

Prashant K. Jha

Research Associate

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(a) Research Interests

My research is driven by the application of mathematical modeling and computational methods to present-day relevant and challenging problems. Specific areas include continuum and fracture mechanics, computational oncology, and multiscale modeling.

(b) Education

- B.E. (2006-2010) Mechanical Engineering, Govt. Engineering College, Raipur, India
- M.E. (2010-2012) Mechanical Engineering, Indian Institute of Science, Bangalore, India
Thesis: A monolithic strategy for fluid-structure interaction in compressible flow
Adviser: Dr. Chandrashekhara S. Jog
- Ph.D. (2012-2016) Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, USA
Thesis: Coarse graining of electric field interactions with materials
Adviser: Dr. Kaushik Dayal

(c) Research & Professional Experience

- Oct 2016 – Jul 2019 Postdoctoral Fellow, Louisiana State University (PI: Dr. R. Lipton)
- Aug 2019 – Nov 2020 Peter O'Donnell Postdoctoral Fellow, The University of Texas at Austin (PI: Dr. J. T. Oden)
- Dec 2020 – present Research Associate, The University of Texas at Austin (PI: Dr. J. T. Oden)

(d) Publications

Published

1. P. K. Jha and R. Lipton, "Finite element approximation of nonlocal dynamic fracture models," *Discrete & Continuous Dynamical Systems-B*, vol. 22, no. 11, p. 0, 2017.
2. P. K. Jha and R. Lipton, "Numerical analysis of nonlocal fracture models in holder space," *SIAM Journal on Numerical Analysis*, vol. 56, no. 2, pp. 906–941, 2018.
3. P. K. Jha and R. Lipton, "Numerical convergence of nonlinear nonlocal continuum models to local elastodynamics," *International Journal for Numerical Methods in Engineering*, vol. 114, no. 13, pp. 1389–1410, 2018.
4. P. Diehl, P. K. Jha, H. Kaiser, R. Lipton, and M. Lévesque, "An asynchronous and task-based implementation of peridynamics utilizing hpx—the c++ standard library for parallelism and concurrency," *SN Applied Sciences*, vol. 2, no. 12, pp. 1–21, 2020.
5. R. Lipton, E. Said, and P. K. Jha, "Free damage propagation with memory," *Journal of Elasticity*, vol. 133, no. 2, pp. 129–153, 2018.
6. R. P. Lipton, R. B. Lehoucq, and P. K. Jha, "Complex fracture nucleation and evolution with nonlocal elastodynamics," *Journal of Peridynamics and Nonlocal Modeling*, vol. 1, no. 2, pp. 122–130, 2019.
7. P. K. Jha and R. Lipton, "Numerical convergence of finite difference approximations for state based peridynamic fracture models," *Computer Methods in Applied Mechanics and Engineering*, vol. 351, pp. 184–225, 2019.
8. P. K. Jha and R. Lipton, "Finite element convergence for state-based peridynamic fracture models," *Communications on Applied Mathematics and Computation*, vol. 2, no. 1, pp. 93–128, 2020.
9. P. K. Jha and R. P. Lipton, "Kinetic relations and local energy balance for lefm from a nonlocal peridynamic model," *International Journal of Fracture*, vol. 226, no. 1, pp. 81–95, 2020.
10. P. K. Jha, L. Cao, and J. T. Oden, "Bayesian-based predictions of covid-19 evolution in texas using multispecies mixture-theoretic continuum models," *Computational Mechanics*, 2020.
11. P. K. Jha, P. S. Desai, D. Bhattacharya, and R. Lipton, "Peridynamics-based discrete element method (peridem) model of granular systems involving breakage of arbitrarily shaped particles," *Journal of the Mechanics and Physics of Solids*, vol. 151, p. 104376, 2021.

12. R. P. Lipton and P. K. Jha, "Nonlocal elastodynamics and fracture," *Nonlinear Differ. Equ. Appl.* 28, vol. 23, 2021.

Accepted

13. M. Fritz, P. K. Jha, T. Köppl, J. T. Oden, and B. Wohlmuth, "Analysis of a new multispecies tumor growth model coupling 3d phase-fields with a 1d vascular network," *arXiv preprint arXiv:2006.10477. Revision accepted in Nonlinear Analysis: Real World Applications*, 2020.
14. P. Gadikar, P. Diehl, and P. K. Jha, "Load balancing for distributed nonlocal models within asynchronous many-task systems," *arXiv preprint arXiv:2102.03819. Conference paper accepted in PDSEC 2021*, 2021.

Under Review

15. P. K. Jha, T. Breitzman, and K. Dayal, "Discrete-to-continuum limits of long-range electrical interactions in nanostructures," *Preprint: <https://www.math.cmu.edu/cna/Publications/publications2020/papers/20-CNA-020.pdf>*, 2020.
16. M. Fritz, P. K. Jha, T. Köppl, J. T. Oden, A. Wagner, and B. Wohlmuth, "Modeling and simulation of vascular tumors embedded in evolving capillary networks," *arXiv preprint arXiv:2101.10183*, 2021.

