

**CURRICULUM VITAE of M. Gregory Forest**  
**January 14, 2017**

**Present Positions:**

Grant Dahlstrom Distinguished Professor of Mathematics  
Joint Appointments: Biomedical Engineering, Applied Physical Sciences  
Director, Carolina Center for Interdisciplinary Applied Mathematics  
The University of North Carolina at Chapel Hill (UNC-CH)

Mailing Address: CB 3250, UNC Chapel Hill, Chapel Hill, NC 27599-3250

Email: [forest@unc.edu](mailto:forest@unc.edu)

Webpage: <http://forest.web.unc.edu>

**Major Fields:**

Mathematics of Complex Fluids; Diffusive & Hydrodynamic Transport Phenomena in Passive and Active Soft Matter; Lung Biology; Virology & Immunology; Cell Biology; Nano-Composite Flows and Material Property Characterization

**Educational History:**

B.S., Mathematics, University of New Orleans, May 1972

M.S., Mathematics, University of New Orleans, December 1973

Ph.D., Mathematics, University of Arizona, August 1979

Ph.D. Adviser: David W. McLaughlin

**Tenure-Track Faculty Positions:**

University of North Carolina at Chapel Hill, 1996-present

Ohio State University, 1979-1996

**Visiting Academic Positions:**

Department of Mathematics, University of California-Berkeley: March-May, 1983

Center for Nonlinear Studies, Los Alamos National Laboratory: January 1985;  
January-March 1986, 1989 & 1990; January-May 1987; February 1991-1993

Department of Mathematics, Princeton University: September-December 1986

Mathematical Sciences Research Institute, Berkeley: January '91, March '93 & '94

Program in Applied Mathematics, University of Colorado-Boulder: August 1990

Department of Mathematics, University of Utah: January-June 1995

Institute for Mathematics & Its Applications, Univ. of Minnesota: Sept-Nov 2009

### **Administrative Positions Held (at UNC-CH):**

Associate Chair of Applied Mathematics: 1996-1998, 2000-2004  
Senior Associate Dean for the Sciences, College of Arts and Sciences: 1998-2000  
Co-Director, Institute for Advanced Materials, 2002-2013  
Director, Carolina Center for Interdisciplinary Applied Mathematics, 2012-present  
Associate Chair, Department of Applied Physical Sciences, 2016-present

### **Scholarly Recognition:**

Fellow of the Society for Industrial and Applied Mathematics, 2012

### **Consulting Experience:**

Los Alamos National Laboratory; Hoechst-Celanese Corporation, Charlotte, NC;  
Corning, Inc., Corning, NY; Liquidia Technologies, Durham, NC

**Startup Companies:** Path BioAnalytics (Scientific Founder, no longer associated);  
Carolina Modeling & Simulation LLC (Founder); Artificial Intelligence Tracking  
Solutions (AITS) LLC (Co-Founder with Jay Newby & Sam Lai)

### **Publications**

1. Multiphase averaging and the inverse spectral solution of the KdV equation (with H. Flaschka and D.W. McLaughlin), *Comm. Pure Appl. Math.*, Vol. 33, 739-784 (1980)
2. Spectral theory for the periodic sine-Gordon equation: a concrete viewpoint (with D.W. McLaughlin), *J. Math. Phys.*, Vol. 23(7), 1248-1277 (1982)
3. Modulations of sinh-Gordon and sine-Gordon wavetrains (with D.W. McLaughlin), *Studies in Appl. Mathematics*, Vol. 68, 11-59 (1983)
4. On the modulational stability of two-phase sine-Gordon wavetrains (with N. Ercolani and D.W. McLaughlin), *Studies in Applied Math.*, Vol. 71(2), 91-101 (1985)
5. Modulations of perturbed sine-Gordon wavetrains (with D.W. McLaughlin), *SIAM J. Applied Math.*, Vol. 44(2), 287-300 (1984)
6. The geometry of real sine-Gordon wavetrains (with N. Ercolani), *Comm. Math. Physics*, Vol. 99, 1-49 (1985)
7. Modulational instabilities of periodic sine-Gordon waves: a geometric analysis (with N. Ercolani and D.W. McLaughlin), *Lectures in Appl. Math.*, Vol. 23, 149-166 (1985)
8. Oscillations and instabilities in near integrable pde's (with N. Ercolani and D.W. McLaughlin), *Lectures in Applied Mathematics*, Vol. 23, 3-46 (1985)
9. The origin and saturation of modulational instabilities (with N. Ercolani and D. W. McLaughlin), *Physica D*, Vol. 18, 472-474 (1986)
10. Geometry and modulation theory for the periodic nonlinear Schrödinger equation (with J. E. Lee), *IMA Volumes in Mathematics and Its Applications*, Vol. 2, 35-70, Springer-Verlag (1986)
11. A one-dimensional theory for viscoelastic fluid jets, with application to extrudate swell and draw-down under gravity (with S. Bechtel and D. Bogy), *Journal of Non-Newtonian Fluid Mechanics*, Vol. 21, 273-308 (1986)

12. A quasi-periodic route to chaos in a near-integrable PDE (with A. Bishop, D. W. McLaughlin and E. Overman), *Physica D*, Vol. 23, 293-328 (1986)
13. Hamiltonian structure for the modulation equations of a sine-Gordon wavetrain (with N. Ercolani, D.W. McLaughlin, and R. Montgomery), *Duke Mathematical Journal* Vol. 55(4), 949-983 (1987)
14. Effective stress rates of viscoelastic free jets (with S. Bechtel and K. Lin), *J. Non-Newtonian Fluid Mechanics*, Vol. 26, 1-41 (1987)
15. On the behavior of viscoelastic free jets with elliptical cross-section (with S. Bechtel and K. Lin), *J. Non-Newtonian Fluid Mechanics*, Vol. 27, 87-126 (1988)
16. Correlations between chaos in the perturbed sine-Gordon equation and finite modal equations, *Proceedings of Fourth Inter. Conf. on Nonlinear Evol. Eq. and Dyn. Syst.*, Montpellier, France, June 1987, edited by J. Leon, World Scientific (1988) An extended abstract in *Proceedings Cornell MSI Workshop*, May (1987)
17. Geometry of the modulational instability III. Homoclinic orbits (with N. Ercolani and D.W. McLaughlin), *Physica D*, Vol. 43, 349-384 (1990)
18. 1-D closure models for 3-D incompressible viscoelastic free jets: von Kármán flow geometry and elliptical cross-section (with S. Bechtel, D. Holm, and K. Lin), *J. Fluid Mechanics*, Vol. 196, 241-262 (1988)
19. A quasiperiodic route to chaos in a near-integrable p.d.e.: homoclinic crossings (with A.R. Bishop, D.W. McLaughlin, and E.A. Overman), *Physics Letters A*, Vol. 127, 335-340 (1988)
20. Geometry of the modulational instability, Part I: Local analysis (with N. Ercolani and D.W. McLaughlin), *Memoirs of the A.M.S.*, unpublished.
21. Geometry of the modulational instability, Part II: Global analysis (with N. Ercolani and D.W. McLaughlin), *Memoirs of the A.M.S.*, unpublished.
22. Modal representations of chaotic attractors for the driven, damped pendulum chain (with A.R. Bishop, D.W. McLaughlin, and E.A. Overman), *Phys. Lett. A* Vol. 144, 17-25 (1990)
23. Numerical evidence for global bifurcations leading to switching phenomena in long Josephson junctions (with S. Pagano, R. Parmentier, et.al.), *Journal of Wave Motion*, Vol. 22, 213-226 (1990)
24. Correlations between chaos in a perturbed sine-Gordon equation and a truncated model system, (with A.R. Bishop, R. Flesch, D.W. McLaughlin, and E.A. Overman), *SIAM Journal of Math. Analysis*, Vol. 21(6), 1-26 (1990)
25. Change-of-type behavior in viscoelastic slender jet models (with Q. Wang), *Theoretical and Computational Fluid Dynamics*, Vol. 2, 1-25 (1990)
26. Numerical inverse spectral transform for the periodic sine-Gordon equation: theta function solutions and their linearized stability, (with R. Flesch and A. Sinha), *Physica D*, Vol. 48, 169-231 (1991)
27. Modeling fiber-spinning processes with a comprehensive perturbation theory, (with S. E. Bechtel and J. Cao), *FED - Vol. 124*, refereed proceedings of symposium on Recent Developments in Non-Newtonian Flows and Industrial Applications, ASME Press (1991)
28. Frequency and phase locking of spatially periodic perturbed sine-Gordon breather trains, (with S. P. Sheu and A. Sinha), *SIAM J. Applied Mathematics*, Vol. 52(3), 746-761 (1992)
29. Enhancement of optical bistability by periodic layering, (with R. Camassa and R. Knapp), *Nonlinearity*, Vol. 5, 721-742 (1992)

