

Sachin Shanbhag

Department of Scientific Computing

Florida State University

488 Dirac Science Library

Tallahassee, FL 32306-4120

850.644.6548

sshanbhag@fsu.edu

<http://people.sc.fsu.edu/~sshanbhag>

RESEARCH INTERESTS

Polymer dynamics, rheology, polymer nanocomposites, ring polymers, multiscale modeling, peridynamics, inverse problems, Monte Carlo, Bayesian inference.

EDUCATION

- May 2004 **Doctor of Philosophy, Chemical Engineering**
University of Michigan, Ann Arbor
Thesis: Linear Viscoelasticity of Branched Polymer Melts
- Aug 1999 **Bachelor of Technology, Chemical Engineering**
Indian Institute of Technology (IIT), Bombay

WORK EXPERIENCE

- Aug 2006-
present **Assistant Professor**
Department of Scientific Computing
Florida State University, Tallahassee
- Aug 2006
present Department of Chemical and Biomedical Engineering
FAMU-FSU College of Engineering, Tallahassee
- Jun 2004-
Jun 2006 **Post-doctoral Research Fellow**
University of Michigan, Ann Arbor (with Prof. Nicholas A. Kotov)
- May 1998-
Jul 1998 **Summer Intern**
Hindustan Lever Limited (Unilever India), Taloja, India
- May 1997-
Jul 1997 **Summer Research Intern**
Hindustan Lever (Unilever India) Research Center, Bombay

TEACHING INTERESTS

- Undergraduate Fluid Mechanics, Process Control, Chemical Thermodynamics,
Chemical Kinetics, Molecular Simulation
- Graduate Polymer Physics, Statistical Thermodynamics, Monte Carlo Methods
Numerical Methods

PUBLICATIONS

- [1] Shanbhag, S, Park, SJ, Wang, Z, “Superensembles of linear viscoelastic models of polymer melts”, *J. Rheol.*, 56(2), 279, **2012**
- [2] Subramanian, G and Shanbhag, S, “Conformation and Topology of Cyclic-Linear Polymer Blends”, in *Functional Polymer Blends: Synthesis, Properties and Performance*, Vikas Mittal (Editor), Taylor and Francis (CRC Press), USA, **2012**
- [3] Takeh, A, Worch, J and Shanbhag, S, “Analytical rheology of metallocene-catalyzed polyethylenes”, *Macromolecules*, 44 (9), 3656, **2011**
- [4] Shanbhag, S, “Analytical rheology of branched polymer melts: Identifying and resolving degenerate structures”, *J. Rheol.*, 55(1), 177, **2011**
- [5] Vasquez, R and Shanbhag, S, “Percolation of trace amounts of linear polymers in melts of cyclic polymers”, *Macromol. Theory Simul.*, 20(3), 205, **2011**
- [6] Shanbhag, S, “Analytical rheology of blends of linear and star polymers using a Bayesian formulation”, *Rheol. Acta*, 49(4), 411, **2010**
- [7] Subramanian, G and Shanbhag, S, “Conformational free energy of melts of ring-linear polymer blends”, *Phys. Rev. E*, 80, 041806, **2009**
- [8] Vadlamudi, M, Subramanian, G, Shanbhag, S, Alamo, RG, Varma-Nair, M, Fiscus, DM, Brown, GM, Lu, C and Ruff CJ “Molecular Weight and Branching Distribution of a High Performance Metallocene Ethylene 1-Hexene Copolymer Film-Grade Resin”, *Macromol. Symp.*, 282(1), 1, **2009**
- [9] Subramanian, G and Shanbhag, S, “On the Evolution of Entanglements in Initially Unentangled Polymer Melts”, *Int. J. Mult. Comp. Eng.*, 7(1), 1543, **2009**
- [10] Qin, B, Zhao, Z, Song, R, Shanbhag, S and Tang, Z, “A temperature-driven reversible phase transfer of 2-(diethylamino)ethanethiol-stabilized CdTe nanoparticles”, *Angew. Chemie Int. Ed.*, 47(51), 9875, **2008**
- [11] Subramanian, G and Shanbhag, S, “On the relationship between two popular lattice models for polymer melts”, *J. Chem. Phys.*, 129, 144904, **2008**
- [12] Subramanian, G and Shanbhag, S, “Self-diffusion in binary blends of cyclic and linear polymers”, *Macromolecules*, 41(19), 7232, **2008**
- [13] Iyer, BVS, Shanbhag, S, Juvekar, VA, and Lele, AK, “Self-diffusion coefficient of ring polymers in semidilute solution”, *J. Polym. Sci. Polym. Phys.*, 46(21), 2370, **2008**.
- [14] Shanbhag, S and Alamo, RG, “On the thermodynamic driving force for nucleation at large undercoolings”, *Polymer*, 49(10), 2515, **2008**.
- [15] Subramanian, G and Shanbhag, S, “Conformational properties of blends of cyclic and linear polymer melts”, *Phys. Rev. E*, 77(1), 011801, **2008**.
- [16] Shanbhag, S, Tang, Z, and Kotov, NA, “Self-organization of Te nanorods into V-shaped assemblies: A Brownian dynamics study and experimental insights”, *ACS Nano*, 1(2), 126, **2007**.
- [17] Iyer, BVS, Lele, AK, and Shanbhag, S, “What is the size of a ring polymer in a ring-linear blend?”, *Macromolecules*, 40(16), 5995, **2007**.

