

## CURRICULUM VITAE of M. Gregory Forest

### **Present Positions:**

Professor of Mathematics  
Co-Director, Institute for Advanced Materials, NanoScience & Technology  
Associate Chair of Applied Mathematics  
Member of Curriculum in Applied and Materials Sciences  
The University of North Carolina at Chapel Hill  
Chapel Hill, NC 27599-3250

### **Major Fields:**

Mathematics & Modeling of Complex Fluids & Soft Matter Materials, Transport Phenomena, Nonlinear Waves & Soliton Theory

### **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, Adviser D. W. McLaughlin

### **Tenure-Track Faculty Positions:**

University of North Carolina, 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; January-May, 1987; January-March, 1989, 1990; February, 1991-1993

Department of Mathematics, Princeton University: September-December, 1986

Mathematical Sciences Research Institute, Berkeley: January, 1991, March, 1993, March, 1994

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

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

### **Administrative Positions Held:**

Associate Chair of Applied Mathematics, UNC-CH: 1996-1998, 2000-present

Senior Associate Dean for the Sciences, College of Arts and Sciences, UNC-Chapel Hill: 1998-2000

### **Consulting Experience:**

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

## Publications

- Multiphase averaging and the inverse spectral solution of  $KdV$  (with H. Flaschka and D. W. McLaughlin), *Comm. Pure Appl. Math.* **33**, 739-784 (1980).
- Spectral theory for the periodic sine-Gordon equation: a concrete viewpoint (with D. W. McLaughlin), *J. Math. Phys.*, **23**(7), 1248-1277 (1982).
- Modulations of sinh-Gordon and sine-Gordon wavetrains (with D. W. McLaughlin), *Studies in Appl. Math.* **68**, 11-59 (1983).
- On the modulational stability of two-phase sine-Gordon wavetrains (with N. Ercolani and D. W. McLaughlin), *Studies in Applied Math.* **71**(2), 91-101 (1985).
- Modulations of perturbed  $KdV$  wavetrains (with D. W. McLaughlin), *SIAM J. Applied Math.* **44**(2), 287-300 (1984).
- The geometry of real sine-Gordon wavetrains (with N. Ercolani), *Comm. Math. Phys.* **99**, 1-49 (1985).
- Modulational instabilities of periodic sine-Gordon waves: a geometric analysis (with N. Ercolani and D. W. McLaughlin), *Lectures in Appl. Math.* **23**, 149-166 (1985).
- Oscillations and instabilities in near integrable pde's (with N. Ercolani and D. W. McLaughlin), *Lectures in Appl. Math.* **23**, 3-46 (1985).
- The origin and saturation of modulational instabilities (with N. Ercolani and D. W. McLaughlin), *Physica D* **18**, 472-474 (1986).
- Geometry and modulation theory for the periodic nonlinear Schrödinger equation (with J. E. Lee), *IMA Volumes in Mathematics and Its Applications*, Volume 2, 35-70, Springer-Verlag (1986).
- 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* **21**, 273-308 (1986).
- A quasi-periodic route to chaos in a near-integrable p.d.e. (with A. Bishop, D. W. McLaughlin and E. Overman), *Physica D* **23D**, 293-328 (1986).
- Hamiltonian structure for the modulation equations of a sine-Gordon wavetrain (with N. Ercolani, D. W. McLaughlin, and R. Montgomery), *Duke Mathematical Journal* **55** (4), 949-983 (1987).
- Effective stress rates of viscoelastic free jets (with S. Bechtel and K. Lin), *J. Non-Newtonian Fluid Mechanics* **26**, 1-41 (1987).
- On the behavior of viscoelastic free jets with elliptical cross-section (with S. Bechtel and K. Lin), *J. Non-Newtonian Fluid Mechanics* **27**, 87-126 (1988).
- 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 of this paper also appears in *Proceedings of the Cornell MSI Workshop*, May, 1987.
- Geometry of the modulational instability III. Homoclinic orbits (with N. Ercolani and D. W. McLaughlin) *Physica D* **43**, 349-384 (1990).
- 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 Mech.* **196**, 241-262 (1988).
- 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* **127**, 335-340 (1988).

