MICHAEL CRAIG SOSTARECZ

Professor of Mathematics

347 Center for Science and Business
Department of Mathematics, Statistics, and Computer Science
Monmouth College
Monmouth, IL 61462

Phone: (309) 457-2355
Fax: (309) 457-2141
Email: msostarecz@monmouthcollege.edu
Web: www.monmsci.net/~msostare/

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

2018 – present **Professor of Mathematics**, Department of Mathematics, Statistics, and Computer Science, Monmouth College

2012 – 2018 **Associate Professor**, Department of Mathematics & Computer Science, Monmouth College

2006 – 2012 **Assistant Professor**, Department of Mathematics & Computer Science, Monmouth College

2006 – 2008 **Assistant Professor**, Physics Department, Monmouth College

2004 – 2006 **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

TEACHING EXPERIENCE

2006 – present **Professor of Mathematics** (2018), Monmouth College
Department of Mathematics, Statistics, and Computer Science

Chaos and Fractals
Subjects covered discrete and continuous dynamical systems, bifurcations, iterated functions, fractal geometry, and various applications such as weather and heart attacks

Chaos: Randomness and Order, Free Will and Destiny
A Reflections course taken by juniors as part of Monmouth College's Integrated Studies sequence. This course takes an interdisciplinary perspective of the role that chaos plays in our lives and the world around us. Students consider how small changes can have disproportionately large effects to contemplate how much control we have in determining our path through life.

Complex Analysis
Subjects covered included complex numbers, analytic functions, elementary functions, integration, series, residues and poles, and mappings of complex functions.

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

Differential Equations

Subjects covered included linear and nonlinear first-order ordinary differential equations, higher-order linear ODEs, numerical methods, and Laplace transforms.

Elementary Functions
Subjects covered included power, polynomial, rational, trigonometric, exponential, and logarithmic functions in preparation for a first course in calculus.

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

Introduction to the Liberal Arts
This freshman seminar course puts an emphasis on critical thinking and communications skills as the values of a liberal arts education and the characteristics of an exemplary life are explored.

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

Mathematical Modeling
A combination of modeling and previous coursework from calculus, linear algebra, and programming are used to study applications taken from ecology, warfare, physics, business, chemistry, and politics. This was the capstone course for the mathematics major until Fall 2015.

Multivariate and Vector Calculus
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

Partial Differential Equations and Boundary Value Problems
Subjects covered included Fourier series, boundary value problems, and partial differential equations including the heat equation, the wave equation, Laplace's equation, and Burger's equation.

Project-Based Capstone in Mathematics
Beginning in the Fall of 2016, the Mathematics Capstone moved to a year-long, project-based format. Students formulate an independent project proposal within the first semester and use the second semester for implementation. All faculty within the department provide feedback with one faculty member charged with coordination.

2006 – 2008 **Assistant Professor**, Monmouth College
Physics Department

Astronomy with Lab
Subjects covered include the Earth, the Moon, planets and stars through lecture, simple laboratory experiments, and telescopic observations

Introductory Physics I Lab
Guiding students through the discovery and investigation of topics including statistics, forces, vectors, springs, and collisions

Introductory Physics III
Subjects covered include simple harmonic oscillations, sound, electromagnetic waves, and physical optics

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

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

Business Calculus
Subjects covered included functions, limits, differentiation, exponential and logarithm functions, integration, and various applications of calculus

Differential and Integral Calculus
Subjects covered included functions, limits, analytic geometry, differentiation, differentials, integration, and various applications of calculus

Multivariate and Vector Calculus
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

Ordinary Differential Equations with Linear Algebra
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

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

College Algebra
Subjects covered included quadratic equations, word problems, graphing, algebraic fractions, negative and rational exponents, and radicals

Differential and Integral Calculus
Subjects covered included functions, limits, analytic geometry, differentiation, differentials, integration, and various applications of calculus

Multivariate and Vector Integral Calculus
Subjects covered included multidimensional analytic geometry, double and triple integrals, potential fields, flux through a surface, and Green's and Stokes' theorems

Ordinary and Partial Differential Equations
Subjects covered included first and second-order ordinary differential equations, Laplace transforms, Fourier series, and partial differential equations

RESEARCH EXPERIENCE

2006 – present **Professor of Mathematics,** Monmouth College
Department of Mathematics, Statistics, and Computer Science

Seeing Mathematics through High-Speed Imagery
- A high-speed camera is used to acquire data for use in lecture, classroom activities, and for undergraduate research projects. Since the time between consecutive images is small, average rates of change are good approximations for the time derivative.
- Results from the project have been used in courses such as freshman and multivariate calculus, differential equations, and mathematical modeling to motivate mathematical theory, to question/confirm modeling assumptions, and to verify the validity of mathematical solutions.

GPS Tracking of a Roller Coaster
- Global Positioning System data was student-acquired on the roller coaster, The Boss.
- The GPS data was analyzed numerically.

- Results from the project have been used in freshman calculus as examples for finding the extremes values of a function and on the relation between position, velocity, and acceleration.