- [18] Shanbhag, S, “Confining tube potential in polymer melts explored via direct tube sampling using the bond-fluctuation model”, *Proc. AES-ATEMA*, 27, **2007**.
- [19] Shanbhag, S and Kröger, M, “Primitive path networks generated using annealing and geometrical methods: Insights into differences”, *Macromolecules*, 40(8), 2897, **2007**.
- [20] Shanbhag, S, Park, SJ, Zhou, Q, and Larson, RG, “Implications of microscopic simulations of polymer melts for mean-field tube theories”, *Mol. Phys.*, 105(2), 249, **2007**.
- [21] Larson, RG, Zhou, Q, Shanbhag, S, and Park, SJ, “Advances in modeling of polymer melt rheology”, *AIChE J.*, 53(3), 542, **2007**.
- [22] Lee, J, Shanbhag, S, and Kotov, N, “Inverted colloidal crystal scaffolds as three-dimensional microenvironments for cellular co-cultures”, *J. Mater. Chem.*, 16, 3558, **2006**.
- [23] Shanbhag, S and Kotov, N, “On the origin of a permanent dipole moment in nanocrystals with a cubic crystal lattice: Effects of truncation, stabilizers, and medium for CdS tetrahedral homologues”, *J. Phys. Chem. B*, 110(25), 12211, **2006**.
- [24] Tang, Z, Wang, Y, Shanbhag, S, Giersig, M, and Kotov, NA, “Spontaneous transformation of CdTe nanoparticles into angled Te nanocrystals: From particles and rods to checkmarks, X-marks, and other unusual shapes”, *J. Am. Chem. Soc.*, 128, 6730, **2006**.
- [25] Tang, Z, Wang, Y, Shanbhag, S, and Kotov, NA, “Spontaneous CdTe \rightarrow alloy \rightarrow CdS transition of stabilizer-depleted CdTe nanoparticles induced by EDTA”, *J. Am. Chem. Soc.*, 128, 7036, **2006**.
- [26] Shanbhag, S and Larson, RG, “Identification of topological constraints in entangled polymer melts using the bond-fluctuation model”, *Macromolecules*, 39(6), 2413, **2006**.
- [27] Shanbhag, S, Lee, J, and Kotov, N, “Cell scaffolds with three-dimensional order: The role of modelling in establishing design guidelines”, *Aust. J. Chem.*, 58(10), 713, **2005**.
- [28] Shanbhag, S, Wang, S, and Kotov, N, “Cell distribution profiles in three-dimensional scaffolds with inverted-colloidal-crystal geometry: Modeling and experimental investigations”, *Small*, 1(12), 1208, **2005**.
- [29] Shanbhag, S, Lee, J, and Kotov, N, “Diffusion in three-dimensionally ordered scaffolds with inverted colloidal crystal geometry”, *Biomaterials*, 26(27), 5581, **2005**.
- [30] Park, SJ, Shanbhag, S, and Larson, RG, “A hierarchical algorithm for predicting the linear viscoelastic properties of polymer melts with long-chain branching”, *Rheol. Acta*, 44, 318, **2005**.
- [31] Shanbhag, S and Larson, RG, “Chain retraction potential in a fixed entanglement network”, *Phys. Rev. Lett.*, 94(7), 076001, **2005**.
- [32] Shanbhag, S and Larson, RG, “A slip link model of branch-point motion in entangled polymers”, *Macromolecules*, 37(21), 8160–8166, **2004**.
- [33] Sen, TK, Shanbhag, S, and Khilar, KC, “Subsurface colloids in groundwater contamination: A mathematical model”, *Colloids Surf. A.*, 232(1), 29, **2004**.
- [34] Shanbhag, S, Larson, RG, Takimoto, J, and Doi, M, “Deviations from dynamic dilution in the terminal relaxation of star polymers”, *Phys. Rev. Lett.*, 87, 195502, **2001**.