30. Practical applications of a higher order perturbation theory for slender viscoelastic jets and fibers, (with S. Bechtel and J. Cao), *Journal of Non-Newtonian Fluid Mechanics (JNNFM)*, Vol. 41, 201-273 (1992)
31. Closure to all orders in 1-D models for slender viscoelastic free jets: An integrated theory for axisymmetric torsionless flows, (with S. Bechtel and K. Lin), *Journal of Stability and Applied Analysis of Continuous Media*, Vol. 2, 1-43 (1992)
32. Instability-driven energy transport in nearly integrable, many degree-of-freedom Hamiltonian systems, (with C. Goedde and A. Sinha), *Physical Review Letters* Vol. 68(18), 2722-2725 (1992)
33. Non-isothermal modeling of fiber spinning, (with S. Bechtel and Q. Wang), refereed proceedings of Symposium on Recent Advances in Non-Newtonian Fluid Flows, 1992 Winter Annual Meeting, ASME, edited by D.A. Siginer, Vol. 153, 37-48, ASME Press, New York (1992)
34. Illustration of an optimization procedure for fiber-spinning operating conditions: Maximum draw ratio under a Maxwell thin-filament model, (with S. Bechtel, J. Cao), *Journal of Rheology*, Vol. 37 (2), 237-287 (1993)
35. Fully nonlinear modal equations for nearly integrable partial differential equations, (with N. Ercolani, D. McLaughlin and A. Sinha), *Journal of Nonlinear Science*, Vol. 3, 393-426 (1993)
36. Chaotic transport and integrable instabilities in a nearly integrable, Hamiltonian, discrete sine-Gordon lattice, (with C. Goedde and A. Sinha), *Physica D*, Vol. 67, 347-386 (1993)
37. Dynamics of slender viscoelastic free jets, (with Q. Wang), *SIAM J. Appl. Math.* Vol. 54(4), 996-1032 (1994)
38. A numerical study of nearly integrable modulation equations, (with A. Sinha), *Singular Limits of Dispersive Wave Equations*, edited by N. Ercolani, I. Gabbitov, D. Levermore and D. Serre, Plenum Publishing (1994)
39. Computation and stability of fluxons in a singularly perturbed sine-Gordon model of the Josephson junction, (with D. Brown, B. Miller and N. A. Petersson), *SIAM J. Appl. Math.*, Vol. 54(4), 1048-1066 (1994)
40. Numerical simulations of non-isothermal fiber spinning processes, (with Qi Wang), *Recent Advances in Non-Newtonian Flows*, ASME Press, New York, refereed proceedings of ASME Summer Meeting, Lake Tahoe, June, 1994, edited by G. Vradis and D.A. Siginer (1994)
41. 1-D models for thin filaments of polymeric liquid crystals, (with Q. Wang and S.E. Bechtel), *Developments in Non-Newtonian Flows*, ASME Press, New York, refereed proceedings of ASME International Congress and Exposition, Chicago, IL, November, 1994, edited by S.E. Bechtel and D. Siginer (1994)
42. Modeling failure in polymeric liquid filaments, with Q. Wang and S.E. Bechtel, *Developments in Non-Newtonian Flows*, ASME Press, New York, refereed proceedings of ASME International Congress and Exposition, Chicago, IL, November, 1994, edited by S.E. Bechtel and D. Siginer (1994)
43. Symmetry-breaking instabilities and chaotic transport in Hamiltonian sine-Gordon discrete lattices, (with C. Goedde and A. Sinha), *Mathematics and Computers in Simulation*, Vol. 37, 323-339 (1994)
44. Torsional effects in high-order viscoelastic thin-filament models, (with S. Bechtel, K. Bolinger and J. Cao), *SIAM J. Appl. Math.*, Vol. 55(1), 58-99 (1995)

45. A new model to determine dynamic surface tension and elongational viscosity using oscillating jet measurements, (with S.E. Bechtel, J.A. Cooper, N.A. Petersson, D.L. Reichard, A. Saleh, V. Venkataraman), *Journal of Fluid Mechanics*, Vol. 293, 379-403 (1995)
46. Recovery of the Rayleigh capillary instability from slender 1-D inviscid and viscous models, (with S.E. Bechtel and C.D. Carlson), *Physics of Fluids*, Vol. 7(12), 2956-2971 (1995)
47. Modeling and computation of the onset of failure in polymeric liquid filaments, (with S.E. Bechtel and Q. Wang), *JNNFM*, Vol. 58, 97-129 (1995)
48. Thermomechanical equations governing a material with prescribed temperature-dependent density, with application to non-isothermal plane Poiseuille flow, (with D. Cao and S.E. Bechtel), *J. Applied Mechanics* Vol. 63(4), 1011-1018 (1996)
49. 1-D models for thin filaments of liquid crystalline polymers: coupling of orientation and flow in the stability of simple solutions, (with Q. Wang and S.E. Bechtel), *Physica D* Vol. 99(4), 527-554 (1997)
50. Exploiting accurate spinline measurements for elongational material characterization, (with V. Ramanan, V. Gauri, K. Koelling, S. Bechtel), *J. Rheology*, Vol. 41(2), 1-24 (1997)
51. One-dimensional isothermal spinning models for liquid crystalline polymer fibers, (with Q. Wang, S. Bechtel), *J. Rheology*, Vol. 41(4), 821-850 (1997)
52. Onset of oscillations in nonsoliton pulses in nonlinear dispersive fibers, (with Kenneth T-R McLaughlin), *J. Nonlinear Science*, Vol. 7, 43-62 (1998)
53. The effect of dynamic surface tension on the oscillation of slender elliptical Newtonian jets, (with S. E. Bechtel, N. Youssef, H. Zhou), *J. Applied Mechanics*, Vol. 65(3), 694-704 (1998)
54. Viscoelastic free surface jets and filaments, (with S. E. Bechtel and J. Cao), invited contribution for Proceedings for the Symposium on Rheology and Fluid Mechanics of Nonlinear Materials, ASME International Mechanical Engineering Congress and Exposition, Dallas, TX (1998)
55. A thin-filament melt spinning model with radial resolution of temperature and stress, (with G. Henson, D. Cao, and S. Bechtel), *J. Rheology* (2), 329-360 (1998)
56. The role of microstructure in taming the Rayleigh instability of cylindrical jets, (with Q. Wang), *Physica D*, Vol. 123, 161-182 (1998)
57. Anisotropic microstructure-induced reduction of the Rayleigh instability for liquid crystalline polymers, (with Q. Wang), *Physics Lett. A*, Vol. 245, 518-526 (1998)
58. Free surface viscoelastic and liquid crystalline polymer fibers and jets, (with S. E. Bechtel, Q. Wang, H. Zhou), invited book chapter in **Advances in Non-Newtonian Flows and Rheology**, Part B, 1069-1116, edited by D. Siginer, D. De Kee, R. Chhabra, Elsevier Science Publishers (1998)
59. Dynamics of free surface and pure elongational flows of liquid crystalline polymers, (with Q. Wang and H. Zhou), **Rheology and Fluid Mechanics of Nonlinear Materials**, edited by D. Siginer and D. DeKee, FED-Vol. 246, MD-Vol. 81, ASME, New York, 101-114 (1998)
60. An isothermal model for high-speed spinning of liquid crystalline polymer fibers-Coupling of flow, orientation, and crystallization, (with T. Ueda), *JNNFM*, Vol. 84, 109-121 (1999)

