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PAULA A. VASQUEZ

EDUCATION

2007	University of Delaware	Newark, DE
<i>Ph.D. Applied Mathematics. Thesis Title: "Modeling Wormlike Micellar Solutions"</i>		
2002	Goldey Beacom College	Newark, DE
<i>Masters in Business Administration</i>		
1998	Universidad Nacional de Colombia	Medellin, Colombia
<i>B.S. Petroleum Engineering. Senior Thesis Title: "Packing and Drafting in Gas Pipelines"</i>		

PROFESSIONAL EXPERIENCE

2019–Present	Department of Mathematics University of South Carolina	Columbia, SC
<i>Associate Professor</i>		
2013–2019	Department of Mathematics University of South Carolina	Columbia, SC
<i>Assistant Professor</i>		
2010–2013	Department of Mathematics University of North Carolina	Chapel Hill, NC
<i>Postdoctoral Fellow</i> Research in the computational and theoretical modeling of complex fluids.		
2007–2009	Department of Chemical Engineering University of Delaware	Newark, DE
<i>Postdoctoral Fellow</i> Working on a NASA funded project to study the kinetics of structure formation and low energy suspension structures of field-responsive colloidal suspensions.		
2004–2007	Department of Mathematics University of Delaware	Newark, DE
<i>Research Assistant supported by NSF-DMS #0405931</i> Pursued research interests in asymptotic methods, mathematical modeling and scientific computing. Studied a variety of problems related to complex fluids.		

2002–2004

Department of Mathematics
University of Delaware

Newark, DE

Teaching Assistant and Instructor during summer and winter sections
Teaching assistant for undergraduate courses in Calculus I for business majors, Calculus I, II, III and finite mathematics. Instructor for Calculus I, II and finite mathematics.

PUBLICATIONS

Journals

P.A. Vasquez. "Multiscale Modeling of Complex Fluids." Invited review to *Notices*. In preparation.

C.T. Hann, S.F. Ramage, H. Negi, C. Bequette, P.A. Vasquez and J. Stratmann. "Dephosphorylation of the MAP kinases MPK6 and MPK3 fine-tunes responses to wounding and herbivory in Arabidopsis." Submitted to *Plant Science*, Manuscript Number: PSL-D-23-01089.

M. Cromer and P.A. Vasquez. "Macro-Micro Coupled Simulations of Dilute Viscoelastic Fluids". Accepted to *Applied Sciences*. DOI: 10.20944/preprints202310.0298.v1

P.A. Vasquez, B. Walker, K. Bloom, D. Kolbin, N. Caughman, R. Freeman, M. Lysy, C. Hult, K.A. Newhall, M. Papanikolas, C. Edelmaier, and M.F. Forest. "The power of weak, transient interactions across biology: A paradigm of emergent behavior." *Physica D: Nonlinear Phenomena* 2023, 454, p.133866.

V. Chebotaeva, P.A. Vasquez. "Erlang-Distributed SEIR Epidemic Models with Cross-Diffusion." *Mathematics* 2023, 11, 2167. <https://doi.org/10.3390/math11092167>

A. Medved, R. Davis, and P.A. Vasquez. "Understanding Fluid Dynamics from Langevin and Fokker-Planck Equations." *Fluids* 5.1 (2020): 40.

H. Kim, J. L. Bauer, P.A. Vasquez and E.M. Furst. "Structural coarsening of magnetic ellipsoid particle suspensions driven in toggled fields." *Journal of Physics D: Applied Physics*, 52.18 (2019): 184002.

C. Hult, D. Adalsteinsson, P.A. Vasquez, J. Lawrimore, M. Bennett, A. York, D. Cook, E. Yeh, M.G. Forest, and K. Bloom. "Enrichment of dynamic chromosomal crosslinks drive phase separation of the nucleolus." *Nucleic Acids Research*, 45(19), 11159-11173, 2017.

J. Lawrimore, T.M. Barry, R.M. Barry, A.C. York, B. Friedman, D.M. Cook, K. Akialis, J. Tyler, P.A. Vasquez, E. Yeh, and K. Bloom. "Microtubule dynamics drive enhanced chromatin motion and mobilize telomeres in response to DNA damage." *Molecular Biology of the Cell*, 28(12), 1701-1711, 2017.