PRESENTATIONS

1. Henke, S and Shanbhag, S, “Convergence Studies of a Peridynamic Diffusion Equation In Multiple Dimensions”, *SIAM Southeastern Atlantic Section (SEAS) Meeting*, **2012**
2. Chapman, CD, Shanbhag, S, Smith, DE, and Robertson-Anderson, R, “Single-Molecule Studies of DNA Self-Diffusion in Entangled Blends of Linear and Circular DNA”, *Biophysical Society Annual Meeting*, San Diego, CA, **2012**
3. Ellington, R, Dobrosavljevic, V, Zang, C, and Shanbhag, S, “Materials Research at Florida State”, *Materials Genome Meeting*, Oak Ridge National Laboratory, TN, **2011**
4. Shanbhag, S, “Is it dilute enough? An examination of random walk polymer solutions”, *Society of Rheology Annual Meeting*, Cleveland, OH, **2011**
5. Takeh, A, and Shanbhag, S “Analytical rheology of metallocene polyethylenes”, *American Physical Society Annual Meeting*, Dallas, TX, **2011**
6. Shanbhag, S, “Analytical Rheology: Identifying and Resolving Degenerate Structures”, *Society of Rheology Annual Meeting*, Santa Fe, NM, **2010**
7. Shanbhag, S, Takeh, A, and Worch, J, “Analytical rheology of branched metallocene-catalyzed polyethylenes”, *Materials Science and Technology*, Columbus, OH, **2010**
8. Takeh, A, and Shanbhag, S “Inferring structural information of metallocene-catalyzed polyethylenes using rheological data”, *Florida Society of Materials Simulation Meeting*, Orlando, FL, **2010**
9. Vásquez, RL, Vásquez, RJ, and Shanbhag, S, “Use of the Matlab[®] computational tool to model polymeric systems and verify experimental results”, *XIII National Congress of Science and Technology*, Panama City, Panama, **2010**.
10. Shanbhag, S, “Modeling Soft Matter”, NSF-REU kickoff meeting, Gainesville, FL, **2010**.
11. Shanbhag, S, “Inverse problems in polymer melt rheology”, Arizona State University, Chemical Engineering Department seminar, Tempe, AZ, **2010**.
12. Zeng, C, Shanbhag, S, Okoli, O, Vanli, A, and Jones, A, “Simulation and characterization of nanotube-reinforced fabric composites using displaced foam dispersion (DFD) process - modeling, experimental validation and uncertainty quantification”, Advanced Simulation and Computing PI meeting, Las Vegas, NV, **2010**.
13. Shanbhag, S, “Analytical Rheology”, University of Florida Chemical Engineering Department seminar, Gainesville, FL, **2009**.
14. Shanbhag, S, “Dynamic Monte Carlo simulations of polymers subject to shearing flows”, *Society of Rheology Annual Meeting*, Madison, WI, **2009**.
15. Shanbhag, S, “Inverse problems in polymer rheology”, NSF-REU kickoff meeting, Gainesville, FL, **2009**.
16. El-Azab, A, Shanbhag, S, and Gunzburger, M, “Computational Materials Science Education as Part of a Degree Program in Computational Science”, *TMS Annual Meeting*, San Francisco, CA, **2009**.