61. Near-equilibrium dynamics of Doi models for liquid crystal polymer flows: catastrophic and regularized behavior, (with Q. Wang), *JNNFM*, Vol. 83, 131-150 (1999)
62. An anelastic, scale-separated model for mixing, with application to atmospheric transport phenomena, (with R. McLaughlin), *Phy. Fluids*, Vol. 11(4), 1-13 (1999)
63. On the exact solution of the geometric optics approximation of the defocusing nonlinear Schrodinger equation, (with O. Wright and K. T-R McLaughlin), *Physics Letters A*, Vol. 257, 170-174 (1999)
64. A model study of the spinning of thermotropic liquid crystalline polymers: Fiber performance predictions and bounds on throughput, (with Q. Wang and H. Zhou), *Advances in Polymer Technology*, Vol. 18(4), 314-335 (1999)
65. Non-soliton pulse evolution in normally dispersive optical fibers, (with N. Kutz and K. T-R McLaughlin), *J. Optical Society of America B*, Vol. 16(11), 1856-1862 (1999)
66. Nonhomogeneous patterns with core defects in elongational flows of liquid crystal polymers, (with Q. Wang and H. Zhou), *J. Rheol.*, Vol. 43(6), 1573-1582 (1999)
67. Thermotropic liquid crystalline polymer fibers, (with H. Zhou and Q. Wang), *SIAM J. Appl. Math.*, Vol. 60(4), 1177-1204 (2000)
68. Non-focusing instabilities in coupled, integrable nonlinear Schrodinger PDEs, (with O. Wright, D.W. McLaughlin, and D. Muraki), *J. Nonlinear Science*, Vol. 10, 291-331 (2000)
69. Exact banded patterns from a Doi-Marrucci-Greco model of nematic liquid crystal polymers, (with Q. Wang and H. Zhou), *Physical Review E*, Vol. 61(6), 6665-6672 (2000)
70. Homogeneous pattern selection and director instabilities of nematic liquid crystal polymers induced by elongational flows, (with Q. Wang and H. Zhou), *Physics of Fluids*, Vol. 12(3), 490-498 (2000)
71. On the construction of orbits homoclinic to plane waves in integrable coupled nonlinear Schrodinger systems, (with S. Sheu and O. Wright), *Physics Letters A*, Vol. 266, 24-33 (2000)
72. On the Backlund-Gauge transformation and homoclinic orbits of a coupled nonlinear Schrodinger system, (with O. Wright), *Physica D: Nonlinear Phenomena*, Vol. 141, 104-116 (2000)
73. Some Riemann-Green functions for the geometric optics approximation of the defocusing nonlinear Schrodinger equation, (with O. Wright and K. T-R McLaughlin), refereed proceedings of the 16th IMACS World Congress (2000)
74. Methods for the exact construction of mesoscale patterns in rod-like nematic liquid crystal polymers, (with Q. Wang and H. Zhou), *Physica D-Nonlinear Phenomena*, Vol. 152, 288-309 (2001)
75. A model for a spreading and melting droplet on a heated substrate, (with D. M. Anderson and R. Superfine), *SIAM J. Appl. Math.*, Vol. 61(5), 1502-1525 (2001)
76. On the flow-phase diagram for discotic liquid crystals in uniaxial extension and compression, (with Q. Wang and H. Zhou), *Liquid Crystals*, Vol. 28(5), 717-720 (2001)
77. Non-Newtonian viscous oscillating free surface jets, and a new strain-rate dependent viscosity form for flows experiencing low strain rates, (with S. Bechtel, K. Koelling, N. Youseff, and H. Zhou), *Rheol. Acta*, Vol. 40, 373-383 (2001)

78. Transient behavior of thermal optical glass fiber drawing processes, (with H. Zhou), *European J. Appl. Math.*, Vol. 12(4), 479-496 (2001)
79. Symmetries of the Doi kinetic theory for nematic polymers of arbitrary aspect ratio: at rest and in linear flows, (with Q. Wang and R. Zhou), *Physical Review E*, Vol. 66, 031712 (2002)
80. Explicit flow-aligned orientational distribution functions for dilute nematic polymers in weak shear, (with Q. Wang and R. Zhou), refereed proceedings of ASME International Mechanical Engineering Congress, N.O., La., IMECE2002-32185 (2002)
81. Full-tensor alignment criteria for sheared nematic polymers (with R. Zhou, Q. Wang), *J. Rheology*, Vol. 47(1), 105-128 (2003)
82. Monodomain response of finite-aspect-ratio macromolecules in shear and related linear flows, (with Q. Wang), *Rheologica Acta*, Vol. 42, 20-46 (2003)
83. An integrable model for stable:unstable wave coupling phenomena, (with O. Wright), *Physica D*, Vol. 178, 173-189 (2003)
84. Computational observation of a weakly compressible mixing barrier in idealized anelastic fluid equations, (with R. McLaughlin and H. Zhou), *Physics of Fluids*, Vol. 15(10), 2872-2885 (2003)
85. Thermal expansion models of viscous fluids based on limits of free energy, (with S. Bechtel, F. Rooney, Q. Wang), *Phys. Fluids*, Vol. 15(9), 2681-2693 (2003)
86. The weak shear kinetic phase diagram for nematic polymers, (with Q. Wang, R. Zhou), *Rheologica Acta*, Vol. 43(1), 17-37 (2004)
87. Internal constraint theories for thermal expansion of viscous fluids, (with S.E. Bechtel, F.J. Rooney), *Int. J. Engineering Science*, Vol. 42, 43-64 (2004)
88. Structure scaling properties of confined nematic polymers in plane Couette cells: the weak flow limit, (with Q. Wang, H. Zhou, R. Zhou), *J. Rheology*, Vol. 48(1), 175-192, January/February (2004)
89. Scaling behavior of kinetic orientational distributions for dilute nematic polymers in weak shear, (with Q. Wang, R. Zhou), *JNNFM* Vol. 116(2-3), 183-204 (2004)
90. A kinetic theory for solutions of nonhomogeneous nematic liquid crystalline polymers with density variations, (with Q. Wang, R. Zhou), *Journal of Fluids Engineering*, Vol. 126, 180-188 (2004)
91. Monodomain response of arbitrary aspect ratio nematic polymers in general linear planar flows, (with Q. Wang, R. Zhou, E. Choate), *JNNFM*, Vol. 118(1), 17-31 (2004)
92. Kinetic theories and mesoscopic models for solutions of nonhomogeneous liquid crystal polymers, (with C. Calderer, Q. Wang), *JNNFM*, Vol. 120(1), 69-78 (2004)
93. Likelihood & expected-time statistics of monodomain attractors in sheared discotic and rod-like nematic polymers, (with X. Zheng, R. Zhou, Q. Wang), *Rheol. Acta*, Vol. 43(1), 17-37 (2004)
94. The flow-phase diagram of Doi theory for sheared nematic polymers, II: finite shear rates, (with R. Zhou, Q. Wang), *Rheol. Acta*, Vol. 44(1), 80-93 (2004)
95. Chaotic boundaries of nematic polymers in mixed shear and extensional flows, (with R. Zhou, Q. Wang), *Physical Review Letters*, Vol. 93(8), 088301, (2004)
96. Exact scaling laws for electrical conductivity properties of nematic polymer nano-composite monodomains, (with X. Zheng, R. Lipton, R. Zhou, Q. Wang), *Advanced Functional Materials*, Vol. 15(4), 627-638, April (2005)

97. Kinetic structure simulations of nematic polymers in plane Couette cells, I: The algorithm and benchmarks, (with R. Zhou, Q. Wang), *SIAM Multiscale Modeling and Simulation*, Vol. 3(4), 853-870 (2005)
98. Extension-enhanced conductivity of liquid crystalline polymer nano-composites, (with H. Zhou, X. Zheng, Q. Wang, R. Lipton), *Macromolecular Symposia*, Vol. 28, 81-85 (2005)
99. A numerical study of unsteady, thermal, glass fiber drawing processes, (with H. Zhou), *Communications in Mathematical Sciences*, Vol. 3(1), 27-45 (2005)
100. Connections between stability, convexity of internal energy, and the second law for compressible Newtonian fluids, (with S.E. Bechtel, F. Rooney, and Q. Wang), *ASME J. Applied Mechanics*, Vol. 72, 299 (2005)
101. Anisotropy and dynamic ranges in effective properties of sheared nematic polymer nano-composites, (with X. Zheng, R. Zhou, Q. Wang, R. Lipton), *Advanced Functional Materials*, Vol. 15, 2029-2035 (2005)
102. Hydrodynamic theories for mixtures of polymers and rod-like liquid crystalline polymers, (with Q. Wang), *Physical Review E*, Vol. 72, 041805: 1-17 (2005)
103. Anisotropy and heterogeneity of nematic polymer nano-composite film properties, (with R. Zhou, Q. Wang, X. Zheng, R. Lipton), *Institute for Mathematics and Its Applications*, Vol. 141, **Modeling of Soft Matter**, 85-98 (2005)
104. A new proof on uniaxial equilibria of a 3-dimensional Smoluchowski equation, (with H. Zhou, H. Wang, and Q. Wang), *Nonlinearity*, Vol. 18, 2815-2825 (2005)
105. Kinetic structure simulations of nematic polymers in plane Couette cells, II: In-plane structure transitions, (with R. Zhou, Q. Wang), *SIAM Multiscale Modeling and Simulation*, Vol. 4(4), 1280-1304 (2005)
106. Alignment and rheo-oscillator criteria for sheared nematic polymer films in the monolayer limit, (with J. Lee, R. Zhou), *Discrete and Continuous Dynamical Systems (DCDS)*, Vol. 6, 339-356 (2006)
107. Anchoring distortions coupled with plane Couette & Poiseuille flows of nematic polymers in viscous solvents: morphology in molecular orientation, stress & flow, (with H. Zhou), *DCDS*, Vol. 6, 407-425 (2006)
108. On weak plane Couette and Poiseuille flows of rigid rod and platelet ensembles, (with Z. Cui, Q. Wang, H. Zhou), *SIAM J. Applied Math*, Vol. 66(4), 1227-1260 (2006)
109. A classical problem revisited: Rheology of nematic polymer monodomains in small amplitude oscillatory shear, (with E. Choate), *Rheologica Acta*, Vol. 46(1), 83-94 (2006)
110. Monodomain dynamics for rigid rod & platelet suspensions in strongly coupled coplanar linear flow and magnetic fields, II: Kinetic theory, (with S. Sircar, Q. Wang, R. Zhou), *Phys. Fluids*, Vol. 18, 103102:1-14 (2006)
111. Nematic polymer mechanics: flow-induced anisotropy, (with X. Zheng, R. Lipton, R. Zhou), *Continuum Mechanics & Thermodynamics*, Vol.18, 377-394 (2007)
112. Monodomain dynamics for rigid rod & platelet suspensions in strongly coupled coplanar linear flow and magnetic fields, (with Q. Wang, R. Zhou), *J. Rheology*, Vol. 51(1), 1-21 (2007)