Book Chapters & Reports

17. P. K. Jha and R. Lipton, *Well-posed nonlinear nonlocal fracture models associated with double-well potentials*, pp. 1–40. Cham: Springer International Publishing, 2018.
18. P. K. Jha and R. Lipton, *Finite differences and finite elements in nonlocal fracture modeling: A priori convergence rates*, pp. 1–38. Cham: Springer International Publishing, 2018.
19. R. Lipton, E. Said, and P. K. Jha, *Dynamic brittle fracture from nonlocal double-well potentials: A state-based model*, pp. 1–27. Cham: Springer International Publishing, 2018.
20. R. Lipton, E. Said, and P. K. Jha, *Dynamic damage propagation with memory: A state-based model*, pp. 1–29. Cham: Springer International Publishing, 2018.

(e) Major Projects

- **Development of tumor growth model.** Develop a multi-physics model of angiogenesis explicitly accounting for the effects of the vasculature on cancer, in collaboration with the Technical University of Munich.
- **Mechanistic model for HP MRI signal recovery.** Develop and apply a high-fidelity model for signal recovery in HP (Hyperpolarized) MRI. In collaboration with experts at MD Anderson Cancer Center.
- **Application of tumor model to breast cancer.** Application of angiogenesis model for breast cancer for a patient-specific response. With members of the Center for Computational Oncology at Oden Institute.
- **Peridynamics.** Work on analysis and application of peridynamics and study of granular media using PeriDEM. With researchers at LSU and Rice University.

(f) Proposals & Grants

1. A mechanistic tumor growth model for HP MRI (Sep 2020 – Aug 2021). Grant awarded under the joint initiative of Oden Institute-MDACC-TACC. In collaboration with MD Anderson Cancer Center.

(g) Open-sourced softwares

- **PeriDEM.** Implementation of high-fidelity model (PeriDEM, JMPS 2021) for the granular media.
- **NLMech.** Peridynamics simulation library.
- **BayesForSEIRD.** Bayesian calibration and validation of the SEIRD epidemic model.

(h) Professional Activities

Mentoring

- Co-mentored a student working on the development of parallel solver for a nonlocal diffusion equation. Google Summer of Code 2020.

Journal Reviews

CMAME (10 reviews), JMPS (2 reviews), JALCOM (1 review)

Minisymposium Organization

- Co-organized minisymposium M19 on "Nonlocal models in mathematics and computation" at SIAM TX-LA 3rd Annual Meeting. October 2020.

Talks

1. Seminar: *Coarse graining of electric field interactions with materials*. Mechanical Engineering Seminar, Indian Institute of Science, Bangalore, India. August 2016.
2. Seminar: *Coarse graining of electric field interactions with materials*. Mechanical Engineering Seminar, Indian Institute of Technology, Chennai, India. August 2016.
3. Seminar: *Coarse graining of electric field interactions with materials*. AEM Mechanics Research Seminar, University of Minnesota Twin Cities, Minneapolis, USA. March 2017.
4. Seminar: *Numerical analysis of nonlocal fracture models*. IMA Postdoctoral Seminar, University of Minnesota Twin Cities, Minneapolis, USA. April 2017.
5. Conference: *Numerical analysis of nonlocal fracture models*. US National Congress on Computational Mechanics USNCCM14, Montreal, Canada. July 2017.
6. Seminar: *Finite element approximation of nonlocal fracture models*. Mathematics Department Applied Analysis Seminar, Louisiana State University, Baton Rouge, USA. March 2018.
7. Seminar: *Well-posedness of nonlocal fracture models and apriori error estimates of numerical approximations*. Mathematics Department Seminar, Indian Institute of Science, Bangalore, India. May 2018.
8. Conference: *Free damage propagation with memory*. 13th World Congress in Computational Mechanics, New York, USA. July 2018.
9. Conference: *Convergence results for finite element and finite difference approximation of nonlocal fracture models*. SIAM TX-LA Annual Meeting, Baton Rouge, USA. October 2018.
10. Seminar: *Modelling fracture in solids using nonlocal interaction: A brief overview of Peridynamics*. Mechanical Engineering Seminar, Indian Institute of Technology, Delhi, India. April 2019.
11. Conference: *Convergence results for finite element and finite difference approximation of nonlocal fracture*. ICIAM 2019, Valencia, Spain. July 2019. Presented by Dr. R. Lipton.
12. Conference: *Numerical fracture experiments using nonlinear nonlocal models*. US National Congress on Computational Mechanics USNCCM15, Austin, USA. July 2019.
13. Informal seminar: *Numerical fracture experiments using nonlinear nonlocal models*. Oden Institute, The University of Texas at Austin, Austin, USA. August 2019.
14. Seminar: *A mechanistic tumor growth model for HP MRI*. Center for Computational Oncology Seminar, The University of Texas at Austin, Austin, USA. September 2020.
15. Seminar: *A mechanistic tumor growth model for HP MRI*. Civil and Environmental Engineering Seminar, Carnegie Mellon University, Pittsburgh, USA. October 2020.
16. Seminar: *Application of peridynamics to fracture in solids and granular media*. Special Mechanics Seminar, University of Houston, Houston, USA. October 2020.
17. Conference: *Application of peridynamics to fracture in solids and granular media*. SIAM TX-LA Annual Meeting 2020, USA. October 2020.
18. Seminar: *Application of peridynamics to fracture in solids and granular media*. MAE Seminar Series, University at Buffalo, Buffalo, USA. October 2020.

(i) Awards & Achievements

- GATE Exam: All India rank 31 in GATE-2010
- Best TA award for finite element methods (May 2013)
- Peter O'Donnell Postdoctoral Fellowship (August 2019)

(j) References

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