

Prashant K. Purohit

(<http://www.seas.upenn.edu/~purohit>)

Education

Indian Institute of Technology, Delhi, B.Tech., Mechanical Engineering, 1997.
California Institute of Technology, Pasadena, M.S., Applied Mechanics, 1998.
California Institute of Technology, Pasadena, Ph.D., Applied Mechanics, 2002.
Ph.D. Thesis: *Dynamics of phase boundaries in strings, beams and atomic chains*.
Thesis advisor: Kaushik Bhattacharya.

Positions held

07/12-present Associate Professor, Mechanical Engineering and Applied Mechanics, University of Pennsylvania.
01/06-06/12 Assistant Professor, Mechanical Engineering and Applied Mechanics, University of Pennsylvania.
09/04-12/05 Postdoctoral scholar, Physics and Astronomy, University of Pennsylvania.
Supervisor: Philip Nelson.
12/01-08/04 Postdoctoral scholar, Mechanical Engineering, California Institute of Technology.
Supervisor: Rob Phillips.
09/97-11/01 Research assistant, Mechanical Engineering and Applied Mechanics, California Institute of Technology. Supervisor: Kaushik Bhattacharya.

Honors/Awards

1. NSF CAREER Award 2010, "Entropic elasticity of fluctuating filaments and networks".
2. Ferdinand P. Beer and E. Russell Johnston, Jr., Outstanding New Mechanics Educator Award, 2010, from the American Society for Engineering Education.
3. *Charles Lee Powell Graduate Fellowship*, California Institute of Technology, Pasadena, 1997.
4. *Silver medal* for graduating with the highest GPA in the mechanical engineering class, Indian Institute of Technology, Delhi, 1997.

Research interests

Problems at the interface of mechanics and physics - Statistical mechanics of DNA and filamentous bio-molecules, bio-polymer networks and bio-membranes, martensitic phase transitions in solids, micro-scale propulsion.

Current grants

1. "Analysis of moving unfolding fronts in long protein molecules", PI-Prashant K. Purohit, Agency: National Science Foundation, Grant number: NSF CMMI-1066787, Amount - \$299,793, Oct 2011-Sept 2014.
2. "Flexoelectricity in PZT nanoribbons and biomembranes", PI-Prashant K. Purohit, Agency: Army Research Office, Proposal number: 60735-EG, Amount - \$360,000, Oct 2011-Sept 2014.
3. Nano/Bio Interface Center at the University of Pennsylvania, Grant number NSF DMR08-32802 (PI-Dawn Bonnell, Co-PI- Yale Goldman), Amount - \$287,000, Sept 2010-Aug 2014.

4. "CAREER: Entropic elasticity of fluctuating filaments and networks", PI-Prashant K. Purohit, Agency: National Science Foundation, Grant number: NSF CMMI-0953548, Amount - \$400,000, July 2010-Jun 2015.
5. "Tuning the mechanical properties of fibrin gels by altering the nanoscale structure of fibrin", PI-Prashant K. Purohit, Co-PI-John W. Weisel, Agency: Innovation Award, Nano/Bio Interface Center at the University of Pennsylvania, Grant number NSF DMR08-32802 (PI-Dawn Bonnell, Co-PI- Yale Goldman), Amount - \$50,000, Sept 2010-Jun 2011.

Editorial boards

1. Member of the Editorial Board of the journal 'Molecular and Cellular Biomechanics'.

Professional Societies

1. Member of the Society of Engineering Science,
2. Member of the Society of Industrial and Applied Mathematics,
3. Member of the American Physical Society.

Professional Service

1. Served on review panels for NSF-CMMI, 2009, 2010, 2011, 2012.
2. Reviewed papers for the Journal of the Mechanics and Physics of Solids, Physical Review E, Physical Review Letters, Biophysical Journal, Acta Biomaterialia, International Journal of Solids and Structures, Molecular and Cellular Biomechanics, Macromolecules.
3. Co-organizer of the mini-symposium on 'Entropic Solid Mechanics' in the SIAM conference on the Mathematical Aspects of Materials Science, May 2010.
4. Co-organizer of the mini-symposium on 'Coarse-grained and multi-scale modeling in molecular and cellular biomechanics' at the US National Congress on Computational Mechanics-10, 2009.
5. Co-organizer of the mini-symposium on 'Biophysics problems in the mechanics of rods, surfaces and particles and their interactions with viscous fluids', SIAM conference on the Mathematical Aspects of Materials Science, 2008.
6. Co-chair of session on 'Bio-Inspired problems in Elasticity', ASME Mechanics of Materials Conference, 2007.
7. Co-chair of session at the World Conference on Computational Mechanics, Los Angeles, California, 2006.