P.A. Vasquez, C. Hult, D. Adalsteinsson, J. Lawrimore, M.G. Forest, and K. Bloom. "Entropy gives rise to topologically associating domains." *Nucleic Acids Research*, 44(12), 5540-5549, 2016.

M. Lysy, N.S. Pillai, D.B. Hill, M.G. Forest, J. Mellnik, P.A. Vasquez, and S.A. McKinley. "Model comparison and assessment for single particle tracking in biological fluids." *Journal of the*

American Statistical Association, 111(516), 1413-1426, 2016.

P.A. Vasquez, Y. Jin, E. Palmer, D.B. Hill, and G. Forest, "Modeling and Simulation of Mucus Flow in Human Bronchial Epithelial Cell Cultures – Part I: Idealized Axisymmetric Swirling Flow." *PLOS Comput Biol* 12(8), e1004872, 2016.

J. Mellnik, M. Lysy, P.A. Vasquez, N.S. Pillai, D.B. Hill, J. Cribb, S.A. McKinley, and M.G. Forest. "Maximum likelihood estimation for single particle, passive microrheology data with drift." *Journal of Rheology*, 60(3), 379-392, 2016.

J. G. Lawrimore, P.A. Vasquez, M. Falvo, R. Taylor II, L. Vicci, E. Yeh, M.G. Forest, K. Bloom, "DNA loops generate intracentromere tension in mitosis." *The Journal of Cell Biology*, 210(4), 553-64, 2015.

Y. Zhu, L.H. Abdullah, S.P. Doyle, K. Nguyen, C. Ribeiro, P.A. Vasquez, M.G. Forest, M.I. Lethem, B.F. Dickey, and C.W. Davis, "Baseline Goblet Cell Mucin Secretion in the Airways Exceeds Stimulated Secretion over Extended Time Periods, and is Sensitive to Shear Stress and Intracellular Mucin Stores." *PloS one*, 10(5), e0127267, 2015

P.A. Vasquez, K. Bloom, "Polymer models of interphase chromosomes." *Nucleus*, 5(5), 0-1, 2014.

J.W. Swan, P.A. Vasquez, and E. M. Furst, "Buckling instability of self-assembled colloidal columns." *Physical Review Letters*, 113(13), 138301, 2014

J. Mellnik, P.A. Vasquez, S.A. McKinley, J. Witten, D.B. Hill, and M.G. Forest, "Micro-heterogeneity metrics for diffusion in soft matter." *Soft matter*, 10(39), 7781-7796, 2014

D.B. Hill, P.A. Vasquez, J. Mellnik, S.A. McKinley, A. Vose, F. Mu, A.G. Henderson, S.H. Donaldson, N.E. Alexis, R.C. Boucher and M.G. Forest, "A Biophysical Basis for Mucus Solids Concentration as a Candidate Biomarker for Airways Disease." *PloS one*, 9(2), e8768, 2014.

J.A. Cribb*, P.A. Vasquez*, P. Moore, S. Norris, S. Shah, M.G. Forest, and R. Superfine, "Nonlinear Signatures of Entangled Polymer Solutions in Active Microbead Rheology." *Journal of Rheology*, 57(4), 1247-1264, 2013.

P.A. Vasquez, Y. Jin, K. Vuong, D.B. Hill and M.G. Forest, "A New Twist on Stokes' Second Problem: Partial Penetration of Nonlinearity in Sheared Viscoelastic Layers." *Journal of Non-Newtonian Fluid Mechanics*, 196, 36-50, 2013.

A.D. Stephens, R.A. Haggerty, P.A. Vasquez, L. Vicci, C.E. Snider, F. Shi, C. Quammen, C. Mullins, J. Haase, R.M. Taylor II, J.S. Verdaasdonk, M.R. Falvo, Y. Jin, M.G. Forest, K. Bloom, "Pericentric chromatin loops function as a nonlinear spring in mitotic force balance." *The Journal of Cell Biology*, 193(7), 1167-1180, 2013.