113. On the correspondence between creeping flows of viscous and viscoelastic fluids, (with I. Klapper, K. Xu), *J. Non-Newtonian Fluid Mech.*, Vol. 145, 148–170, (2007)
114. Characterization of stable kinetic equilibria of rigid, dipolar rod ensembles for coupled dipole-dipole and excluded-volume potentials, (with H. Zhou, H. Wang, Q. Wang), *Nonlinearity*, Vol. 20, 277-297 (2007)
115. Nematic liquids in weak capillary Poiseuille flow: structure scaling laws and effective conductivity implications, (with H. Zhou), *Int. J. Numerical Analysis & Modeling*, Vol. 4 (3), 460-477 (2007)
116. Nano-rod suspension flows: a 2D Smoluchowski-Navier-Stokes solver, (with R. Zhou, Q. Wang), *Int. J. Numerical Analysis & Modeling*, Vol. 4(3), 478-488 (2007)
117. Anchoring-induced structure transitions of flowing nematic polymers in plane Couette cells, (with H. Zhou, Q. Wang), *Discrete and Continuous Dynamical Systems B*, Vol. 8(3), 707-733 (2007)
118. A strategy for dimensional percolation in sheared nano-rod dispersions, (with X. Zheng, R. Vaia, M. Arlen), *Advanced Materials*, Vol. 19 (22), 4038-4043 (2007)
119. Microscopic-macroscopic simulations of rigid-rod polymer hydrodynamics: heterogeneity & rheochaos, (with R. Zhou, Q. Wang), *SIAM Multiscale Modeling & Simulation*, Vol. 6(3), 858-878 (2007)
120. Effects of strong anchoring on the dynamic moduli of heterogeneous nematic polymers, (with E. Choate, Z. Cui), *Rheol. Acta*, Vol. 47, 223–236 (2008)
121. Dipole-induced first-order phase transitions of nano-rod monolayers, (with J. Lee, Q. Wang, R. Zhou), *Physics Letters A*, Vol. 372, 3484–3487 (2008)
122. Dimensional robustness & instability of sheared, semi-dilute, nano-rod dispersions, (with X. Yang, Z. Cui, J. Shen, Q. Wang), *SIAM Multiscale Modeling and Simulation*, Vol. 7(2), 622-644 (2008)
123. Extensions of the Ferry shear wave model for active linear and nonlinear microrheology, (with S. Mitran, B. Lindley, L. Yao, D. Hill), *J. Non-Newtonian Fluid Mechanics*, Vol. 154, 120-135 (2008)
124. Direct and Inverse Modeling for Stochastic Data in Microbead Rheology, (with C. Hohenegger), *Proceedings in Applied Mathematics and Mechanics (PAMM)*, Special Issue: Sixth International Congress on Industrial Applied Mathematics (ICIAM07) and GAMM Annual Meeting, Zürich 2007, Published Online: Oct 30 (2008)
125. Robustness of pulsating jet-like layers in sheared nano-rod dispersions, (with S. Heidenreich, S. Hess, X. Yang, R. Zhou), *J. Non-Newtonian Fluid Mechanics*, Vol. 155(3), 130-145 (2008)
126. Oscillating hydrodynamical jets in steady shear of nano-rod dispersions, (with S. Heidenreich, S. Hess, S. H. L. Klapp, X. Yang, R. Zhou, Q. Wang), 15th International Congress on Rheology and 80th Annual Meeting of the Society of Rheology, August 3-8, 2008, XV International Congress on Rheology, Soc. Rheology 80<sup>th</sup> Annual Meeting, Vol. 1027: 168-170 (2008)
127. Effects of tilted director angle anchoring conditions on the dynamic moduli of heterogeneous nematic polymers, (with E. Choate, Z. Cui, L. Ju), 15th International Congress on Rheology and 80th Annual Meeting of the Society of Rheology, August 3-8, 2008, XV International Congress on Rheology, Soc. Rheology 80<sup>th</sup> Annual Meeting, Vol. 1027: 481-483 (2008)

128. Modeling aspects of two-bead microrheology, (with C. Hohenegger), 15th International Congress on Rheology and 80th Annual Meeting of the Society of Rheology, August 3-8, 2008, XV International Congress on Rheology, Soc. Rheology 80<sup>th</sup> Annual Meeting, Vol. 1027: 1093-1095 (2008)
129. Two-point microrheology: modeling protocols, (with C. Hohenegger), *Phys. Rev. E*, Vol. 78, 031501 (2008)
130. Stress communication and filtering of viscoelastic layers in oscillatory shear, (with E. Howell, B. Smith, G. Rubinstein, B. Lindley, D. Hill, R. Superfine, S. Mitran), *J. Non-Newtonian Fluid Mechanics*, Vol. 156, 112-120 (2009)
131. Sheared nematic liquid crystal polymer monolayers, (with H. Wang, H. Zhou), *Discrete & Continuous Dynamical Systems B*, Vol. 11(2), 497-517 (2009)
132. Time-domain methods for passive microrheology and anomalous diffusive transport in soft matter, (with J. Fricks, L. Yao, T. Elston), *SIAM J. Appl. Math.*, Vol. 69(5), 1277-1308 (2009)
133. Dynamic defect morphology and hydrodynamics of sheared nematic polymers in two space dimensions, (with X. Yang, Q. Wang, W. Mullins), *J. Rheology*, Vol. 53(3), 589-615, May/June (2009)
134. Quench sensitivity of defects and shear banding in nematic polymer film flows, (with X. Yang, W. Mullins, Q. Wang), *J. Non-Newtonian Fluid Mechanics*, Vol.159 (1-3), 115-129 (2009)
135. On the exact solution for smooth pulses of the defocusing nonlinear Schrodinger modulation equations prior to breaking, (with O. Wright, C-J Rosenberg), *Nonlinearity*, Vol. 22, 2287-2308 (2009)
136. Transient anomalous diffusion of tracer particles in soft matter, (with S. McKinley, L. Yao), *J. Rheology*, Vol. 53(6), 1487-1506 (2009)
137. A simple model for non-topological defects in sheared nematic polymer monodomains, (with E. Choate, L. Yao, X. Zheng, R. Zhou), *J. Computational and Theoretical Nanosciences*, Vol. 7, 787-794 (2010); special issue on Nematic Liquid Crystalline Polymers and Nanocomposites, Forest, Zhou, Wang Editors
138. Mathematical studies and simulations of nematic liquid crystalline polymers and nanocomposites (A review), (with H. Zhou, H. Wang), *J. Comput. Theor. Nanosci.* Vol. 7, 645-660 (2010); special issue on Nematic Liquid Crystalline Polymers and Nanocomposites, Forest, Zhou, Wang Editors
139. 2D lid-driven cavity flow of nematic polymers: an unsteady sea of defects, (with X. Yang, Q. Wang, W. Mullins), *Soft Matter*, Vol. 6, 1138-1156 (2010)
140. A 2-D kinetic theory for monodomain flows of polymer-rod nanocomposites, (with L. Liao, Q. Wang), *Communications in Computational Physics*, Vol. 7, No. 2, 250-282 (2010)
141. Effects of strong anchoring on the dynamic moduli of heterogeneous nematic polymers II: Oblique anchoring angles, (with E. Choate, L. Ju), *Rheologica Acta*, DOI:10.1007/s00397-009-0397-1 (2010)
142. Dynamic texture scaling of sheared nematic polymers in the large Ericksen number limit, M.G. Forest, S. Heidenreich, S. Hess, R. Zhou, X. Yang, *J. Non-Newtonian Fluid Mechanics*, Vol. 165 (13), 687-697 (2010)
143. Spatial Stress and Strain Distributions of Viscoelastic Layers in Oscillatory Shear, B. Lindley, B. Smith, S. Mitran, D. Hill, M.G. Forest, *Mathematics and Computers in Simulation*, DOI:10.1016/j.matcom.2010.07.031 (2010)
144. A Kinetic Theory and Benchmark Predictions for Polymer Dispersed, Semi-Flexible Macromolecular Rods or Platelets, M.G. Forest, J. Li, Q. Wang, R. Zhou, *Physica D: Nonlinear Phenomena*, Vol. 240, 114-130 (2011)