Courses taught (* = developed the syllabus and introduced this new course in curriculum)

1. Principles and Techniques of Applied Mathematics* - I (*Engineering Mathematics 520*), Fall 2011.
2. Mechanics of Solids* (*Mechanical Engineering and Applied Mechanics 354*), Fall 2006, Spring 2008, Spring 2009, Spring 2010, Spring 2011, Spring 2012.
3. Entropic Forces in Biomechanics* (*Mechanical Engineering and Applied Mechanics 663*), Spring 2007, Fall 2008, Fall 2010.
4. Elasticity (*Mechanical Engineering and Applied Mechanics 519*), Fall 2007, Fall 2009.

Graduate students supervised (MEAM = *Mechanical Engineering and Applied Mechanics*)

1. Qingze Zhao, MEAM Ph.D. student, (expected graduation – 2016).
2. Mao Sheng, MEAM Ph.D. student, (expected graduation – 2016).
3. David Argudo, MEAM Ph.D. student, (expected graduation – 2014).

4. Ritwik Raj, MEAM Ph.D. (graduated 2011, currently employed with Sefaira, New York).
5. Tianxiang Su, MEAM Ph.D. (graduated 2011, currently postdoctoral scholar jointly at Harvard University and MIT).

Other students/postdocs (with whom I worked/collaborated closely for a significant period)

1. Neeraj Agrawal, CBE Ph.D. (graduated 2009, advisor – Ravi Radhakrishnan).
2. Mark Arsenault, MEAM Ph.D. (graduated 2009, advisor – Haim Bau, co-advisor – Yale Goldman).
3. Josue Sznitman, MEAM postdoc (supervisor – Paulo Arratia).
4. Andre E. X. Brown, Physics Ph.D. (graduated 2009, advisor – Dennis Discher).

Undergraduate students supervised

1. Michael Mele (MEAM, summer research in 2011 in collaboration with Paulo Arratia)
2. Adam Haque (Phys/Math, summer research in 2009 in collaboration with Paulo Arratia)

University service

1. MEAM seminar chair, Fall 2007-Summer 2012.
2. Co-organized symposium on 'Building cellular complexity one molecule at a time' in the Perelman School of Medicine at Penn. (Organizers: Bau, Composto, Goldman, Holzbour, Nelson, Purohit, Weisel), March, 2012.
3. Member of MEAM sub-committee for SEAS Nano cluster hiring initiative, 2011-2012.
4. Outreach presentation to students at University of Puerto Rico through the LRSM at Penn, January, 2012.
5. Outreach presentation to high-school teachers on 'Mechanics of DNA packaging and ejection in viruses', LRSM at Penn, November, 2011.
6. Member of the MEAM Applied Mathematics committee, 2010-2011.
7. Organized a 'Panel discussion on research careers in industry' and 'Graduate research poster exchange' for the Nano/Bio Interface Center at Penn, 2008, 2009, 2010.
8. Member of MEAM faculty search committee for the micro/nano search, 2006, 2008.
9. Member of MEAM graduate admissions committee, 2006 – present.
10. Member of MEAM undergraduate curriculum review committee, 2006.
11. Member of Academic Performance Committee, 2006 – present.

Invited seminars at universities/institutes

1. Department of Mathematics, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland, July 2012.
2. Laboratoire de Mecanique des Solides, Ecole Polytechnique, Paris, France, July 2012.
3. School of Physics, Georgia Institute of Technology, April 2012. (*Soft condensed matter and biophysics seminar*).
4. Mechanical Engineering, University of Michigan, Ann Arbor, October 2011.
5. Princeton Institute for the Science and Technology of Materials, Princeton University, October 2011.
6. Department of Mechanical Engineering, Massachusetts Institute of Technology, September 2011. (*Mechanics: Modeling, experimentation, computation seminar*).
7. School of Engineering and Applied Sciences, Harvard University, August 2011. (*Applied Mechanics Colloquium*).
8. Scuola Internazionale Superiore di Studi Avanzati (SISSA), Trieste, Italy, July 2011.