- Geometry of the modulational instability, Part I: Local analysis (with N. Ercolani and D.W. McLaughlin), *Memoirs of the A.M.S.*, unpublished.
- Geometry of the modulational instability, Part II: Global analysis (with N. Ercolani and D. W. McLaughlin), *Memoirs of the A.M.S.*, unpublished.
- 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* **144** 17-25 (1990).
- Numerical evidence for global bifurcations leading to switching phenomena in long Josephson junctions (with S. Pagano, R. Parmentier, et.al.) *Journal of Wave Motion* **22**, 213-226 (1990).
- 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* **21** (6), 1-26 (1990).
- Change-of-type behavior in viscoelastic slender jet models (with Q. Wang), *Theoretical and Computational Fluid Dynamics* **2**, 1-25 (1990).
- 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* **48**, 169-231 (1991).
- 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.
- Frequency and phase locking of spatially periodic perturbed sine-Gordon breather trains, (with S. P. Sheu and A. Sinha), *SIAM J. Applied Mathematics* **52** (3), 746-761 (1992).
- Enhancement of optical bistability by periodic layering, (with R. Camassa and R. Knapp), *Journal of Nonlinearity* **5**, 721-742 (1992).
- 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* **41**, 201-273 (1992).
- 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* **2**, 1-43 (1992).
- Instability-driven energy transport in nearly integrable, many degree-of-freedom Hamiltonian systems, (with C. Goedde and A. Sinha), *Physical Review Letters* **68**(18), 2722-2725 (1992).
- Non-isothermal modelling 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).
- 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* **37** (2), 237-287 (1993).
- Fully nonlinear modal equations for nearly integrable p.d.e., (with N. Ercolani, D. McLaughlin and A. Sinha), *Journal of Nonlinear Science* **3**, 393-426 (1993).
- Chaotic transport and integrable instabilities in a nearly integrable, Hamiltonian, discrete sine-Gordon lattice, (with C. Goedde and A. Sinha), *Physica D* **67**, 347-386 (1993).
- Dynamics of slender viscoelastic free jets, ( with Q. Wang), *SIAM J. Appl. Math.* **54** (4), 996-1032 (1994).
- A numerical study of nearly integrable modulation equations, (with A. Sinha), *Singular Limits of Dispersive Wave Equations*, edited by N. Ercolani, I. Gabitov, D. Levermore and D. Serre, Plenum Publishing (1994).

- 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.* **54**(4), 1048-1066 (1994).
- Numerical simulations of nonisothermal 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).
- 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).
- 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).
- Symmetry-breaking instabilities and chaotic transport in Hamiltonian sine-Gordon discrete lattices, (with C. Goedde and A. Sinha), *Mathematics and Computers in Simulation* **37**, 323-339 (1994).
- Torsional effects in high-order viscoelastic thin-filament models, (with S. Bechtel, K. Bolinger and J. Cao), *SIAM J. Appl. Math.* **55**(1), 58-99 (1995).
- 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, and V. Venkataramanan), *Journal of Fluid Mechanics* **293**, 379-403 (1995).
- 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* **7**(12), 2956-2971 (1995).
- Modeling and computation of the onset of failure in polymeric liquid filaments, (with S. E. Bechtel and Q. Wang), *Journal of Non-Newtonian Fluid Mechanics* **58**, 97-129 (1995).
- Thermomechanical equations governing a material with prescribed temperature-dependent density, with application to nonisothermal plane Poiseuille flow, (with D. Cao and S. E. Bechtel), *Journal of Applied Mechanics* **63**(4), 1011-1018 (1996).
- 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* **99**(4), 527-554 (1997).
- Exploiting accurate spinline measurements for elongational material characterization, (with V. Ramanan, V. Gauri, K. Koelling, S. Bechtel), *J. Rheology* **41**(2), 1-24 (1997).
- One-dimensional isothermal spinning models for liquid crystalline polymer fibers, (with Q. Wang, S. Bechtel), *J. Rheology* **41**(4), 821-850 (1997).
- Onset of oscillations in nonsoliton pulses in nonlinear dispersive fibers, (with Kenneth T-R McLaughlin), *J. Nonlinear Science* **7**, 43-62 (1998).
- 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* **65**(3), 694-704 (1998).
- 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).
- A thin-filament melt spinning model with radial resolution of temperature and stress, (with G. Henson, D. Cao, and S. Bechtel), *J. Rheology* **42**(2), 329-360 (1998).
- The role of microstructure in taming the Rayleigh instability of cylindrical jets, (with Q. Wang), *Physica D* **123**, 161-182 (1998).