145. Shearing the I-N phase transition of liquid crystalline polymers: long-time memory of defect initial data, K. Xu, X. Yang, M.G. Forest, *Discrete and Continuous Dynamical Systems B*, Vol. 15 (20), 457-473 (2011)
146. Shear cell rupture of liquid crystal droplets in a viscous fluid, X. Yang, C. Liu, J. Shen, M.G. Forest, *J. Non-Newtonian Fluid Mechanics*, Vol. 166, 487-499 (2011)
147. Dependence of the dynamic moduli of heterogeneous nematic polymers on planar anchoring relative to flow direction, E. Choate, M.G. Forest, *Rheol. Acta*, Vol. 50 (9-10), 767-778 (2011)
148. Computational and Modeling Strategies for Cell Motility, M.G. Forest, Q. Wang, X. Yang, D. Adalsteinsson, T. Elston, K. Jacobson, M. Kapustina, invited chapter for **Computational Modeling of Biological Systems: From Molecules to Pathways**, N. Dokholyan, Editor, Springer, Biological and Medical Physics Series, ISBN 978-1-4614-2145-0 (2012)
149. LCP droplet dispersions: a two-phase, diffuse-interface kinetic theory and global droplet defect predictions, M.G. Forest, Q. Wang, X. Yang, *Soft Matter*, Vol. 8, 9642-9660 (2012) DOI: 10.1039/c2sm25512j
150. Ring-waves dominate mass transport in air-driven core-annular flows, R. Camassa, M.G. Forest, H. R. Ogrosky, J. Olander, *Phys. Rev. E* 86, 066305 (2012)
151. Modeling and Simulations of Drop Pinch-Off from Liquid Crystal Filaments and the Leaky Liquid Crystal Faucet, X. Yang, H. Li, C. Liu, J. Shen, Q. Wang, M.G. Forest, *J. Computational Physics*, Vol. 236, 1-14 (2013) DOI: <http://dx.doi.org/10.1016/j.jcp.2012.10>
152. A New Twist on Stokes' Second Problem: Partial Penetration of Nonlinearity in Sheared Viscoelastic Layers, P. Vasquez, Y. Jin, K. Vuong, D. Hill, M.G. Forest, *J. Non-Newtonian Fluid Mechanics*, Vol. 196, 36-50 (2013)
153. Pericentric Chromatin Loops Function as a Non-linear Spring in Mitotic Force Balance, A. Stephens, P. Vasquez, R. Haggerty, L. Vicci, J. Verdassdonk, F. Shi, R. Taylor, M. Falvo, M. G. Forest, K. Bloom, *J. Cell Biology*, Vol. 200 (6), 757-772 (2013) [www.jcb.org/cgi/doi/10.1083/jcb.201208163](http://www.jcb.org/cgi/doi/10.1083/jcb.201208163)
154. A mechanochemical model for auto-regulation of lung airway surface layer volume, G. Herschlag, G.J.M. Garcia, B. Button, R. Tarran, B. Lindley, B. Reinhardt, T. Elston, M.G. Forest, *Journal of Theoretical Biology*, Vol. 325, 42-51, (2013) <http://dx.doi.org/10.1016/j.jtbi.2013.01.023>
155. Kinetic theory and simulations of active polar liquid crystalline polymers, M. G. Forest, Q. Wang, R. Zhou, *Soft Matter*, Vol. 9, 5207-5222, (2013) DOI: <http://dx.doi.org/10.1039/C3SM27736D>
156. Nonlinear signatures of entangled polymer solutions in active microbead rheology, J. Cribb, P.A. Vasquez, P. Moore, S. Norris, S. Shah, R. Superfine, M.G. Forest, *J. Rheology*, **57**, 1247-1265 (2013)
157. Individual pericentromeres display coordinated motion and stretching in the yeast spindle, A. Stephens, C. Snider, J. Haase, R. Haggerty, P. Vasquez, M. G. Forest, K. Bloom, *J. Cell Biology*, **203**, 407-416 (2013) doi:10.1083/jcb.201307104
158. Percolation-induced exponential scaling in the large current tails of random resistor networks, F. Shi, S. Wang, P. Mucha, M.G. Forest, *SIAM Multiscale Modeling and Simulation*, **11**(4), 1298-1310 (2013)

159. Centromere tethering confines chromosome domains, J. Verdaasdonk, P. Vasquez, R. Barry, T. Barry, S. Goodwin, M.G. Forest, K. Bloom, *Molecular Cell* **52**(6), 819-831 (2013)
160. Network-based assessments of percolation-induced current distributions in sheared rod macromolecular dispersions, F. Shi, P. Mucha, S. Wang, R. Zhou, M.G. Forest, *SIAM Multiscale Modeling and Simulation*, **12**(1), 249-264 (2014)
161. A biophysical basis for mucus solids concentration (wt%) as a candidate biomarker for airways disease: relationships to clearance in health and stasis in disease, D. B. Hill, S. McKinley, P. Vasquez, J. Mellnik, A. Vose, F. Mu, N. Alexis, R. Boucher, M.G. Forest, *PLoS ONE*, **9**(2): e87681 (2014)
162. Transient antibody-mucin interactions produce a dynamic molecular shield against viral invasion, A. Chen, S. McKinley, S. Wang, F. Shi, P. Mucha, M.G. Forest, S. Lai, *Biophysical Journal*, **106**, 2028-2036 (2014)
163. Rheological signatures in limit cycle behavior of dilute, active, polar LCPs in steady shear, M.G. Forest, P. Phuworawong, Q. Wang, R. Zhou, *Phil. Trans. Royal Soc. A* **372**: 20130362 <http://dx.doi.org/10.1098/rsta.2013.0362> (2014)
164. Near Equilibrium Dynamics and 1-D Spatio-Temporal Structures of Polar Active Liquid Crystals, X. Yang, M.G. Forest, Q. Wang, *Chinese Physics B*, **23** (11): 117502 (2014)
165. Modeling neutralization kinetics of HIV by broadly neutralizing monoclonal antibodies in genital secretions coating the cervicovaginal mucosa, S. McKinley, A. Chen, F. Shi, S. Wang, P. Mucha, M.G. Forest, S. Lai, *PLoS ONE* **9**(6): e100598. doi:10.1371/journal.pone.0100598 (2014)
166. Pulmonary Fluid Flow: Experimental and Mathematical Modeling Challenges, R. Levy, DB Hill, MG Forest, J Grotberg, *Integrative and Comparative Biology* **54**(6), 985-1000. doi:10.1093/icb/icu107 (2014)
167. Microheterogeneity metrics for diffusion in soft matter, J. Mellnik, P. Vasquez, S. McKinley, J. Witten, D. Hill, M.G. Forest, *Soft Matter* **10**, 7781-7796 (2014)
168. Structure formation in sheared polymer-rod nano-composites, G. Ji, Q. Wang, M.G. Forest, *Discrete and Continuous Dynamical Systems B*, **8**(2) (2015)
169. 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, ISBN 978-1-4939-2065-5 (2015)
170. 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, Y. Zhu, L. Abdullah, P. Vasquez, B. Dickey, M.G. Forest, C.W. Davis *et al.*, *PLoS ONE* **10**(5): e012726 (2015) <http://dx.doi.org/10.1371/journal.pone.0127267>
171. Modeling of virion collisions in mucus reveals limits on agglutination as the protective mechanism of secretory immunoglobulin A, A. Chen, S. McKinley, F. Shi, S. Wang, P. Mucha, D. Harit, M.G. Forest, S. Lai, *PLoS ONE* **10**(7): e0131351, doi:10.1371/journal.pone.0131351 (2015)
172. Centromere DNA loops generate intracentromere tension in mitosis, J. G. Lawrimore, P.A. Vasquez, M. Falvo, R. Taylor II, L. Vicci, E. Yeh, M.G. Forest, K. Bloom, *J. Cell Biol.* **210**(4), 553–564 (2015) [www.jcb.org/cgi/doi/10.1083/jcb.201502046](http://www.jcb.org/cgi/doi/10.1083/jcb.201502046)

