

MICHAEL CRAIG SOSTARECZ

Curriculum Vitae

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EDUCATION

Ph.D. Mathematics, December 2004

The Pennsylvania State University, University Park, PA

Dissertation: "Experiments and Modeling in Viscoelastic Fluids: Dimpled Drops and Beaded Filaments"

Advisor: Dr. Andrew Belmonte

B. S. Mathematics, May 1999

The Pennsylvania State University, University Park, PA

PROFESSIONAL EXPERIENCE

2006 – Present **Visiting Assistant Professor**, Department of Mathematics & Computer Science, Monmouth College

2006 – Present **Visiting Assistant Professor**, Physics Department, Monmouth College

2004 – 2006 **Visiting Assistant Professor**, Department of Mathematical Sciences, University of Delaware

1999 – 2004 **Research Assistant**, Department of Mathematics, The Pennsylvania State University

W. G. Pritchard Fluid Mechanics Laboratory

Advisor: Dr. Andrew Belmonte

1999 – 2002 **Teaching Assistant**, Department of Mathematics, The Pennsylvania State University

1997 – 1998 **Undergraduate Teaching Assistant**, Department of Mathematics, The Pennsylvania State University

TEACHING EXPERIENCE

2006 – Present **Visiting Assistant Professor**, Monmouth College

Department of Mathematics & Computer Science

Differential and Integral Calculus (Fall 2007)

Subjects covered included functions, early transcendentals, limits, analytic geometry, differentiation, differentials, integration, and various applications of calculus

Multivariate and Vector Calculus (Fall 2007)

Subjects covered included vectors, velocity and acceleration, partial derivatives, directional derivatives, optimization of multivariate functions, double and triple integration, line integrals, and Green's and Stokes' theorems

Mathematical Methods in Physics (Spring 2007)

Subjects covered systems of differential equations, complex variables, conformal mapping, and various applications such as electrical circuits, vibrating drums, and airplane flight

Elementary Statistics (Fall 2006)

Subjects covered included mean and variance, data displays, normal distribution, correlation and regression, and test of significance for means and proportions.

- 2006 – Present **Visiting Assistant Professor**, Monmouth College
Physics Department
- Astronomy** (Spring 2007)
 Subjects covered include the Earth, the Moon, planets and stars through lecture, simple laboratory experiments, and telescopic observations
- Mathematical Methods in Physics** (Spring 2007)
 Subjects covered systems of differential equations, complex variables, conformal mapping, and various applications such as electrical circuits, vibrating drums, and airplane flight
- Introductory Physics I Lab** (Fall 2006)
 Guiding students through the discovery and investigation of topics including statistics, forces, vectors, springs, and collisions
- Introductory Physics III** (Fall 2006)
 Subjects covered include simple harmonic oscillations, sound, electromagnetic waves, and physical optics
- 2004 – 2006 **Visiting Assistant Professor**, University of Delaware
Department of Mathematical Sciences
- Ordinary Differential Equations with Linear Algebra** (Fall 2005 and Spring 2006)
 Subjects covered included first and second-order ordinary differential equations, systems of algebraic equations, matrices, determinants, vector spaces, eigenvalues and eigenvectors, and systems of ordinary differential equations
- Multivariate and Vector Calculus** (Fall 2005)
 Subjects covered included vectors, velocity and acceleration, partial derivatives, directional derivatives, optimization of multivariate functions, double and triple integration, line integrals, and Green's and Stokes' theorems
- Differential and Integral Calculus** (Fall 2004, Spring 2005, and Spring 2006)
 Subjects covered included functions, limits, analytic geometry, differentiation, differentials, integration, and various applications of calculus
- Business Calculus** (Winter 2006)
 Subjects covered included functions, limits, differentiation, exponential and logarithm functions, integration, and various applications of calculus
- 1999 – 2002 **Teaching Assistant**, The Pennsylvania State University
Department of Mathematics
- Multivariate and Vector Integral Calculus** (Fall 2002)
 Subjects covered included multidimensional analytic geometry, double and triple integrals, potential fields, flux through a surface, and Green's and Stokes' theorems
- Differential and Integral Calculus** (Summer 2001)
 Subjects covered included functions, limits, analytic geometry, differentiation, differentials, integration, and various applications of calculus
- Ordinary and Partial Differential Equations** (Spring 2001)
 Subjects covered included first and second-order ordinary differential equations, Laplace transforms, Fourier series, and partial differential equations
- College Algebra** (Fall 1999 and Spring 2000)
 Subjects covered included quadratic equations, word problems, graphing, algebraic fractions, negative and rational exponents, and radicals
- 1997 – 1998 **Undergraduate Teaching Assistant**, Department of Mathematics, The Pennsylvania State University