- Anisotropic microstructure-induced reduction of the Rayleigh instability for liquid crystalline polymers, (with Q. Wang), *Physics Letters A* **245**, 518-526 (1998).
- 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).
- 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).
- An isothermal model for high-speed spinning of liquid crystalline polymer fibers-Coupling of flow, orientation, and crystallization, (with T. Ueda), *Journal of Non-Newtonian Fluid Mechanics* **84**, 109-121 (1999).
- Near-equilibrium dynamics of Doi models for liquid crystal polymer flows: catastrophic and regularized behavior, (with Q. Wang), *Journal of Non-Newtonian Fluid Mechanics* **83**, 131-150 (1999).
- An anelastic, scale-separated model for mixing, with application to atmospheric transport phenomena, (with R. McLaughlin), *Physics of Fluids* **11**(4), 1-13 (1999).
- 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* **257**, 170-174 (1999).
- 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* **18**(4), 314-335 (1999).
- Non-soliton pulse evolution in normally dispersive optical fibers, (with N. Kutz and K. T-R McLaughlin), *J. Optical Society of America* **B16**(11), 1856-1862 (1999).
- Nonhomogeneous patterns with core defects in elongational flows of liquid crystal polymers, (with Q. Wang and H. Zhou), *J. Rheology* **43**(6), 1573-1582 (1999).
- Thermotropic liquid crystalline polymer fibers, (with Hong Zhou and Qi Wang), *SIAM J. Appl. Math.* **60**(4), 1177-1204 (2000).
- Non-focusing instabilities in coupled, integrable nonlinear Schrodinger PDEs, (with O. Wright, D. W. McLaughlin, and D. Muraki), *J. Nonlinear Science* **10**, 291-331 (2000).
- Exact banded patterns from a Doi-Marrucci-Greco model of nematic liquid crystal polymers, (with Q. Wang and H. Zhou), *Physical Review E* **61**(6), 6665-6672 (2000).
- Homogeneous pattern selection and director instabilities of nematic liquid crystal polymers induced by elongational flows, (with Q. Wang and H. Zhou), *Physics of Fluids* **12**(3), 490-498 (2000).
- On the construction of orbits homoclinic to plane waves in integrable coupled nonlinear Schrodinger systems, (with S. Sheu and O. Wright), *Physics Letters A* **266**, 24-33 (2000).
- On the Backlund-Gauge transformation and homoclinic orbits of a coupled nonlinear Schrodinger system, (with O. Wright), *Physica D: Nonlinear Phenomena* **141**, 104-116 (2000).
- 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).
- 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* **152**, 288-309 (2001).
- A model for a spreading and melting droplet on a heated substrate, (with D. M. Anderson and R. Superfine), *SIAM J. Appl. Math.* **61**(5), 1502-1525 (2001).

- On the flow-phase diagram for discotic liquid crystals in uniaxial extension and compression, (with Q. Wang and H. Zhou), *Liquid Crystals* **28**(5), 717-720 (2001).
- 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), *Rheologica Acta* **40**, 373-383 (2001).
- Transient behavior of thermal optical glass fiber drawing processes, (with H. Zhou), *European J. Appl. Math.* **12**, 479-496 (2001).
- 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* **66**, 031712 (2002).
- A hydrodynamic theory for solutions of nonhomogeneous nematic liquid crystalline polymers with density variations, (with Q. Wang and R. Zhou), refereed proceedings of ASME International Mechanical Engineering Congress, N.O., La., IMECE2002-32189 (2002).
- 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).
- Full-tensor alignment criteria for sheared nematic polymers (with R. Zhou, Q. Wang), *J. Rheology* **47**(1), 105-128 (2003).
- Monodomain response of finite-aspect-ratio macromolecules in shear and related linear flows, (with Q. Wang), *Rheologica Acta* **42**, 20-46 (2003).
- An integrable model for stable:unstable wave coupling phenomena, (with O. Wright), *Physica D* **178**, 173-189 (2003).
- Computational observation of a weakly compressible mixing barrier in idealized anelastic fluid equations, (with R. McLaughlin and H. Zhou), *Physics of Fluids*, to appear (2003).
- Thermal expansion models of viscous fluids based on limits of free energy, (with S. Bechtel, F. Rooney, and Q. Wang), *Physics of Fluids*, to appear (2003).
- The weak shear kinetic phase diagram for nematic polymers, (with Q. Wang and R. Zhou), *Rheologica Acta*, to appear (2003).

