheli, D.**, and Lipton, R. *Crushing, comminution and fracture: extreme particle deformation in three-dimensional granular aggregates.* Submitted to *Mechanics Research Communications*. arXiv:2506.05362.

[S6] **Damircheli, D.** *Symbol-based residual certification of reduced and neural surrogates for tempered-fractional CGMY pricing.* Submitted to *Journal of Scientific Computing*. arXiv:2611.03463.

Preprints

[P1] **Damircheli, D.** *Certified neural approximations for parabolic obstacle problems.* Preprint, arXiv:2610.24202, 2026.

[P2] **Damircheli, D.** *Recovered-coefficient discontinuous Galerkin approximation of an averaged-state credit-rating migration PDE.* Preprint, arXiv:2107.09248 (v2), 2026.

In preparation

[M1] **Damircheli, D.** *Discontinuous Petrov–Galerkin methods for linear Black–Scholes option pricing II: Asian and barrier options.*

Refereed journal articles

[J1] **Damircheli, D.** and Razzaghi, M. *Time-space collocation based on fractional-order generalized Chebyshev wavelets for fractional advection problem. Journal of Computational and Applied Mathematics*, 117776 (2026).

[J2] Carvajal, J. J., **Damircheli, D.**, Führer, T., Fuica, F., and Karkulik, M. *A space-time finite element method for parabolic obstacle problems. IMA Journal of Numerical Analysis*, draf132 (2025).

[J3] Coskun, S., **Damircheli, D.**, and Lipton, R. *Quasi-brittle fracture: the blended approach. Journal of the Mechanics and Physics of Solids*, 205, 106302 (2025).

[J4] **Damircheli, D.** and Razzaghi, M. *A wavelet collocation method for fractional Black–Scholes equations by subdiffusive model. Numerical Methods for Partial Differential Equations*, 40(5), e23103 (2024).

[J5] **Damircheli, D.**, Razzaghi, M., Kazemi, S.-M.-M., and Foroush Bastani, A. *A de-singularized meshfree approach to default probability estimation under a regime-switching synchronous-jump tempered stable Lévy model. Engineering Analysis with Boundary Elements* (2023). arXiv:2109.04676.

[J6] Foroush Bastani, A. and **Damircheli, D.** *An adaptive algorithm for solving stochastic multi-point boundary value problems. Numerical Algorithms*, 74, 1–25 (2017).

[J7] Foroush Bastani, A., Ahmadi, Z., and **Damircheli, D.** *A radial basis collocation method for pricing American options under regime-switching jump-diffusion models. Applied Numerical Mathematics*, 65, 79–90 (2013).

Refereed conference proceedings

[C1] **Damircheli, D.** and Bhatia, M. *Solution approaches and sensitivity analysis of variational inequalities. AIAA SciTech 2019 Forum*, AIAA 2019-0977 (2019).

Grants, Honors and Awards

2023–2026 **Postdoctoral research funded under two DoD MURI awards**, *Louisiana State University*
ARO MURI *Predicting and Controlling the Response of Particulate Systems through Grain Scale Engineering* and DoD MURI *Complexity, Nonlocality, and Uncertainty in Heterogeneous Solids* (LSU lead: R. Lipton).

2025 **Selected participant, NSF-sponsored Hot Topics Workshop "From Modeling to Learning with HPC"**, *ICERM, Brown University*, Providence, RI

2019 **IMA Math-to-Industry Bootcamp (competitive, funded)**, *Institute for Mathematics and its Applications, University of Minnesota*, Minneapolis, MN

2016 **Presidential Graduate Initiative Fellowship**, *Mississippi State University*