17. Vadlamudi, M, Subramanian, G, Shanbhag, S, Alamo, RG, Varma-Nair, M, Fiscus, DM, Brown, GM, Lu, C, and Ruff, CJ, "Molecular and branching distribution of a high performance metallocene ethylene 1-hexene copolymer film-grade resin", *Second International Conference on Polyolefin Characterization*, Valencia, Spain, **2008**. (poster)
18. Subramanian, G and Shanbhag, S, "Dynamics of ring-linear blends", *International Congress on Rheology*, Monterey, CA, **2008**.
19. Subramanian, G and Shanbhag, S, "Self-diffusion in binary blends of cyclic and linear Polymers", *MMM*, Tallahassee, FL, **2008**. (poster)
20. Shanbhag, S, "Introduction to Monte Carlo simulations of materials", *Florida Society of Materials Simulations*, Tallahassee, FL, **2008**.
21. Shanbhag, S, "Rheology of polymer melts", National Chemical Laboratories, Pune, India, **2008**.
22. Shanbhag, S, "Simulating polymer melts", Indian Institute of Science, Bangalore, India, **2008**.
23. Iyer, BVS, Lele, AK, and Shanbhag, S, "What is the size of a ring polymer in a ring-linear blend?", *Society of Rheology Annual Meeting*, Salt Lake City, UT, **2007**.
24. Shanbhag, S and Kröger, M, "Primitive path networks generated using annealing and geometrical methods: Insights into differences", *Society of Rheology Annual Meeting*, Salt Lake City, UT, **2007**.
25. Shanbhag, S, "Confining tube potential in polymer melts explored via direct tube sampling using the bond-fluctuation model", *AES-ATEMA*, Montreal, Canada, **2007**.
26. Larson, RG, Zhou, Q, Shanbhag, S, and Park, SJ, "Analysis of long-chain branching in polymers using rheology", *ACS Annual Meeting*, Atlanta, GA, **2006**.
27. Larson, RG, Park, SJ, Shanbhag, S, Heo, Y, and Zhou, Q, "Linear and Nonlinear Rheology of Semi-Dilute Polymer Solutions and Melts", *International Workshop on Mesoscale and Multiscale Description of Complex Fluids*, Prato, Australia, **2006**.
28. Shanbhag, S and Larson, RG, "Identification of topological constraints in entangled polymer melts using the bond-fluctuation model", *Society of Rheology Annual Meeting*, Portland, ME, **2006**.
29. Shanbhag, S, "Introduction to Polymer Rheology", *Chemical and Biomedical Engineering Departmental Seminar*, Tallahassee, FL, **2006**.
30. Shanbhag, S, "Monte Carlo Simulation of Polymer Melts", *Mechanical Engineering Departmental Seminar*, Tallahassee, FL, **2006**.
31. Shanbhag, S, Park, SJ, Zhou, Q, and Larson, RG, "Implications of microscopic simulations of polymer melts for mean-field tube theories", *Foundations of Molecular Modeling*, Blaine, WA, **2006**. (poster)
32. Shanbhag, S and Larson, RG, "Chain retraction potential in a fixed entanglement network", *Society of Rheology Annual Meeting*, Lubbock, TX, **2005**.
33. Shanbhag, S., Park, SJ and Larson, RG, "Tube dilation and reptation in binary blends of monodisperse linear polymers", *Society of Rheology Annual Meeting*, Lubbock, TX, **2005**.

34. Shanbhag, S, "Slithering Polymers and Migrating Cells: Application of Computational Methods to Problems in Polymer Physics and Cell Organization", *AIChE Annual Meeting*, Cincinnati, OH, **2005**. (poster)
35. Shanbhag, S, Lee, J, and Kotov, N, "Modeling cell-matrix Interactions and nutrient transport in cell scaffolds possessing inverted colloidal crystal geometry", *AIChE Annual Meeting*, Cincinnati, OH, **2005**. (poster)
36. Lee, J, Shanbhag, S, and Kotov, N, "Inverted colloidal crystal scaffolds as three-dimensional microenvironments for cellular co-cultures", *AIChE Annual Meeting*, Cincinnati, OH, **2005**. (poster)
37. Shanbhag, S and Larson, RG, "A slip link model for branch point motion in entangled polymers", *Society of Rheology Annual Meeting*, Pittsburgh, PA, **2003**.
38. Shanbhag, S and Larson, RG, "Branch-point motion in asymmetric stars", *International Symposium of Soft Solids*, Nagoya, Japan, **2002**. (poster)
39. Shanbhag, S and Larson, RG, "Rheology of asymmetric star melts using the dual slip link model", *APS Annual Meeting*, Indianapolis, IN, **2002**.
40. Shanbhag, S, Larson, RG, Takimoto, J, and Doi, M, "Deviations from dynamic dilution in the terminal relaxation of star polymers", *Pacific Rim Conference on Rheology*, Vancouver, Canada, **2001**.