#### **Submitted refereed research articles and web-posted preprints**

- Structure evolution in tumbling and kayaking nematic liquid crystalline polymers between shearing plates, (with Q. Wang and H. Zhou), UNC-CH Program in Applied Mathematics Preprint PAMPS2002-2, to be submitted to *J. Non-Newtonian Fluid Mech.*
- Connections between stability, convexity of internal energy, and the second law for compressible Newtonian fluids, (with S.E. Bechtel, F. Rooney, and Q. Wang), *J. Appl. Mechanics*, revision in review.
- Structure scaling properties of confined nematic polymers in plane Couette cells: the weak flow limit, (with Q. Wang, H. Zhou, and R. Zhou), *J. Rheology*, submitted June, 2003.
- Scaling behavior of kinetic orientational distributions for dilute nematic polymers in weak shear, (with Q. Wang, R. Zhou), *JNNFM*, submitted January, 2003.
- Monodomain response of arbitrary aspect ratio nematic polymers in general linear planar flows, (with Q. Wang, R. Zhou, and E. Choate), *JNNFM*, submitted April, 2003.

### 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! website for international journalists (2002).

### Federal Grant Support:

- Principal Investigator (PI), National Science Foundation (N.S.F.) Grant No. MCS-8002969, July, 1980- December, 1983, “Inverse Spectral Theory and Concrete Aspects of Periodic Solitons”.
- Co-PI, N.S.F. MCS-8202288 (with N. Ercolani), July, 1982-December, 1984, “Applications of Algebraic Geometry to Quasi-Periodic Soliton Theory”.
- Co-PI, N.S.F. DMS-8411002 (with N. Ercolani), October, 1984-April, 1988, “Applications of Algebraic Geometry to Quasi-Periodic Soliton Theory”.
- Co-PI, Air Force Office of Scientific Research (A.F.O.S.R.) Grant 88-064 (with S. Bechtel), effective April, 1988-April, 1990, “Modeling of Free Viscoelastic Jets and Instability Mechanisms”.
- PI, N.S.F. DMS-8803465, June, 1988-September, 1991, “Development and Applications of Periodic Soliton Theory for Nearly Integrable P.D.E.”.
- Co-PI, A.F.O.S.R. 90-0253 (with S. Bechtel), April, 1990-March, 1993, “On the Behavior of Non-Newtonian Fluids: Analysis, Computation, and Experiment”.
- PI, N.S.F. DMS-9104806, April, 1991-March, 1994, “Nearly Integrable Nonlinear Wave Phenomena: Theory and Applications”.
- Co-PI, A.F.O.S.R. 93-NM001 (with S. Bechtel), July, 1993-September, 1996, ”Toward Technological Application of Non-Newtonian Fluids and Complex Materials”.
- Co-PI, A.F.O.S.R. 93-NM229 (with S. Bechtel), AASERT Program, “Modeling of Viscoelastic Jets and Fibers: Inverse Problems for Material Characterization”, July, 1993-June, 1996.
- Co-PI, N.S.F. CTS-9319128 (with S. E. Bechtel), May, 1994-April, 1997, “Measuring material properties in manufacturing and agricultural processes”.
- Co-PI, N.S.F. DMS-9403596 (with E. Overman), June, 1994-May, 1997, “Nearly Integrable Nonlinear Wave Phenomena: Theory and Applications”.
- PI, A.F.O.S.R. F49620-97-1-0001, October, 1996-November, 1999, “Fiber Flows and Technological Applications”.
- PI, N.S.F. DMS-9704549, July, 1997-June, 2000, “Nearly Integrable PDES: Open Mathematical Problems and Their Technological Applications”.
- Principal Investigator, Department of Defense “DURIP” grant for research equipment, October, 1998-September, 1999, “Full resolution of melt to solid phases of liquid crystalline polymers and glasses in fiber processing”.
- Co-PI, N.S.F. CTS-9711109 (with S.E. Bechtel), July, 1997-June, 2000, “Material characterization of agricultural and industrial solutions and melts in extensional processes”.
- PI, N.S.F. DMS-9977409 (with applied math group at UNC-CH), SCREMS Program, September, 1999-August, 2002, for equipment and systems support.