J.S. Verdaasdonk, P.A. Vasquez, R.M. Barry, T. Barry, S. Goodwin, M.G. Forest, K. Bloom, "Centromere tethering confines chromosome domains." *Molecular Cell*, 52(6), 819-831, 2013

A.D. Stephens, C.E. Snider, J. Haase, R.A. Haggerty, P.A. Vasquez, M.G. Forest, K. Bloom, "Individual pericentromeres display coordinated motion and stretching in the yeast spindle." *The Journal of Cell Biology*, 203(3), 407-416, 2013.

J.W. Swan, P.A. Vasquez, P.A. Whitson, E.M. Fincke, K. Wakata, S.H. Magnus, F.D. Winne, M.R. Barratt, .H. Agui J, R.D. Green, N.R. Hall, D.Y. Bohman, C.T. Bunnell, A.P. Gast, E.M. Furst, "Multi-scale kinetics of a field-directed colloidal phase transition." *Proceedings of the National Academy of Sciences*, 109, 16023-16028, 2012.

C.J. Pipe, N.J. Kim, P.A. Vasquez, L.P. Cook, and G.H. McKinley, "Wormlike Micellar Solutions II: Comparison Between Experimental Data and Scission Model Predictions." *Journal of Rheology*, 54(4), 881-913, 2010.

M.W. Liberatore, F. Nettesheim, P.A. Vasquez, M.E. Helgeson, N.J. Wagner, E.W. Kaler, L.P. Cook, L. Porcar, and Y.T. Hu, "Microstructure and Shear Rheology of Entangled Wormlike Micelles in Solution." *Journal of Rheology* 53(2), 441-458, 2009.

M.E. Helgeson, P.A. Vasquez, E.W. Kaler and N.J. Wagner, "Constitutive modeling and spatially-resolved structure of cetyltrimethylammonium bromide wormlike micelles through the shear banding transition." *Journal of Rheology*, 53(3), 727-756, 2009.

L. Zhou, P.A. Vasquez, G.H. McKinley and L.P. Cook, "Modeling the Inhomogeneous Response and Formation of Shear Bands in Steady and Transient Flows of Entangled Liquids." *Journal of Rheology*, 52(2), 591- 623, 2008.

P.A. Vasquez, L.P. Cook, and G.H. McKinley, "Wormlike Micellar Solutions: A Scission Model and Predictions." *Journal of Non-Newtonian Fluid Mechanics*, 144(2-3), 122-139, 2007.

Proceedings (Non-refereed)

M.G. Forest, P.A. Vasquez, "Mathematical and numerical challenges in living biological materials." *AIP Conference Proceedings*, 1558, 2013

E.M. Furst, P.A. Vasquez, J. Agui, J. Williams, D. Petit, and E. Lu, "Field-Responsive Colloidal Suspensions in Microgravity." *Proceedings of the 46th AIAA Aerospace Sciences Meeting*, AIAA, 955, 2009

P.A. Vasquez, E.M. Furst, J. Agui, J. Williams, D. Petit, and E. Lu, "Structural Transitions of MR fluids in Microgravity." *Proceedings of AIAA Aerospace Sciences Meeting and Exhibit*, 2008

P.A. Vasquez, J.A. Pelesko, "A Variational Approach to Microneedle Design," *Proceedings of ICMENS*, pp. 283, 2005

H. Boateng, V. Elander, C. Jin, Y. Li, P.A. Vasquez, P. Fast, "Numerical Algorithms for Two Dimensional Dry Granular Flow with Deformable Elastic Grains." *Proceedings of IMA Mathematics in Industry Workshop IX*, 2005.

Book chapters

Complex Fluids and Soft Structures in the Human Body, P. Vasquez, M.G. Forest, Invited Chapter for Complex Fluids in Biological Systems: Experiment, Theory, and Computation, Springer Series on Biological and Medical Physics, Biomedical Engineering, Saverio Spagnolie, Editor (2015)

EXTERNAL GRANTS AND AWARDS

National Science Foundation (DMS-1751339). *"CAREER: Multi-Scale Modeling of Biological Gels by Coupling Langevin Equations and Fractional Viscoelastic Constitutive Models."* Funding amount \$288,106. PI. Funding period 07/01/18 – 06/30/23.

NASA (17-17PSI_D-0017). *"Investigating the role of pre-shear and pre-stretching in the transient extensional flow of dilute polymer solutions: Modeling benchmarking and numerical simulations."* Co-PI. Funding amount \$23,744. Funding period 10/01/18 – 09/30/19.