COURSES

- Algorithms for Science Applications (ISC 4220), F10, F12
- Symbolic and Numerical Computations (ISC 3222), F11
- Applied Computational Science (ISC 5315), Sp09-10, Sp12
- Molecular Dynamics: Algorithms and Applications (ISC 5225), F09, Sp11
- Chemical Engineering Thermodynamics (ECH 3101), F06-08
- Kinetics and Reactor Design (ECH 4504), Su08
- Applied Computational/Monte Carlo Methods (ECH 5934), Sp07
- Complex Fluids (ChE 629), Sp05 (Co-instructor, Michigan)
- Chemical Process Control (ChE 466), F04 (TA, Michigan)

HONORS AND ACTIVITIES

Mar 2010	National Science Foundation CAREER award
May 2007	Petroleum Research Fund, New Faculty Award
May 2007	FSU CRC, First Year Assistant Professor Award
Mar 2005	Nominated for Rackham Outstanding Doctoral Dissertation Award
2003-2005	President, Detroit chapter of the IIT Bombay Heritage Fund
Jan 2002	Facilitator, Leadership Initiative for Today and Tomorrow, Michigan
1999-2000	Awarded Chemical Engineering Departmental Fellowship
1993-1999	Awarded National Talent Scholarship by NCERT, India

PROFESSIONAL AFFILIATIONS

- Society of Rheology
- American Physical Society

FUNDING

- CAREER: Analytical rheology and the dynamics of polymer melts (PI), **National Science Foundation, (NSF-DMR)**, 08/10- 07/15, \$410,000.
- Simulation and characterization of nanotube-reinforced fabric composites using displaced foam dispersion process - modeling, experimental validation and uncertainty quantification (co-PI), **Department of Energy, Massey Chair (DOE-NNSA)**, 08/09-07/10, \$100,000.
- REU Site in Computational Materials Science: Designing Materials in a Virtual Laboratory (Contractor), **National Science Foundation**, 07/09- 06/12, \$104,197/year.
- Modeling the crystallization of branched polymers, (P.I.), **Petroleum Research Fund, American Chemical Society (PRF-G)**, 08/07-07/10, \$40,000.
- Modeling the crystallization of branched polymers, (P.I.), **Petroleum Research Fund, American Chemical Society (PRF-SUMR)**, 05/08-08/08, \$5,000.
- Dynamics of ring polymers, (P.I.) **Florida State University, CRC Planning Grant (PG)**, 04/07-03/08, \$12,000.
- Modeling the crystallization of branched polymers (P.I.), **Florida State University, CRC Cornerstone (FYAP)**, 05/07-07/07, \$16,000.

THESIS COMMITTEES

Seungyong You	PhD	Physics	2008-2009
Sida Luo	PhD	Ind. and Manufac. Engg.	2009-
Micah McCrary	PhD	Ind. and Manufac. Engg.	2011-
Ben McLaughlin	MS	Dept. Sci. Comput.	2011-
Ysela Chiari	MS	Chem. and Biomed. Engg.	2007
Madhavi Vadlamudli	PhD	Chem. and Biomed. Engg.	2007-2010
Mario-Jean Rejouis	BS Honors	Chem. and Biomed. Engg.	2008
Peng Zhong	MS	Chem. and Biomed. Engg.	2007
Myngsoo Kim	PhD	Ind. and Manufac. Engg.	2008-2009
Xiang Fu	PhD	Ind. and Manufac. Engg.	2008-2010
Hanna Mochona	BS Honors	Chem. and Biomed. Engg.	2009
Lauren Wilson	BS Honors	Chem. and Biomed. Engg.	2009
Pablo Seleson	PhD	Dept. Sci. Comput.	2008-2010
Fernando Rios	MS	Dept. Sci. Comput.	2009-2010

ADVISING

Nathaniel Kohl	MS	Physics	2011-2012
Steve Henke	PhD	Dept. Sci. Comput.	2010-
Joshua Worsch	BS	Chemical Engineering, REU	2010
Danielle Nicholson	BS	Math	2010
Arsia Takeh	PhD	Dept. Sci. Comput.	2009-
Christopher Golding	BS	Chem. and Biomed. Engg.	2009-2010
Rafael Vasquez	BS	Chem. and Biomed. Engg.	2009-2010
Michael Ericson	BS	Chemical Engineering, REU	2009
Gopinath Subramanian	Postdoc	Dept. Sci. Comput.	2007-2008
Daniel Duthiers	BS	Chem. and Biomed. Engg.	2008
Marlon Herrera	BS	Chem. and Biomed. Engg.	2008

REVIEWER SERVICES

- Journal of Chemical Physics
- Macromolecules
- Journal of Rheology
- Langmuir
- Industrial and Engineering Chemistry
- Polymer
- Polymer Science and Engineering
- Rheologica Acta
- ACS Nano
- AES Technical Reviews
- Department of Energy
- Petroleum Research Fund
- Defense Threat Reduction Agency
- National Science Foundation