- PI, A.F.O.S.R. F49620-99-1-008, October, 1999-November, 2002, “High-Performance Macromolecular Materials”.
- PI, N.S.F. DMS-0072553, August, 2000-September, 2002, “Mathematical Descriptions of Anisotropic Fluids and Optical Pulse Propagation”.
- Co-PI, N.S.F. INT-0096938, June, 2000-August, 2002, support for Otis Wright to visit from Middle East to UNC-CH.
- Co-PI, N.S.F. CTS (with K. Koelling, S. Bechtel, Ohio State U.), August, 2001-September, 2004, “Shear and extensional rheology of nanoclays and nanotubes in polymer melts and solutions”.
- Co-PI, N.S.F. Major Research Instrumentation Program (with applied math group and computational scientists at UNC-CH), A Distributed Computing Environment, August, 2001-July, 2004.
- Co-PI, NASA URETI multi-university grant on Biologically Inspired Materials, with E.T. Samulski et al., 2002-2007.
- PI, A.F.O.S.R., “High-Performance Macromolecular Materials”, December, 2002-November, 2005.
- PI, N.S.F., “Mathematical Aspects of Flow-Processed Nano-Materials”, June, 2003-May, 2006.

#### **Teaching Recognition:**

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

#### **Ph.D. Students Advised**

- Jong-Eao Lee, “Geometry and modulation theory for the periodic nonlinear Schrödinger equation”, 1986, now tenured at National Chiao Tung University, Hsinchu, Taiwan
- Karen Bolinger, “Pointwise closure models for slender, non-Newtonian free jets”, 1990, now Assistant Professor at Arkansas State University
- Qi Wang, “Dynamics of slender viscoelastic free jets”, 1991, now Assistant Professor at Indiana-Purdue University at Indianapolis
- Jian-Zhong Cao, “Higher Order Perturbation Theory for Slender Viscoelastic Jets and Fibers with Torsion”, June, 1992, now Assistant Professor at Michigan Technological University
- S. P. Sheu, “Homoclinic Orbits for a System of Coupled Nonlinear Schrodinger Equations”, August, 1992, now Assistant Professor in Taiwan
- C. D. Carlson, “An analysis of the Rayleigh capillary instability in slender jets”, March, 1996, now employed by the Hoechst Celanese Corporation, Charlotte, NC

#### **Current Ph.D. Students (post comprehensive examination)**

- Eric Choate
- Joohee Lee
- Xiaoyu Zheng

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

- Greg Robbins, graduated August, 2002
- Alison Hall
- Lingxing Yao
- Peiyong Zuo
- John Bakken

### **Postdoctoral Students 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 funding, 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-present