RESEARCH EXPERIENCE

2006 – Present **Visiting Assistant Professor**, Monmouth College
Department of Mathematics & Computer Science
Physics Department
Undergraduate research with Nathaniel Coleman

The Belousov-Zhabotinsky reaction is being investigated to model heart attacks and defibrillation.

- Oscillating chemical reaction that changes colors from red to blue
- UV/Vis Spectroscopy is being used to acquire quantitative data for this periodic-like behavior
- Beginning to investigate spatial patterns
- Plan to model the experimental system mathematically with differential equations

2004 – 2006 **Visiting Assistant Professor**, University of Delaware
Department of Mathematical Sciences
Collaboration with Dr. Richard J. Braun and Dr. L. Pamela Cook

Surfactant spreading on thin fluid films was investigated to model the tear film in the eye after blinking.

- Derived a system of partial differential equations that governs the surfactant concentration and the height of the fluid film through the use of lubrication theory
- Computed solutions numerically using an implementation of the method of lines with finite difference discretizations in space
- Collaboration with Dr. P. Ewen King-Smith at The Ohio State University to use interferometry to image the lipid surface of the eye
- Collaboration with Dr. John A. Pelesko at the MEC laboratory to investigate surfactant spreading in a simplified model system

1999 – 2004 **Research Assistant**, The Pennsylvania State University
W. G. Pritchard Fluid Mechanics Laboratory
Department of Mathematics
Advisor: Dr. Andrew Belmonte

Free boundary problems involving non-Newtonian fluids were investigated with experiments, theory, and numerical simulations.

- Determined experimentally that a drop of dilute polymer solution translating through a quiescent viscous Newtonian fluid may exhibit a stable dimple at low volumes and a toroidal shape at larger volumes
- Analytically reproduced experimental findings for a viscoelastic drop falling through a Stokes fluid by using a double perturbation analysis in low elasticity and high surface tension
- Investigated the dynamics of wormlike micellar filaments surrounded by an immiscible viscous bulk fluid
- Determined that, for certain concentrations, wormlike micellar filaments develop a beads-on-string structure previously observed only in polymer jets and filaments surrounded by air
- Derived an integro-differential evolution equation that governs the development of a viscoelastic filament
- Investigated fingering patterns within a Hele-Shaw cell involving a chemically reactive interface
- Collaborations included Dr. Thomas Podgorski at the University of Grenoble
- Assisted REU students in projects

Spring 1999 **Research Experience for Undergraduates**, The Pennsylvania State University
W. G. Pritchard Fluid Mechanics Laboratory
Department of Mathematics
Advisor: Dr. Joseph Hammack (deceased)

- Investigated a vertically driven pendulum
- Determined that this system displays chaotic behavior at certain frequencies