9. Department de Matematica Aplicada, Universitat Politecnica de Catalunya, Barcelona, Spain, July 2011.
10. IMDEA Materials Institute (Madrid Institute for Advanced Studies of Materials), Madrid, Spain, July 2011.
11. Department of Mechanical Engineering, Stanford University, February, 2011. (*Mechanics and computation seminar*).
12. Department of Mechanical and Aerospace Engineering, University of California, Los Angeles, December, 2010. (*Structural and solid mechanics seminar*).
13. National Center for the Biological Sciences, Tata Institute of Fundamental Research, Bangalore, India, August 2010.
14. Department of Mechanical Engineering, Indian Institute of Science, Bangalore, India, August 2010.
15. Department of Mechanical Engineering, Johns Hopkins University, Baltimore, Maryland, February, 2010.
16. Department of Physics, Vrije University, Amsterdam, September 2009.
17. Department of Chemical and Biomolecular Engineering, University of Pennsylvania, Philadelphia, February 2009.
18. Department of Theoretical and Applied Mechanics, Cornell University, Ithaca, April 2008.
19. Department of Applied Mechanics, Indian Institute of Technology, Madras, Chennai, India, January 2008.
20. Solid Mechanics, Division of Engineering, Brown University, Providence, October 2007.
21. Department of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore, India, December 2003.

Invited presentations at conferences and workshops

1. Multiscale Methods and Validation in Medicine and Biology I: Biomechanics and Mechanobiology, (USACM thematic conference), San Francisco, February 2012.
2. European Nonlinear Dynamics Conference, Sapienza University, Rome, Italy, July 2011.
3. Symposium in honor of Professor L. Ben Freund, Brown University, Providence, June 2011.
4. Workshop on Mathematical Foundations of Mechanical Biology, Banff, Canada, September, 2010.
5. 4th Shanghai International Conference on Biophysics and Molecular Biology, Shanghai-Jiashan, August 2010.
6. European Conference on Computational Mechanics, Paris, May 2010. (*Keynote talk.*)
7. JSME Young Researchers Symposium, California Institute of Technology, Pasadena, March 2010.
8. Summer school on New Trends in the Physics and Mechanics of Biological Systems, Les Houches, France, July 2009.
9. Single molecule biophysics world networking workshop, Drexel University, February 2009.
10. Centennial celebrations of Mechanical Engineering at California Institute of Technology, Pasadena, March 2007.
11. Workshop on Discrete models for materials, University of Warwick, England, June 2003.

Contributed presentations and posters at conferences and workshops

1. European Solid Mechanics Conference, Graz, Austria, July 2012.

2. Symposium on 'Building cellular complexity one molecule at a time', Perelman School of Medicine, University of Pennsylvania, March 2012.
3. APS March Meeting, Boston, Massachusetts, February/March 2012.
4. ASME International Mechanical Engineering Congress and Exposition, Denver, Colorado, November, 2011.
5. Society of Engineering Science, Northwestern University, October 2011.
6. ASME McMat conference, Chicago, May 2011.
7. NSF-CMMI conference, Atlanta, January, 2011. (*poster*)
8. ASME International Mechanical Engineering Congress and Exposition, Vancouver, Canada, November, 2010.
9. 16th US National Congress on Theoretical and Applied Mechanics, College Station, Pennsylvania, July 2010.
10. SIAM conference on Mathematical Aspects of Materials Science, Philadelphia, May 2010.
11. Materials Research Society Conference, San Francisco, April 2010.
12. Nano Engineering in Medicine and Biology Conference, Houston, February 2010.
13. European Solid Mechanics Conference, Lisbon, Portugal, September 2009.
14. ASME-IDETC conference, San Diego, August 2009.
15. Society of Engineering Science, University of Illinois, Urbana-Champaign, October 2008.
16. ICTAM, Adelaide, Australia, August 2008.
17. IUTAM symposium on cellular, molecular and tissue mechanics, Woodshole, June 2008.
18. SIAM conference on the Mathematical Aspects of Materials Science, Philadelphia, May, 2008.
19. US-India Nano Science and Engineering Institute, Chennai, India, January 2008.
20. Society of Engineering Science, Texas A&M University, October, 2007.
21. ASME Mechanics of Materials Conference, University of Texas, Austin, June 2007.
22. Workshop in Nanomechanics of Biomolecules, Ascona, Switzerland, August 2006. (*poster*)
23. World Conference on Computational Mechanics, Los Angeles, California, July 2006.
24. Gordon Research Conference on Single Molecule Approaches to Biology, New London, New Hampshire, June 2006. (*poster*)
25. Materials Research Society Meeting, San Francisco, California, March 2005.
26. Biophysical Society Meeting, Long Beach, California, February 2005.
27. Single Molecule Biophysics Workshop, Aspen, Colorado, January 2005. (*poster*)
28. SIAM Conference on Mathematical Aspects of Materials Science, Los Angeles, California, May 2004.
29. NATO Summer School on Soft Condensed Matter Physics in Molecular and Cell Biology, University of Edinburgh, Scotland, April 2004. US National Congress on Theoretical and Applied Mechanics, Blacksburg, Virginia, July 2002. (*poster*)
30. Workshop on Atomistic and Continuum Models for Long Molecules and Thin Films, Ascona, Switzerland, July 2001. (*poster*)
31. ASME International Mechanical Engineering Congress and Exposition, Orlando, Florida, November, 2000.
32. 20th International Congress of Theoretical and Applied Mechanics, Chicago, Illinois, August, 2000.