### **Presentations (since 2000)**

- 2000, “Flows of liquid crystalline polymers”, University of California-Irvine Colloquium, Irvine, CA, March 13, 2000
- 2000, “Flows of liquid crystal polymers, Southeastern Regional Meeting of the American Mathematical Society, Lafayette, LA, April 15
- 2000, “Mesoscale patterns from a Doi-Marrucci-Greco model for liquid crystalline polymers”, Materials Research Society Spring Meeting, Symposium on Multiscale Modeling of Organic Materials, San Francisco, CA, April 25
- 2000, “Phase and conformation transitions in liquid crystalline polymers”, SIAM Materials Science Meeting, Philadelphia, PA, May 24
- 2000, “Liquid crystalline polymers and other macromolecular fluids”, Center for Advanced Scientific Computation, Lawrence Livermore National Laboratory, June 27
- 2000, “High performance macromolecular materials”, Air Force Office of Scientific Research Grantees’ and Contractors Meeting, Stanford University, June 29
- 2000, “Discotic liquid crystals in extension and compression”, Wright-Patterson Air Force Base, Richard Vaia host scientist, Dayton, OH, July 20
- 2000, “Modeling of mesoscale structures in flows of liquid crystalline polymers”, Liquid Crystal Institute, Kent State University, October 11
- 2000, “Modeling of mesoscale structures in flows of liquid crystalline polymers”, North Carolina State University, Mathematics Department, November 1; UNC-Chapel Hill, November 17
- 2001, “Dynamics of structures in macromolecular fluids”, Dynamics Days 2001, hosted by Duke University, Durham, NC, January 4
- 2001, “Flow phenomena of rodlike and discotic LCPs”, Clemson University, joint Mathematics and Center for Advanced Engineering Fibers and Films colloquium, Clemson, SC, January 29
- 2001, “Mesostructure evolution in tumbling nematic LCPs between shearing plates”, 72nd Annual Meeting of Society of Rheology, Hilton Head, SC, February 15
- 2001, “Mesostructure evolution in tumbling nematic LCPs between shearing plates”, 3rd Pacific Rim Rheology Conference, Vancouver, BC, July 9

- 2001, “Shear-induced monodomains of nematic polymers: finite aspect ratio effects”, 3rd Pacific Rim Rheology Conference, Vancouver, BC, July 9
- 2001, ”Dynamic precursors to structure formation in sheared macromolecular fluids”, A.F.O.S.R. Contractor and Grantee Annual Meeting, Stanford, CA, July 24
- 2001, “Dynamics of shear-induced monodomains for finite-aspect-ratio macromolecules”, Society of Rheology Meeting, Bethesda, MD, October 21
- 2001, “Dynamic precursors to structure formation in sheared macromolecular fluids”, AIChE Annual Meeting, Reno, Nevada, November 4-9
- 2001, “Mathematical aspects of simple flows containing simple molecules”, Applied Mathematics Seminar, UNC-CH, November 16
- 2001, “Monodomain precursors and mesostructure evolution in linear and nearly linear flows of rigid, ellipsoidal macromolecules”, Materials Research Society Fall Meeting, Boston, MA, November 28
- 2002, ”The dynamics of nematic liquids in shear and related linear flows”, Utah State Workshop on Mathematics in Industry, Logan, UT, March 1-2
- 2002, “The dynamics of nematic liquids: molecular theory and averaged descriptions”, University of New Mexico Symposium of the Center for Advanced Studies, Albuquerque, NM, April 18-19
- 2002, ”The orientational degeneracy of nematic liquids and its role in the dynamical response to shear flow”, Fourth International Conference on Dynamical Systems and Differential Equations, Wilmington, NC, May 24-27
- 2002, “The dynamics of nematic liquids: molecular theory and averaged descriptions”, Joint meeting of Italy and U.S. Mathematics Societies, Symposium on Mathematical Problems in Soft Matter Modeling, Pisa, Italy, June 12-16
- 2002, “Free energy characterizations of mechanical incompressibility in thermal viscous flow”, Fourteenth U.S. National Congress of Theoretical and Applied Mechanics, Symposium for Dan Joseph, Blacksburg, VA, June 23-28
- 2002, “Dynamic Precursors and Structure Formation in Flowing Nematic Polymers”, SIAM Fiftieth Anniversary Meeting, Symposium on Materials Science, Philadelphia, PA, July 10
- 2002, “Microscopic and mesoscopic predictions of nematic polymers in shear-dominated flows”, Marrucci Symposium, National Meeting of the Society of Rheology, Minneapolis, MN, Oct. 15
- 2002, “Passing between molecular and mesoscopic descriptions of high-performance macromolecular materials”, International Mechanical Engineering Congress and Exposition, New Orleans, LA, Nov. 19
- 2002, “Laminar flows of nematic polymers: molecular theory and averaged descriptions”, Northwestern University, Applied Mathematics Colloquium, Evanston, IL, Dec. 5
- 2003, “Laminar flows of nematic polymers: issues critical to high-performance materials”, University of Colorado-Boulder, Applied Mathematics Colloquium, Boulder, CO, Jan. 18
- 2003, “Mathematics of high-performance materials”, AMS Special Session on the Mathematics of Materials, Rob Lipton, Organizer, Baton Rouge, LA, March 14
- 2003, “Laminar flows of nematic polymers: passing between kinetic and mesoscopic scale models”, Workshop on Multiscale Theory and Computation in Nano Materials, Wright-Patterson AFB, Dayton, OH, March 29
- 2003, “What’s math got to do with nano-materials?”, UNC-Chapel Hill Mathematics Graduate Visions Seminar, April 14