173. Kinetic attractor phase diagrams of active nematic suspensions: the dilute regime, M.G. Forest, R. Zhou, Q. Wang, *Soft Matter* **11**(32): 6393-402 (2015) DOI: 10.1039/c5sm00852b
174. Using computational modeling to optimize the design of antibodies that trap viruses in mucus, T. Wessler, A. Chen, S. McKinley, R. Cone, M.G. Forest, S. Lai, *ACS Infect. Dis.*, **2**(1), 82–92 (2016) DOI: 10.1021/acsinfecdis.5b00108
175. Model comparison and assessment for single particle tracking in biological fluids, M.Lysy, N. Pillai, D.B. Hill, M.G. Forest, J. Mellnik, P. Vasquez, S.A. McKinley, *Journal of the American Statistical Association*, **111**(516),1413-1426 <http://dx.doi.org/10.1080/01621459.2016.1158716> (2016)
176. Maximum likelihood estimation for single particle, passive microrheology data with drift, J. Mellnik, M. Lysy, N. Pillai, S. McKinley, J. Cribb, D. Hill, P. Vasquez, M.G. Forest, *J. Rheology* **60**, 379 (2016) DOI: 10.1122/1.4943988
177. Modeling the excess cell surface stored in a complex morphology of bleb-like protrusions, M. Kapustina, D. Tsygankov, J. Zhao, T. Wessler, A. Chen, X. Yang, N. Roach, T. Elston, Q. Wang, K. Jacobson, M.G. Forest, *PLoS Computational Biology*, **12**(3):e1004841 (2016) <http://dx.doi.org/10.1371/journal.pcbi.1004841>
178. Modeling and Simulation of Mucus Flow in Human Bronchial Epithelial Cell Cultures - Part I: Idealized Axisymmetric Swirling Flow, P. Vasquez, Y. Jin, E. Palmer, D.B. Hill, M.G. Forest, *PLoS Computational Biology*, Aug 5, 2016 <http://dx.doi.org/10.1371/journal.pcbi.1004872>
179. Hydrodynamic Theories for Flows of Active Liquid Crystals and the Generalized Onsager Principle, X. Yang, J. Li, M.G. Forest, Q. Wang, *Entropy* **18**, 202 (2016) Special issue on Recent Advances in Non-Equilibrium Statistical Mechanics and Its Applications, Guest Editor Giorgio Sonnino, doi:10.3390/e18060202
180. Entropy gives rise to topologically associating domains, P. Vasquez, C. Hult, J. Lawrimore, D. Adalsteinsson, M.G. Forest, K. Bloom, *Nucleic Acids Research* (2016), doi:10.1093/nar/gkw510
181. The Binding Site Barrier Elicited by Tumor Associated Fibroblasts Interferes Disposition of Nanoparticles in Stroma-Vessel Type Tumors, ACS Nano, L. Miao, J. Newby, M. Lin, L. Zhang, F. Xu, W. Kim, S. Lai, M.G. Forest, L. Huang, *ACS Nano*, accepted September 2016
182. Development of optimized inhalable gemcitabine-loaded gelatin nanocarriers for lung cancer, *Journal of Aerosol Medicine and Pulmonary Drug Delivery*, S. Youngren-Ortiz, P. Hoffmann, K. Morris, M.G. Forest, M. Chougule, accepted January 2017

### Conference Abstracts

- Hill, D., B. Lindley, M. Forest, R. Superfine, M. Kesimer, R. Boucher and J. Sheehan (2009). MEASURING AND MIMICKING MUCOCILIARY CLEARANCE. *PEDIATRIC PULMONOLOGY*, WILEY-LISS DIV JOHN WILEY & SONS INC, 111 RIVER ST, HOBOKEN, NJ 07030 USA.
- Hill, D., S. McKinley, P. Vasquez, J. Mellnik, M. Forest and R. Boucher (2012). MUCUS: MEMORY AND MESH. *PEDIATRIC PULMONOLOGY*, WILEY-BLACKWELL 111 RIVER ST, HOBOKEN 07030-5774, NJ USA.

3. C. I. Sandefur, M. Forest, R. Boucher, T. Elston, COMPUTATIONAL MODEL OF AIRWAY SURFACE LIQUID HOMEOSTASIS VIA PURINERGIC REGULATION OF ION TRANSPORT *Pediatric Pulmonology* 10/2013; 48:257-257
4. Hill, D., C. Ehre, B. Button, G. Dixon and M.G. Forest (2014). DEFINING SUCCESSFUL MUCUS: A MULTI-DISCIPLINARY APPROACH. PEDIATRIC PULMONOLOGY, WILEY-BLACKWELL 111 RIVER ST, HOBOKEN 07030-5774, NJ USA.
5. Hill, D., M.G. Forest, J. Mellnik, C. Ehre, M. Muhlebach, C. Esther, S. Stick and R. Boucher (2015). CHARACTERIZING EARLY CF AIRWAY DISEASE: COMPLEX BIOPHYSICAL ANALYSIS AND DATA ANALYTICS OF PEDIATRIC CF BAL SAMPLES. PEDIATRIC PULMONOLOGY, WILEY-BLACKWELL 111 RIVER ST, HOBOKEN 07030-5774, NJ USA.
6. Chaudhry, I., Rushton, Z., Quinney, N. L., Boyles, S. E., Cholon, D. M., Sears, P., Randell, S. H., Mellnik, J., Forest, M. G., Ehre, C., Gentsch, M. "CFTR Rescue Affects Secreted Mucins and Mucus." North American Cystic Fibrosis Conference (2015).
7. Gentsch, M., Cholon, D. M., Guimbellot, J. S., Chua, M., Sears, P. R., Mellnik, J. W., Forest, M. G., Randell, S. H. "Novel Resources and Model Systems for Mutation-Specific and Personalized Rescue of CFTR" Cystic Fibrosis Foundation Research Conference: Pushing the Frontiers (2015)
8. Vasquez, P. A., J. Mellnik, S. A. McKinley, M.G. Forest, R. C. Boucher and D. Hill (2015). Defining Successful Mucus: Marrying Biochemistry And Biophysics. B110. COPD GALORE: NEW INSIGHTS INTO BRONCHITIS AND EMPHYSEMA DEVELOPMENT AND TREATMENT, American Thoracic Society.
9. Martina Gentsch, Deborah M. Cholon, Nancy L. Quinney, Susan E. Boyles, Imron G. Chaudhry, Jennifer S. Guimbellot, Scott H. Randell, John Mellnik, M. Gregory Forest, "Targeting channel transport to promote fluid balance in cystic fibrosis", Federation of American Societies for Experimental Biology, Conference on The Lung Epithelium in Health and Disease, July 31, 2016
10. David B Hill, M Gregory Forest, Ian Seim, Kathryn Ramsey, Marianne Muhlebach, Charles R Esther Jr, Stephen Stick, and Richard C Boucher, CHARACTERIZING EARLY CF AIRWAYS DISEASE: COMPLEX BIOPHYSICAL ANALYSIS AND DATA ANALYTICS OF PEDIATRIC CF BALS
11. Mellnik J, Quinney NL, Boyles SE, Kucera KS, Forest MG, Gentsch M (2016). Viscoelastic properties of mucus within airway organoid models predict outcomes of CF therapeutics. *Pediatr Pulmonol Suppl.* 45, 248 (NACFC Abstract #149).

### Submitted papers

- A blueprint for robust crosslinking of mobile species in biogels using third-party molecular anchors with short-lived anchor-matrix bonds, J. Newby, J. Schiller, T. Wessler, M.G. Forest, S. Lai, *Nature Communications*, December 2016

## **UNC preprints, to be submitted**

- The self-similar microrheology of highly entangled polymeric hydrogels is tunable by polymer concentration, D.B. Hill, J. Cribb, I. Seim, J. Newby, P. Vasquez, M.G. Forest
- Parametric and non-parametric estimation of drift and diffusivity from particle-tracking data in heterogeneous complex fluids, I. Seim, J. Newby, D. Hill, M. Lysy, Y. Li, M.G. Forest
- Modeling barrier properties of intestinal mucus reinforced with IgG and secretory IgA against highly motile bacteria, F. Xu, T. Wessler, J. Newby, A. Chen, M.G. Forest, S. Lai
- Deep learning automates detection and tracking of diverse, mobile, microscopic populations in 2D and 3D, J. Newby, A. Schaefer, P.T. Lee, S.K. Lai, M.G. Forest

## **Non-research scholarly articles**

- “Mathematical challenges in nanoscience and nanotechnology”, an essay for the September 2000 Workshop on "Societal Implications of Nanoscience and Nanotechnology", U.S. Interagency Working Group on Nanoscience and Nanotechnology, Washington, DC, Kluwer Academic Publishers (2001)
- “Nano-Materials: Can we do the Math?” solicited essay by the American Association for the Advancement of Science, for posting on the EurekAlert! Web site for international journalists (2002)
- “Mechanistic Models of Lung Disease”, an essay for the Applied Mathematics feature issue of International Innovation, Research Media Ltd., U.K. (2015)

## **Federal and State Grant Support (current):**

- Co-PI, NSF Research Training Grant, “Mathematical Fluids Theory, Modeling, and Experiment”, 10/1/2010-9/30/2017, PI: R. McLaughlin, UNC.
- Co-PI, National Institutes of Health, “Cytoskeletal Oscillations: Mathematical Modeling Integrated with Experiments”, 5/1/2012-4/30/2017, PI: T. Elston, UNC
- Co-PI, NSF, “Collaborative Research: A Molecular-to-Continuum, Data-Driven Strategy for Mucus Transport Modeling”, 8/1/2014-7/31/2017, PI: P. Vasquez, U. South Carolina
- Co-PI, NIH 1T32 CA201159-01, Big Data to Knowledge in Biomedicine Graduate Training Program, 5/1/2015-4/30/2020, Co-PI: Michael Kosorok, UNC Biostatistics
- PI, NSF DMS-1462992, “A Mathematical-Experimental Strategy to Discern the Molecular Basis of (Un)Successful Mucus”, 09/15/15 – 08/31/18, co-PI: David Hill, UNC Physics & Cystic Fibrosis and Pulmonary Biology Center
- PI, NSF DMS-1517274, “Collaborative Research: Kinetic to Continuum Modeling of Active Anisotropic Fluids”, 09/15/15 – 08/31/18, co-PIs: Q. Wang, U. So. Carolina, R. Zhou, Old Dominion
- Co-PI, S. Lai (UNC Pharmacy) PI, R. Carbonell (NC State Chemical Engineering) Co-PI, NC General Assembly – Research Opportunities Initiative, “Research Program in Immunoengineering, 07/01/2015-06/20/2018