Book chapters

1. Rob Phillips, Prashant K. Purohit and Jane' Kondev, "Mechanics of biological nanotechnology", chapter in *Springer handbook of nanotechnology*, Springer-Verlag, 693-727, (2003).

Journal publications (published or accepted for publication, * = student advised by PKP)

1. Thanh D. Nguyen, Nikhil Deshmukh, John M. Nagarah, Tal Kramer, Prashant K. Purohit, Michael J. Berry, Michael C. McAlpine, "Piezoelectric nanoribbons for monitoring cellular deformations", To appear in *Nature Nanotechnology*, (2012).
2. David Argudo and Prashant K. Purohit, "Competition between supercoils and toroids in single molecule DNA condensation", To appear in *Biophysical Journal*, (2012).
3. A. S. Abhilash, Prashant K. Purohit and Shailendra P. Joshi, "Stochastic rate-dependent elasticity and failure of soft fibrous networks", *Soft Matter* **8**, 7004-7016, (2012).
4. Predrag Krajacic, Xiaoning Shen, Prashant K. Purohit, Paulo Arratia and Todd Lamitina, "Biomechanical profiling of C.elegans motility", To appear in *Genetics*, (2012).
5. Tianxiang Su* and Prashant K. Purohit, "Semiflexible filament networks viewed as fluctuating beam frames", *Soft Matter* **8**(17), 4664-4674, (2012).
6. David Argudo* and Prashant K. Purohit, "The dependence of DNA supercoiling on solution electrostatics", *Acta Biomaterialia* **8**, 2133-2143, (2012).
7. Tianxiang Su* and Prashant K. Purohit, "Fluctuating elastic filaments under distributed loads", *Molecular and Cellular Biomechanics* **8**(3), 215-232, (2011).
8. Tianxiang Su* and Prashant K. Purohit, "Entropically driven diffusion – Application to motion of polymers in non-uniform nanochannels", *Phys. Rev. E* **83**, 061906 (11 pages), (2011).
9. Ritwik Raj* and Prashant K. Purohit, "Phase boundaries as agents of structural change in macromolecules", *J. Mech. Phys. Solids* **59**, 2044-2069, (2011).
10. Yi Qi, Thanh D. Nguyen, Bozhena Lisko, Prashant K. Purohit, and Michael C. McAlpine, "Enhanced piezoelectricity and stretchability in energy harvesting devices fabricated from buckled PZT ribbons", *Nano Letters* **11**(3), 1331-1336, (2011).
11. Prashant K. Purohit, Rustem I. Litvinov, Andre E. X. Brown, Dennis E. Discher, and John W. Weisel, "Protein unfolding accounts for the unusual mechanical behavior of fibrin networks", *Acta Biomaterialia* **7**, 2374-2382, (2011).
12. Tianxiang Su*, Somes K. Das, Ming Xiao and Prashant K. Purohit, "Transition between two regimes describing internal fluctuation of DNA in a nanochannel", *PLoS One* **6**, e16890 (9 pages), (2011).
13. Mark E. Arsenault, Prashant K. Purohit, Yale E. Goldman, Henry Shuman, and Haim H. Bau, "Comparison of Brownian-dynamics-based estimates of polymer tension with direct force measurements", *Phys. Rev. E* **82**, 051923 (13 pages), (2010).
14. Ritwik Raj* and Prashant K. Purohit, "Moving interfaces in rod-like macromolecules", *Europhys. Lett.* **91**, 28003 (6 pages), (2010).
15. Josue Sznitman, Xiaoning Shen, Prashant K. Purohit, Paulo E. Arratia, "The effects of fluid viscosity on the kinematics and material properties of C.elegans swimming at low Reynolds number", *Journal of Experimental Mechanics* **50**, 1303-1310, (2010).
16. Tianxiang Su* and Prashant K. Purohit, "Thermomechanics of heterogeneous fluctuating chains", *J. Mech. Phys. Solids* **58**, 164-186, (2010).
17. Josue Sznitman, Prashant K. Purohit, Predrag Krajacic, Todd Lamitina and Paulo E. Arratia, "The material properties of swimming nematodes reveal novel muscle phenotypes", *Biophys. J.* **98**, 617-626, (2010).