National Science Foundation (DMS-1410047). *"Collaborative Research: A Molecular-to-Continuum, Data-Driven Strategy for Mucus Transport Modeling."* PI. Funding amount \$292,066. Funding period 09/15/14 – 08/31/18.

PATENTS

"Methods, Systems, And Computer Readable Media For Data Analysis And Inference Of Particle Diffusion In Target Materials And Target Material Simulants." (WO/2014/116827).

INTERNAL GRANTS AND AWARDS

SC Research Foundation (ASPIRE-I). *"Mathematical Modeling of Plant Responses to Multiple Stress Signals."* Funding amount \$15,000 Funding period 05/15/14 - 09/15/16

SPARC Graduate Research Grant (PI) 2017, 2021.

Magellan Scholar Grant (PI) 2016(2), 2017.

SURF 2021(2), 2023.

RECENT SCIENTIFIC ACTIVITIES (Since 2009)

Presentations

"Coupling macro-micro simulations in complex fluids." 10th International Congress on Industrial and Applied Mathematics. Waseda University, Tokyo, Japan. August 20-25, 2023

"Principles of Organization in the Yeast Genome." The AIMS Conference on Dynamical Systems, Differential Equations and Applications. UNC-Wilmington, May 31-June 4, 2023

"Macro-micro simulations in complex biological fluids using GPU Computing." The AIMS Conference on Dynamical Systems, Differential Equations and Applications. UNC-Wilmington, May 31- June 4, 2023

“Micro-macro coupling of fluid dynamics in complex fluids.” SIAM Southeastern Atlantic Section Conference. (September 19, 2021)

“Modeling Viscoelastic Materials with Applications in Biology.” AWM Guest Speaker. Washington University at St. Louis, St. Louis, MO (October 19, 2018)

“Gel-Gel Transition of Interphase Chromosomes.” SIAM Conference on Mathematical Aspects of Materials Science. Portland, OR (July 9-13, 2018)

“Modeling phase separation in the nucleus,” and “Mathematical modeling of pituitary organogenesis.” 42nd SIAM Southern Atlantic, Sectional Conference. Chapel Hill, NC (March 9-11, 2018)

“Viscoelastic Modeling of Biological Materials.” Research Colloquium, Kimberly-Clark Corporation. Neenah, WI (October 13, 2017)

“Dynamical modeling of the yeast genome.” Mathematical Congress of the Americas. Montreal, Canada (July 26, 2017)

“Dynamical modeling of phase separation in the yeast nucleus.” Modeling Complex Fluids and Gels for Biological Applications. University of Utah, Salt Lake, UT (May 4-6, 2017)

“Modeling the Dynamics of the Yeast Genome.” University of Delaware, Winter Research Symposium, Newark, DE (February 10, 2017)

“Mathematical Modeling of Viscoelastic Materials.” Carolina Math Seminar, Columbia, SC, (November 4, 2016).

“Role of Entropy in the Organization Yeast Genome.” Workshop on DNA Reactions & DNA/Chromosome Dynamics . Woods Hole, MA, (September 12, 2016)

“Polymeric Aspects of DNA Repair.” SIAM Mathematical Aspects of Material Sciences, Philadelphia, PA, (May 2016)

“Polymer models of interphase chromosomes.” The 8th The International Congress on Industrial and Applied Mathematics (ICIAM), Beijing China (August 2015)

“Constitutive Modeling of Human Lung Mucus.” Annual Meeting for The Society for Mathematical Biology, Atlanta, GA, (July 2, 2015)

“Mathematical Models of Chromosomal DNA in Yeast Cells.” Colloquium University of Texas at Dallas (November 20, 2014) and MRS Fall meeting, Boston, MA (December 2, 2014)

“Microheterogeneity Metric for diffusion in Soft Matter.” 86th Annual Meeting. The Society of Rheology. Philadelphia, PA. (October 6, 2014) and SACNAS. Los Angeles, CA. (October 18, 2014).