- PI, Army Research Office W911NF-16-1-0356, “A Network-Science-Integrated Feedback Loop for Design of Multifunctional Polymeric Rod-Like Nanocomposites”, co-PIs: T. Dingemans, D. Klotsa, P. Mucha, 06/10/16 – 09/30/18
- Co-PI, DHP16A-00 H16A-001-0005, Department of Defense, “Bio-Mathematical Models of Aggregated Tissues and Organ Properties”, Christine Heneghan (BioMojo LLC) PI, Forest Co-PI, 10/01/16 – 04/16/17

### **Teaching Recognition:**

Meritorious Teaching Award, Liberal Arts College, University of Arizona, 1979

### **Ph.D. Students Advised, Year of Degree, Current Affiliation**

- Jong-Eao Lee, “Geometry and modulation theory for the periodic nonlinear Schrödinger equation”, 1986, National Chiao Tung University, Taiwan
- Karen Bolinger, “Pointwise closure models for slender, non-Newtonian free jets”, 1990, Clarion University, Clarion, PA
- Qi Wang, “Dynamics of slender viscoelastic free jets”, 1991, University of South Carolina, Columbia, SC
- Jian-Zhong Cao, “Higher Order Perturbation Theory for Slender Viscoelastic Jets and Fibers with Torsion”, 1992, deceased
- S. P. Sheu, “Homoclinic Orbits for a System of Coupled Nonlinear Schrodinger Equations”, 1992, National Chung-Hsing University, Taiwan
- C. D. Carlson, “An analysis of the Rayleigh capillary instability in slender jets”, 1996, Mitsubishi Polyester Film, Columbus, NC
- Xiaoyu Zheng, “On the effective properties of nematic polymer nanocomposites”, 2006, Kent State University, Kent, OH
- Eric Choate, “Dynamic moduli and linear viscoelasticity of nematic polymers”, 2007, Radford University, Radford, VA
- Joohee Lee, “Mathematical descriptions of nematic polymers in the monolayer limit”, 2007, Ewha Women’s College, S. Korea
- Lingxing Yao, “Viscoelasticity at Microscopic and Macroscopic Scales: Characterization and Prediction”, 2007, Case Western Reserve Univ., Cleveland, OH
- Brandon Lindley, “Linear and Nonlinear Shear Wave Propagation in Viscoelastic Fluids”, 2008, Wagner and Associates, Vienna, VA
- Ke Xu, “Mathematics of microrheology with applications to pulmonary liquids”, 2009, Simulations Plus, Lancaster, CA
- Feng (Bill) Shi, “Modeling networks and dynamics in complex systems”, 2013, co-advised with Peter Mucha, Computation Institute, University of Chicago
- Simi Wang, “Modeling Networks in Nanorod Composites and Power Grids”, 2014, co-advised with Peter Mucha, Amazon, Seattle, WA
- Yuan Jin, “Computational modeling of complex fluids and human bronchial epithelial cell cultures”, May 2015, Google, CA
- John Mellnik, “Stochastic modeling of biological fluids”, May 2015, CEO of Path BioAnalytics, Inc., Chapel Hill, NC



### **Current Ph.D. Students, Topic, Tentative Degree Date**

- Caitlin Hult, Modeling of chromosomes in living yeast nuclei, joint with D. Adalsteinsson, P. Vasquez, K. Bloom 2017
- Tim Wessler, Modeling of mammalian cell mechanics, Antibody-based strategies for viral immunity and protection, joint with S. Lai, 2017
- Samuel Heroy, Network analyses of nano-rod composites and genome organization in yeast, joint with P. Mucha, 2018
- Jeff Olander, Experiments and modeling of mucus flow in the trachea, joint with R. Camassa, 2017
- Yunyan He, Chromosomal dynamics and structure in mitosis, joint with D. Adalsteinsson and K. Bloom, 2019
- Fuhui Fang, Stochastic immersed boundaries and cellular motility, joint with J. Zhao and B. Griffith, 2019

### **M.S. Students at UNC-CH, advised or co-advised**

- Greg Robbins, 2002
- Alison Hall, 2003
- John Bakken, 2005
- Jessica Wehner, 2010
- Caitlin Hult, 2015
- Susan Kolim, 2017 (expected)

### **Postdoctoral Scholars Supervised & Co-Supervised**

- B. Maulik, Battelle Postdoctoral Fellowship, 1988-1990
- D. Muraki, AFOSR funding, 1990
- O. Wright, AFOSR funding 1991-1993
- B. Umarov, funded by Uzbek Academy of Science, 1990
- C. Goedde, Battelle Postdoctoral Fellowship, 1990-1992, NSF, 1992-1994
- J. Cao, AFOSR funding, 1992-1995
- H. Zhou, UNC and AFOSR funding, 1996-1999
- T. Ueda, UNC and AFOSR funding, 1996-1997
- D. Anderson, UNC and AFOSR funding, 1997-1999
- R. Zhou, UNC and AFOSR funding, 2001-2004
- L. Lee, UNC Virtual Lung Project funding, 2003-2005
- Z. Cui, UNC and AFOSR funding, 2005-2007
- X. Zheng, NASA funding, 2006
- C. Hohenegger, ARO funding, w/ P. Mucha, 2006-2007
- L. Yao, NIH and NSF funding, 2007-2008
- J. Lee, ARO and UNC funding, 2007-2009
- X. Yang, AFOSR funding, 2007-2009
- B. Lindley, NSF funding, summer of 2008
- E. Choate, NSF funding, 2009-2010
- P. Vasquez, NSF and DOE funding, 2010-2013
- A. Chen, SAMSI and NIH funding, 2011-2015
- J. Zhao, NSF-NIH funding, w/ Q. Wang, U. So. Carolina, 2015-

- J. Newby, NSF-NIGMS & NC General Assembly funding, 2015-
- Feifei Xu, NSF-NIGMS & NC General Assembly funding, 2016-

### **Undergraduate Honors Theses Advised**

- R. Waters, with E. T. Samulski, Electrospinning of Liquid Crystals, 2005
- B. Smith, Stress Filtering in Sheared Viscoelastic Layers and Hypotheses for Biological Relevance, 2007

### **Selected Presentations (2010 - present)**

- 2010, The Virtual Lung Project at UNC, University of California at San Diego, Mathematics, February 18
- 2010, Dynamic defect morphology and hydrodynamics of sheared nematic polymers in physically confined geometries, LSU, Baton Rouge, LA, Applied Mathematics Seminar, April 26
- 2010, Defect diagnostics for nematic polymer flows, Dynamical Systems and PDEs conference, Barcelona, Spain, June 1
- 2010, Soft matter and mathematics as seen through three model systems, Lead-off lecture of NSF Workshop on Mathematical Modeling and Computer Simulations for Soft Materials, Colorado State University, September 13
- 2010, Length-scale dependent flow and diffusive transport in biological fluids, Math Biology Colloquium Series, Duke University, Durham, NC, November 19
- 2011, Lengthscale-dependent microrheology of soft biological materials, SIAM Computational Science & Engineering Annual Meeting, Reno, NV, March 4
- 2011, Anomalous diffusion in soft matter materials: experiment, theory and simulations, SIAM CS&E Meeting, Reno, NV, March 4
- 2011, The Virtual Lung Project at UNC: What's Math Got to Do with It? University of British Columbia-Pacific Institute for Mathematical Sciences Distinguished Lecture, Vancouver, BC, Canada, March 18
- 2011, Kinetic Theory of Complex Fluids, University of Wisconsin-University of Maryland Workshop on Kinetic Theory, Madison, WI, May 25
- 2011, Anomalous Diffusion in Soft Matter, International Conference on Applied Mathematics and Interdisciplinary Research, Beijing Computational Science Research Center, Beijing, China, June 16
- 2011, Community detection in social networks meets percolation-induced transport properties of sheared nano-rod dispersions, Workshop on Complex Fluids and Flows in Industry and Nature, University of British Columbia, July 14
- 2011, Hydrodynamics of nano-rod and nano-platelet dispersions, Minisymposium on Computational Modeling of Multiscale Systems with Dynamic Constitutive Laws, Organizers S. Mitran, D. Trebotich, International Congress of Industrial and Applied Mathematics (ICIAM), Vancouver, BC, July 19
- 2011, Flow and diffusive transport in viscoelastic soft matter, Minisymposium of the same title, Organizer M.G. Forest, International Congress of Industrial and Applied Mathematics (ICIAM), Vancouver, BC, July 21
- 2011, Defect hydrodynamics of nematic polymers, Liquid Crystals Minisymposium, Organizer P. Palffy-Muhorah, International Congress of Industrial and Applied Mathematics (ICIAM), Vancouver, BC, July 22