SPECIAL RESEARCH AND TEACHING WORKSHOPS

- June 2006 **New Directions Short Course – Biophysical Fluid Dynamics**
Institute for Mathematics and its Applications, University of Minnesota
Dr. Michael J. Shelley and Dr. Raymond E. Goldstein
- An intensive short course intended to efficiently provide researchers in the mathematical sciences the basic knowledge prerequisite to undertake research in fluid dynamics relevant to the biological realm.
- January 2006 **Problem-Based Learning**
Institute for Transforming Undergraduate Education, University of Delaware
- In problem-based learning, complex real world problems or cases are used to motivate students to identify and research concepts and principles they need to know in order to progress through the problems. In this workshop, there was an introduction to problem-based learning and a session on writing effective problem-based materials.
- February 2003 **From Elasticity to Plastic Flow in Condensed Media**
Ecole de Physique – Les Houches, France
- A two week international winter school consisting of short courses presented on topics such as granular material, shock propagation, and complex fluids.
- June 2002 **Complex Systems Summer School**
St. John’s College and The Santa Fe Institute
Dr. Raymond E. Goldstein and Dr. Andrew Belmonte
- A four week international summer school consisting of short courses presented on topics such as nonlinear dynamics, information and computation theory, and evolution and adaptation.
- Responsible for preparing laboratory experiments to model various complex systems
 - Assisted one of the participants, Dr. Cindy Skach of The Minda de Gunzburg Center for European Studies at Harvard University, in a project involving the use of the ability of soap films to coarsen in order to model the interaction between political party systems in Western Europe
- May 2002 **Mathematical Modeling in Industry – A Workshop for Graduate Students**
Institute for Mathematics and its Applications, University of Minnesota
- A collaborative project with five other graduate students performed under the direction of Dr. Leonard Borucki, formerly of Motorola.
- Modeled the planarization in chemical-mechanical polishing
 - Presented results at the workshop in an oral presentation and a written report

PUBLICATIONS

- T. Podgorski, M. C. Sostarecz, S. Zorman, and A. Belmonte, “**Fingering instabilities of a reactive micellar interface**”, *Phys. Rev. E* **76**, 016202 (2007).
- M. C. Sostarecz and A. Belmonte, “**Beads-on-string phenomena of wormlike micellar fluids**”, *Phys. Fluids* **16**(9), L67-L70 (2004).
- M. C. Sostarecz and A. Belmonte, “**Motion and shape of a viscoelastic drop falling through a viscous fluid**”, *J. Fluid Mech.* **497**, 235-252 (2003).
- M. C. Sostarecz and A. Belmonte, “**Dynamics inside polymer drops: from dimple to Rayleigh instability to torus**”, *Phys. Fluids* **15**(9), S5 (2003).
- L. Borucki, D. Alagoz, S. Hoogendoorn, S. Kakollu, M. Reznikoff, R. Schugart, and M. Sostarecz, “**Modeling planarization in chemical-mechanical polishing**”, *IMA Preprint* **1866-1** (2002).

SELECTED PRESENTATIONS

- “**Motion and shape of a falling polymer drop**”, Mathematics Colloquium, Department of Mathematics, Western Illinois University, Macomb, IL, October 2007 (invited talk; Dr. Beth Hansen).
- “**The Michelson Interferometer and Fourier Transforms**”, Advanced Analytical Chemistry, Monmouth College, Monmouth, IL, April 2007 (guest lecture).
- “**One dimensional models for bubble bursts on a tear film**”, 58th Annual Meeting of the American Physical Society, Division of Fluid Dynamics, Chicago, IL, November 2005 (talk).
- “**Motion and shape of a falling polymer drop**”, Applied Mathematics Colloquium, Department of Mathematics and Statistics, University of Maryland at Baltimore County, Baltimore, MD, March 2005 (invited talk; Dr. John Zweck).
- “**Beads-on-string phenomena in wormlike micellar fluids**”, 57th Annual Meeting of the American Physical Society, Division of Fluid Dynamics, Seattle, WA, November 2004 (talk).
- “**Motion and shape of a falling viscoelastic drop**”, SIAM Conference on Mathematical Aspects of Materials Science, Los Angeles, CA, May 2004 (talk).
- “**Motion and shape of a falling polymer drop**”, Colloquium, Department of Physics, Rochester Institute of Technology, Rochester, NY, April 2004 (invited talk; Dr. Scott V. Franklin).
- “**Motion and shape of a falling viscoelastic drop**”, Applied Math Seminar, Department of Mathematical Sciences, University of Delaware, Newark, DE, April 2004 (invited talk; Dr. Philip Broadbridge).
- “**Motion and shape of a falling polymer drop**”, Center for Interdisciplinary Research in Fluid Physics Seminar, Department of Chemical Engineering, University of California, Santa Barbara, CA, March 2004 (invited talk; Dr. George M. Homsy).
- “**A twist on beads-on-a-string**”, 56th Annual Meeting of the American Physical Society, Division of Fluid Dynamics, East Rutherford, NJ, November 2003 (Gallery of Fluid Motion).
- “**Falling viscoelastic droplets**”, Gordon Research Conference: Nonlinear Science, Tilton, NH, August 2003 (poster).
- “**Motion and shape of a falling polymer drop**”, GREPHE Soft Matter / Grey Matter Seminar, Laboratoire de Spectrométrie Physique, University of Grenoble, Grenoble, France, February 2003 (invited talk; Dr. Thomas Podgorski).
- “**Dynamics inside polymer drops: from dimple to Rayleigh instability to torus**”, 55th Annual Meeting of the American Physical Society, Division of Fluid Dynamics, Dallas, TX, November 2002 (winning poster in Gallery of Fluid Motion).
- “**Dimpled polymer drops**”, 55th Annual Meeting of the American Physical Society, Division of Fluid Dynamics, Dallas, TX, November 2002 (talk).