18. Andre E. X. Brown, Rustem I. Litvinov, Dennis E. Discher, Prashant K. Purohit, John W. Weisel, "Multiscale mechanics of fibrin polymer: Gel stretching with protein unfolding and loss of water", *Science* **325**, 741-744, (2009).
19. Tianxiang Su* and Prashant K. Purohit, "Mechanics of forced unfolding of proteins", *Acta Biomaterialia* **5**, 1855-1863, (2009).
20. Shravan Veerapaneni, Ritwik Raj*, George Biro and Prashant K. Purohit, "Analytical and numerical solutions for shapes of quiescent 2D vesicles", *Intl. J. Nonlin. Mech.* **44**, 257-262, (2009).
21. Prashant K. Purohit, "Plectoneme formation in twisted fluctuating rods", *J. Mech. Phys. Solids* **56**, 1715-1729, (2008).
22. Neeraj Agrawal, Ravi Radhakrishnan and Prashant K. Purohit, "Geometry of mediating protein affects the probability of loop formation in DNA", *Biophys. J.* **94**(8), 3150-3158, (2008).
23. Prashant K. Purohit, Mark E. Arsenault, Yale E. Goldman and Haim H. Bau, "The mechanics of short rod-like molecules in tension", *Intl. J. Nonlin. Mech.* **43**, 1056-1063, (2008).
24. Mark Arsenault, Hui Zhao, Prashant K. Purohit, Yale E. Goldman and Haim H. Bau, "Confinement and manipulation of actin filaments by electric fields", *Biophys. J.* **93**(8), L42-L44, (2007).
25. Prashant K. Purohit and Philip C. Nelson, "Effect of supercoiling on formation of protein mediated DNA loops", *Phys. Rev. E* **74**, 061907 (14 pages), (2006).
26. Paul Grayson, Alex Evilevitch, Mandar Inamdar, Prashant K. Purohit, William Gelbart, Charles Knobler and Rob Phillips, "The effect of genome length on ejection forces in bacteriophage lambda", *Virology* **348**, 430-436, (2006).
27. Prashant K. Purohit, Mandar Inamdar, Paul Grayson, Todd Squires, Jane Kondev and Rob Phillips, "Forces during viral DNA packaging and ejection", *Biophys. J.* **88**, 851-866, (2005).
28. Prashant K. Purohit, Jane Kondev and Rob Phillips, "Mechanics of DNA packaging in viruses", *Proc. Natl. Acad. Sci.* **100**(6), 3173-3178, (2003).
29. Prashant K. Purohit, Jane Kondev and Rob Phillips, "Force steps during viral DNA packaging". *J. Mech. Phys. Solids*, **51** 2239-2257, (2003).
30. Prashant K. Purohit and Kaushik Bhattacharya, "Dynamics of strings made of phase transforming materials", *J. Mech. Phys. Solids* **51**, 393-424, (2003).
31. K. Bhattacharya, P. Purohit and B. Craciun, "Mobility of twin and phase boundaries", *J. de Physique IV* **112**, 163-166, (2003).
32. Prashant K. Purohit and Kaushik Bhattacharya, "On beams made of phase transforming materials", *Intl. J. of Solids Structures* **39**, 3907-3929, (2002).

Submitted journal publications (* = student advised by PKP)

1. Irina N. Chernysh, Chandrasekaran Nagaswami, Prashant K. Purohit and John W. Weisel, "Fibrin clots are equilibrium polymers that can be remodeled without proteolytic digestion", submitted to *Nano Letters*, (2012).

Refereed conference publications (* = student advised by PKP)

1. Tianxiang Su* and Prashant K. Purohit, "Mechanics of heterogeneous fluctuating elastic rods", (8 pages, *Proceedings of the ASME-IDETC 2009 conference, San Diego*).

2. Prashant K. Purohit, "Shape and energetics of DNA plectonemes", Chapter in IUTAM book series, "*IUTAM symposium in Cell, Molecular and Tissue Mechanics*", Springer, ISBN 978-90-481-3347-5, (Editors: K. Garikipati and E.M. Arruda), (2010).
3. Prashant K. Purohit and Kaushik Bhattacharya, "Dynamics of strings made of phase transforming materials", *Proceedings of the 20th International Congress on Theoretical and Applied Mechanics*, (2001).

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