- 2012, The Dissipative Side of Fluctuation-Dissipation in Soft Matter, tutorial plenary for SAMSI Workshop on Nonlocal Continuum Models for Diffusion, Mechanics, and Other Applications, SAMSI, Research Triangle, NC, June 25
- 2012, Nematics near and far from equilibrium, SIAM Annual Meeting, Minneapolis, MN, Minisymposium on Mathematics & Mechanics of Soft Matter, Organizers: Raffaella De Vita & Paolo Biscari, July 11
- 2012, Illustrative examples of building collaborations between mathematics and biology/medicine, Young Investigators' Workshop, Mathematical Biosciences Institute (MBI), Columbus, OH, August 28
- 2012, Overview of flow and diffusive transport properties of lung mucus, Workshop on Cilia-Induced Fluid Mechanics, MBI, Columbus, OH, October 17
- 2012, Active nematic flows, American Physical Society-Division of Fluid Dynamics Annual Meeting, San Diego, CA, Mini-Symposium in Memory of Daniel D. Joseph, Organizer: Howard Hu, November 19
- 2013, Defects in nematic polymer hydrodynamics, Isaac Newton Institute, Cambridge University, Mathematics of Liquid Crystals Program, Workshop on Symmetry, Bifurcation and Order Parameters, January 9
- 2013, The Virtual Lung Project at UNC, Department of Applied Mathematics, University of Colorado - Boulder, Distinguished Lecture Series, April 5
- 2013, Mathematical and Numerical Challenges in Living Biological Materials, International Conference on Numerical Analysis and Applied Mathematics, Rhodes, Greece, plenary, September 24
- 2013, The Virtual Lung Project at UNC, School of Mathematics Colloquium, University of Minnesota, Minneapolis, October 29
- 2014, The Virtual Lung Project at UNC, Department of Mathematics and Statistics, Helen Barton Lecture Series, UNC Greensboro, April 21
- 2014, Nematic polymer hydrodynamics, Arizona Program in Applied Mathematics 35<sup>th</sup> Anniversary Workshop, Tucson, AZ, April 26
- 2014, Transient, often anomalous and heterogeneous, diffusive transport through Nature's favorite barrier fluid: Mucus, Frontier Probability Days Conference, Plenary Lecture, University of Arizona, Tucson, AZ, May 19
- 2014, Active nano-rod dispersions, SIAM Annual Meeting, mini-symposium on Nonlinear Fluids, S. Walker and A. Salgado, organizers, Chicago, IL, July 8
- 2014, Nano-rod dispersion flows and induced material properties, AFOSR Computational Mathematics annual meeting, Arlington, VA, July 29
- 2014, Data-Driven Modeling of Living Cells and Mucus, invited address, Materials Research Society Fall Meeting, Boston, MA, Dec 2
- 2014, Rounded cell oscillations as a model system for understanding cellular mechanical-chemical processes, Materials Research Society Fall Meeting, Boston, MA, Dec 3
- 2015, Modeling mucus flow, Gordon Research Conference on Mucus and Cilia, Galveston, TX, Feb 10, plus 5 posters supporting the lecture
- 2015, Computational challenges in complex biological fluids, Tulane University, Scientific Computing around Louisiana workshop, plenary, March 21
- 2015, Mathematics of Living Fluids, American Mathematical Society Regional Meeting, plenary, Huntsville, AL, March 28
- 2015, Data-Driven Modeling of Living Fluids, Department of Mathematics, Applied Mathematics & Statistics, Case Western Reserve, Cleveland, OH, April 13

- 2015, The Virtual Lung Project at UNC, Origins Institute, Case Western Reserve University, Cleveland, OH, evening public lecture, April 14
- 2015, Mathematics of Complex Fluids either Living or Critical to Life, NYU Shanghai, International Conference on Mathematics of Nonlinearity in Neural and Physical Science, NYU Shanghai University, Shanghai, China, June 10
- 2015, Dynamic Organization of the Yeast Genome, Institute for Nonlinear Science, Shanghai Xiao Tong University, Shanghai, China, June 12
- 2015, Diffusion in Mucus is not Normal, even in Normals, Society for Mathematical Biology Annual Meeting, Atlanta, GA, July 2
- 2015, Quantification of anomalous diffusion in mucus: the miner's canary of human health, Workshop on Advances in Scientific Computing and Applied Mathematics, 70<sup>th</sup> Birthday Celebration of Max Gunzburger, Las Vegas, NV, Oct 10
- 2015, Diffusive transport of particles in mucus, in sickness and in health, Daniel Inouye School of Pharmacy, Hilo, Hawaii, Dec 9
- 2015, Modeling the physical structure and function of living biological soft matter, Pacifichem 2015, Session on The Physical Structure & Function of Biological and Bioinspired Soft Matter, Honolulu, Hawaii, Dec 16
- 2016, Anomalous diffusion in mucus: signatures of health and disease, UC-Boulder, Computational Math Group, February 23, 2016
- 2016, Anomalous diffusion in mucus: signatures of health and disease, Colorado School of Mines, Applied Mathematics and Statistics, February 26, 2016
- 2016, Dynamic Organization of DNA in Living Yeast, Lecture 1 (Colloquium) of the Magnus Lectures, Department of Mathematics, Colorado State University, April 4
- 2016, The Virtual Lung Project at UNC, Lecture 2 (Public) of the Magnus Lectures, Department of Mathematics, Colorado State University, April 5
- 2016, Transient Anomalous Diffusion in Mucus Gels and Other Biological Fluids, Lecture 3 (Technical) of the Magnus Lectures, Department of Mathematics, Colorado State University, April 6
- 2016, Mucus Microrheology as an Assay for Disease Progression & Drug Treatment, Minisymposium on Modeling, Analysis, and Simulations of Biological Complex Fluids, Philadelphia, PA, May 8
- 2016, Human Lung Mucus Rheology at Microscopic and Macroscopic Scales: Implications for Flow Modeling & Simulations, SIAM Mathematical Aspects of Material Sciences, Minisymposium on Soft Matter & Complex Biological Systems, Philadelphia, PA, May 9
- 2016, Microscale Heterogeneity and Equilibrium Viscoelasticity of Biological Hydrogels, Kimberly Clark Corporation, Appleton, WI, December 8

### **Professional Activities and Service (Recent)**

- External Advisory and Review Board, South Carolina Project on Organ Biofabrication, NSF-NIH funded, 2009-2016; Chair, 2010-2016
- Co-Director, UNC Institute for Advanced Materials, Nanoscience & Technology, 2002-2012; Interim Director, Fall 2012-January 2013.
- Chair, SIAM Activity Group on the Life Sciences, Jan 2013 - Dec 2014
- Steering Committee, UNC Center Cancer Nanotechnology Excellence, 2010-2014
- Scientific Advisory Committee, NSF-Mathematical Biosciences Institute (MBI), The Ohio State University, Columbus, OH, 2011-2013

- External Advisory Committee, Institute for Applied Mathematics and Computational Science, Texas A&M University, 2009-2012
- Scientific Advisory Board, Interdisciplinary Mathematics Institute, the University of South Carolina, College of Arts and Sciences, 2010-2014
- Associate Editor for SIAM Journal on Applied Mathematics, 2000-2015
- Associate Editor for Continuum Mechanics & Thermodynamics, 2003-
- Editorial Board of Communications in Applied Mathematics and Computational Science, 2007-
- Editorial Board of Journal of Non-Newtonian Fluid Mechanics, 2010-
- Editorial Board of Advances in Computational Mathematics, 2014-2016
- Organizing Committee, SIAM Conference on the Life Sciences, San Diego, CA, August 7-11, 2012
- Co-Chair, Organizing Committee, Workshop on Cilia- and Flagella-Induced Fluid Mechanics, Mathematical Biosciences Institute, Ohio State, Oct 15-18, 2012
- Scientific Advisory Board for the *Mathematics of Liquid Crystals* research programme (<http://www.newton.ac.uk/programmes/MLC/index.html>) at the Isaac Newton Institute, University of Cambridge, Jan 7 – July 5, 2013
- Co-Chair (with Felix Otto), SIAM Conference on Mathematical Aspects of Materials Science, June 9-12, 2013
- Chair, Organizing Committee, Mathematics of Nonlinearity in Neural and Physical Science, NYU Shanghai University, Shanghai, China, June 8-10, 2015
- Co-PI (with Michael Kosorok, Biostatistics) of NIH Big Data to Knowledge in Biomedicine Training Program, May 2015-