STUDENT PRESENTATIONS

- N. Coleman and M.C. Sostarecz, “**Kinetics and Spatial Patterns of the Belousov-Zhabotinsky Reaction**”, Science Seminar, Monmouth College, Monmouth, IL, April 2007 (talk).
- N. Coleman and M.C. Sostarecz, “**Exploring the Belousov-Zhabotinsky Reaction**”, The Illinois-Iowa Section of the American Chemical Society April Meeting, Clinton Community College, Clinton, IA, April 2007 (talk).
- N. Coleman, R. Kieft, C. Blackledge, and M.C. Sostarecz, “**Exploring the Belousov-Zhabotinsky Reaction**”, The 233rd American Chemical Society Meeting, Chicago, IL, March 2007 (poster).
- N. Coleman and M.C. Sostarecz, “**Exploring the Belousov-Zhabotinsky Reaction**”, Science Seminar, Monmouth College, Monmouth, IL, November 2006 (talk).

AWARDS AND RECOGNITION

- 2006, 2007 FIDC Faculty Development Award
2006 FIDC Student Travel Funds
2006 Travel award to the Institute for Mathematics and its Applications at the University of Minnesota for “New Directions Short Course – Biophysical Fluid Dynamics”
2006 Institute for Transforming Undergraduate Education Fellow, University of Delaware
2004 Teaching Award Nomination, University of Delaware
2002, 2003 Graduate Teaching Award Nomination, The Pennsylvania State University
2002 APS – DFD Gallery of Fluid Motion poster contest winner
2002 Travel award to the Institute for Mathematics and its Applications at the University of Minnesota for “Modeling in Industry – A Workshop for Graduate Students”

PROFESSIONAL SOCIETIES

American Association for the Advancement of Science
American Mathematical Society
American Physical Society
Mathematical Association of America
Society for Industrial and Applied Mathematics

SERVICE

- 2007 Organizer, “Monmouth College Founder’s Day Paper Airplane Contest”
2006-2007 Monmouth College academic advisor
2006 Participant, “Advising in the Major”, Monmouth College faculty symposium
2006 Participant, “Citizen Workshop”, Monmouth College faculty symposium
2005 Session chair for the Special Session on Frontiers on Complex Fluids: Analytic and Computational Models, Spring Eastern Sectional Meeting of the American Mathematical Society, Newark, DE
2004 Session chair for Non-Newtonian Flows II, 57th Annual Meeting of the American Physical Society, Division of Fluid Dynamics, Seattle, WA

Journal reviewer:

Physics of Fluids
Experiments in Fluids
SIAM