“Applications of mathematical modeling in biology: Modeling the human lung barrier and chromosomal DNA.” Invited talk to Tulane University (October 1, 2013) and University of California at Merced (October 4, 2013)

“Modeling nuclear chromatin in yeast cells” Presentation at The SIAM Conference on Mathematical Aspects of Materials Science, June 9-12, 2013 - Philadelphia, Pennsylvania (Invited)

“Transport properties of human lung mucus” Presentation at The Society of Rheology 84th Annual Meeting, February 10-14, 2013 - Pasadena, California

“Mathematical modeling of the mucus barrier in human lungs” Lecture in the Natural Science seminar. New College of Florida, Sarasota FL September 28, 2012. (Invited)

“Non-linear signatures of entangled polymer solutions in active microbead rheology.” Presentation at the AMS 2011 Fall Western Section Meeting, University of Utah, Salt Lake City, UT October 22-23, 2011. (Invited)

“Mathematical Analysis of a "Strain Controlled - Strain Measured" Method for Active Microrheology.” Presentation at the ICIAM 2011 -- 7th International Congress on Industrial and Applied Mathematics, July 18 - 22, 2011, Vancouver, BC, Canada (Invited)

“Continuum-microscopic Computation of Long-chain Rouse Linear Entangled Polymers.” Presentation at the ICIAM 2011 -- 7th International Congress on Industrial and Applied Mathematics, July 18 - 22, 2011, Vancouver, BC, Canada (Invited)

Time Parallel Continuum-Kinetic-Molecular (tP-CKM) Algorithm. Molecular Models of Polymer Systems. Presentation at the Cha-Cha Days 2010, September 24 - 26, 2010, College of Charleston, Charleston, SC (Invited)

Posters

“Experimental and modeling protocols for a micro-parallel plate rheometer” Poster at The Society of Rheology 82nd Annual Meeting, October 24 - 28, 2010 . Santa Fe, New Mexico

Workshops

“Mathematical and Computational Challenges in Cilia- and Flagella-Induced Fluid Dynamics” Workshop participant, Mathematical Biosciences Institute, Columbus OH, October 15-18, 2012.

“Complex Fluids in Industry & Nature” Workshop participant, UBC, Vancouver, July 13-16, 2011.

“Careers in Academia Workshop” American Institute of Mathematics, Palo Alto, California, June 20-23, 2011.

The sixth annual Carolina Workshop on Force Measurement and Manipulation in Biological Microscopy, workshop participant, May 18-21, 2010, University of North Carolina, Chapel Hill, NC.

“Flowing Complex Fluids: Fluid Mechanics-Interaction of Microstructure and Flow.”
participant at workshop, Institute for Mathematics and its Applications, Minneapolis-
Minnesota, October 2009”.

“Flowing Complex Fluids: Rheological Measurements and Constitutive Modeling.”
participant at workshop, Institute for Mathematics and its Applications, Minneapolis-
Minnesota, September 2009.

PROFESSIONAL ACTIVITIES

Calculus reform - Calculus II Coordinator 2019

Faculty Senate representative, University of South Carolina. 2014 - 2017, 2019-2022

Member of the Intellectual Property Committee of Faculty Senate at the University of South Carolina. 2014 - 2017

Reviewer for Journal of Non-Newtonian Fluids Mechanics, SIAM Journal of Applied Mathematics, Journal of Rheology, Fluids, Mathematical Methods in the Applied Sciences, Fluids, Journal of Micromechanics and Microengineering, The Arabian Journal for Science and Engineering, Computer Methods in Biomechanics, Computers in Biology and Medicine, Journal of Engineering Mathematics, Mathematical Methods in the Applied Sciences, Meccanica, and Plos One.

Graduate Student representative to the Graduate Studies Committee of the University of Delaware Faculty Senate. (2005-2007)

Treasurer/Co-founder SIAM Student Chapter, University of Delaware. (2006-2007)

HONORS AND AWARDS

Women in Science and Engineering (WISE) Fellowship, 2005

Travel award to the Student Chapters Meeting with SIAM leadership, Boston-Massachusetts, July 2006.

Graduate Student Travel Award from Graduate Studies Office University of Delaware, October 2006.

Graduate Student Travel Award from Society of Rheology to the 78th Society Meeting, October 2006.

AWM Travel Award to the AWM Workshop Poster Session at the joint Mathematics Meetings, New Orleans, Louisiana, January 2007.

SIAM Travel Award, ICIAM 2011