Talks and Presentations

- *Crushing, comminution and fracture: extreme particle deformation in three-dimensional granular aggregates.* 20th U.S. National Congress on Theoretical and Applied Mechanics (USNCTAM 2026), June 2026.
- *Meshfree methods for three-dimensional simulation of aggregates of elastic and inelastic particles.* 18th U.S. National Congress on Computational Mechanics (USNCCM18), Chicago, IL, July 2025.
- *Meshfree methods for three-dimensional simulation of aggregates of elastic and inelastic particles.* Engineering Mechanics Institute Conference (EMI 2025), Anaheim, CA, May 2025.
- *Innovative application of discontinuous Petrov–Galerkin methodology in financial option pricing: a focus on barrier options.* International Workshop on Minimum Residual and Least-Squares Finite Element Methods, Bilbao, Spain, 2024.
- *Exploring financial derivatives through the lens of the DPG approach: option pricing and sensitivity analysis.* 6th SIAM Texas–Louisiana Sectional Meeting, Lafayette, LA, November 2023.
- *Numerical solution of the credit-rating migration problem with the Galerkin finite element method.* Joint Mathematics Meetings (JMM 2022), April 2022.
- *Solution approaches and sensitivity analysis of variational inequalities.* AIAA SciTech Forum, San Diego, CA, January 2019.
- *Pricing of boundary-linked assets by stochastic boundary value problems.* Joint Mathematics Meetings (JMM 2017), Atlanta, GA, January 2017.
- *On an adaptive algorithm for stochastic boundary value problems.* FINACT-IRAN Workshop on Financial and Actuarial Mathematics, IPM, Tehran, Iran, August 2014.
- *An adaptive multiple shooting method for stochastic boundary value problems.* Fifth Workshop on Stochastic Processes, University of Tehran, Iran, November 2009.
- *Numerical solution of stochastic differential equations.* First Seminar on Financial Mathematics, IASBS, Zanjan, Iran, Spring 2008.

Teaching Experience

2026–present **Lecturer (instructor of record)**, *Department of Mathematics, Louisiana State University*, Baton Rouge, LA
- MATH 1431 – Calculus with Business and Economic Applications, web-based section (Fall 2026)

2022–2023 **Instructor of record**, *Department of Mathematics and Statistics, Mississippi State University*, Starkville, MS
- Business Calculus
- Mathematical Foundations of the Finite Element Method

2011–2016 **Lecturer**, *University of Applied Science and Technology*, Tehran, Iran
- Calculus I and II; Numerical Analysis I and II
- Financial Management; Financial Mathematics

2010 **Teaching Assistant**, *Department of Applied Mathematics, IASBS*, Zanjan, Iran
- Advanced Stochastic Processes; Advanced Numerical Analysis

Industry Experience

2014–2016 **Risk Analyst and Consultant**, *Risk Department, Tourism Bank*, Tehran, Iran
- Liquidity risk modeling, asset–liability management and cash-flow management in MATLAB: gap analysis, liquidity stress testing, liquidity-at-risk, cash-flow-at-risk, higher-order expected shortfall
- Credit risk analysis with machine learning (SVM, k-means)

Professional Service

Leadership Iranian Student Association, Mississippi State University: President (2018–2019), Treasurer (2017–2018), Vice President (2016–2017). Organized the Persian New Year Festival, the largest international event on campus.

Technical Skills

Numerical methods Continuous and discontinuous Galerkin methods; discontinuous Petrov–Galerkin (DPG); space-time finite elements; meshfree and radial-basis collocation; wavelet and spectral collocation; semismooth Newton methods for variational inequalities; numerical SDEs; PDE-constrained optimization

Software PETSc, MFEM, Firedrake, gmsh; MATLAB, Mathematica; Git; Docker and Singularity containers; Linux/HPC environments

Languages C/C++, Python, R, MPI

Scientific ML Neural and reduced-order surrogates for PDEs; Deep Learning Specialization (DeepLearning.AI, 2022)

Spoken English (fluent), Persian (native), Turkish (conversational)

References

- **Robert Lipton**, Nicholson Professor of Mathematics, Louisiana State University (postdoctoral mentor). lipton@lsu.edu
- **Leszek Demkowicz**, Oden Institute for Computational Engineering and Sciences, The University of Texas at Austin. leszek@oden.utexas.edu
- **Mohsen Razzaghi**, Professor, Department of Mathematics and Statistics, Mississippi State University (Ph.D. advisor, Mathematical Sciences). razzaghi@math.msstate.edu
- **Shanti Bhushan**, Associate Professor of Mechanical Engineering and Associate Director, CAVS, Mississippi State University (Ph.D. advisor, Computational Engineering). sb218@msstate.edu
- **Julia Ledet**, Distinguished Instructor, Department of Mathematics, Louisiana State University (teaching reference). ledet@math.lsu.edu, +1 225 578 5309
- **Shantia Yarahmadian**, Department of Mathematics and Statistics, Mississippi State University. syarahmadian@math.msstate.edu
- **Matthew McBride**, Department of Mathematics and Statistics, Mississippi State University. mmcbride@math.msstate.edu