- 2003, “Laminar flows of nematic polymers: high-performance materials in the making”, Carnegie Mellon University, Mathematics Department and Center for Nonlinear Analysis, Pittsburgh, PA, May 1
- 2003, “The dynamics of nematic polymers in laminar flows: a zoo of bifurcations associated with bulk molecular phase transitions”, SIAM Dynamical Systems Annual Meeting, Snowbird, UT, May 28

## Professional Activities and Service

- Editor for SIAM J. Appl. Mathematics
- Referee for Physica D, Mathematical Reviews, SIAM J. Appl. Math., the National Science Foundation (Theoretical Physics, Applied Mathematics, and Classical Analysis), Transactions of the A.M.S., Physical Review B, AFOSR, SIAM J. Math. Analysis, Physical Review Letters, Physics Letters A, Journal of Mathematical Physics, the Department of Energy, Chaos Journal, Journal of Nonlinear Science, Journal of Dynamics and Differential Equations, Physics of Fluids A, Nonlinearity, Physical Review E.
- Co-organizer, with James Turner of a mentoring/research enhancement program, Summer, 1991-1994 for students from historically black colleges, at Ohio State University
- Co-organizer, with Y. Kodama and E. Overman, of a Workshop on Nearly Integrable Nonlinear Wave Phenomena in Nonlinear Optics, December, 1990, at Ohio State University
- Member of Forum Steering Committee, Society of Industrial and Applied Mathematics, May, 1992-1996
- Organizer of SIAM Forum meeting, June 4,5, 1993, Indianapolis, IN
- Member of SIAM Advisory Committee for “Mathematics in Industry” Initiative, 1993-1996
- Member of organizing committee, with E.Wayne and W.Craig, for MSRI Workshop on Dynamical Systems Methods for Partial Differential Equations, Berkeley, CA, March 14-18, 1994
- Member of organizing committee, Math Tower Conference to dedicate the new Math Building at Ohio State University, March 18,19, 1994
- Member of organizing committee, Penn State Workshop on Applied Mathematics for Materials Studies and Industrial Applications, State College, PA, October 24-26, 1996
- Member of Advisory Committee, Curriculum in Applied and Materials Sciences, University of North Carolina, 1997-present
- Member of SIAM Committee on Science Policy, 1998-present
- Member of Director’s Review Committee for Computing Sciences, Lawrence Berkeley Laboratory, May 27,28, 1998
- Member of External Panel to Review UC-Berkeley Physical Sciences Organized Research Units, February 27,28, 2000
- Panel Member of Workshop on ”Societal Implications of Nanoscience and Nanotechnology”, Hosted by the U.S. Interagency Working Group on Nanoscience and Nanotechnology, Washington, DC, September 28-29, 2000
- Panel Member for 2000 Mathematics Chairs’ Colloquium at the National Academy of Sciences in Washington, DC, November 10-11, 2000
- Member, NSF Mathematical Sciences Postdoctoral Research Fellowships Panel, 2000-2003, Chair of 2002 Panel
- Co-organizer of Workshop on ”Nonlinear differential equations, Mechanics and Bifurcation”, Duke University, May 20-22, 2002
- Member, Program Committee for a Workshop of the University of North Carolina System on “Computational Modeling in Higher Education”, March 25,26, 2002, at the North Carolina Supercomputing Center, Research Triangle Park, NC.
- Member, Local Development Committee for the Statistical and Applied Mathematical Sciences Institute (**SAMSI**), an NSF-DMS Institute in the Research Triangle Park, NC.