Modeling Chemical Kinetics with Differential Equations

- In the presence of a certain enzyme, NAD+ and Lactate are converted to NADH and Pyruvate.
- UV/Vis Spectroscopy used to acquire quantitative data on the absorbance of the NADH.
- The system was modeled using differential equations and reaction rate constants were determined from the data.
- Results from the project have been used in differential equations and mathematical modeling in discussions on population growth, modeling, and the relation between analytical and experimental results.

2006 – 2008 **Assistant Professor,** Monmouth College
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 used to acquire quantitative data for this periodic-like behavior
- Investigated spatial patterns
- Modeled the experimental system mathematically with differential equations

2004 – 2006 **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

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

SPECIAL TEACHING AND RESEARCH WORKSHOPS

2010 – 2017 **SO*f*IA Program**
Summer Opportunity for Intellectual Activity
Monmouth College, Monmouth, IL

In the three weeks before Fall classes begin, a small group of incoming freshman work together with a returning student on scholarly or artistic projects under the direction of a faculty mentor. Projects that I supervise combine data collected with a high-speed camera with mathematical modeling in an attempt to understand some physical behavior.

2010: **Laboratories in Mathematics**
Michael Howard, McCahl Murray, and Anders Nelson
2011: **Mathematical Modeling with High Speed Imagery**
Angelic Carr, Megan Lyle, and Anders Nelson
2012: **Water Bottle Rockets**
Brandon Kemerling, Caiti Kozelichki, Emily Schroeter, and Bradley Whitcomb
2013: **Particle Tracking Velocimetry** and **Three-Dimensional Tracking**
Cyrus Turner, Devin King, and Bradley Whitcomb
2014: **Rupture of a Soap Film** and **Experiments with Liquid Nitrogen**
Morgan Holle, Devin King, and Emily Sheetz
2015: **Water Melon Explosion** and **Body Kinetics**
Logan Hoepfner, Ashley Maurer, Laura Salas, and Emily Sheetz
2016: **Chaos in Space Balls** and **Physics of a Yo-Yo**
Logan Heaton, Katie Helme, Ashley Maurer, and Arturo Monroy
2017: **Water Drop Collisions** and **Analysis of a Baseball Pitch**
Savannah Ball, Arturo Monroy, Michael Mueller, and Jesus Valenciana

April 2011 **ISMAA/Project NeXT Technology Panel**
Illinois Sectional Meeting of the Mathematical Association of America
North Central College, Naperville, IL
Dr. Timothy McMurry, Dr. Michael C. Sostarecz, Dr. Ilie Ugarcovici

March 2009 **NITLE Workshop: Teaching with Tablets PCs in Varied Disciplines**
Computer Science Department, DePauw University
Dr. Dave Berque, Logan Mayfield, Michael Gough, Melinda Kraft, and Carol Smith

A workshop designed to bring together faculty members, instructional technologists, and technology directors to engage in dialogue on the effective use of Tablet PCs in teaching and learning in a liberal arts college.

June 2008 **MAA PREP Workshop – Biocalculus: Designing Calculus Courses for Life Science Majors**
Department of Mathematics, Benedictine University
Dr. Timothy J. Comar and Mike Martin

A workshop designed to help mathematicians design and implement biocalculus courses and integrate biological applications into existing calculus courses.

June 2006 **IMA 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**
École 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 coarsening soap films 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

M. C. Sostarecz and A. G. Sostarecz, **"A Conceptual Approach to Limiting Reagent Problems"**, *J. Chem. Ed.* **89**(9), 1148-1151 (2012).

M. C. Sostarecz, E. Smith, and U. M. Moll, **"p53 Ruptures Mitochondria"**, *Cell* **149**, Issue 7 Cover (2012).

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

"Illuminating the Past: An Application of Data Science to Archaeology", Faculty Colloquium, Monmouth College, Monmouth, IL, April 2021 (talk).

"Using Linear Algebra and Probability to Solve Minesweeper", Tri-Sectional Meeting of the Mathematical Association of America, Valparaiso University, Valparaiso, IN, March 2018 (talk).

"Finding Order Within Chaos", Faculty Colloquium, Monmouth College, Monmouth, IL, October 2017 (talk).

"Analysis of Chaotic Motion", Illinois Sectional Meeting of the Mathematical Association of America, College of Dupage, Glen Ellyn, IL, March 2017 (talk).

"In the Blink of an Eye: Seeing Calculus Through High-Speed Imagery", Calculus Class, West Central High School, Biggsville, IL, February 2017 (guest lecture for Samantha Kimmey '15).

"Motion Tracking and Image Analysis for High-Speed Video", Faculty Colloquium, Monmouth College, Monmouth, IL, February 2015 (talk).

"Motion Tracking and Image Analysis for High-Speed Video", Illinois Sectional Meeting of the Mathematical Association of America, Southern Illinois University, Edwardsville, IL, March 2014 (talk).

"An Aggregation Ranking Model for Fishing Tournaments", Illinois Sectional Meeting of the Mathematical Association of America, Roosevelt University, Chicago, IL, April 2013 (talk).

"In the Blink of an Eye: Seeing Mathematics Through High-Speed Imagery", Annual Fall Meeting of the American Physical Society Prairie Section, The University of Kansas, Lawrence, KS, November 2012 (talk).

"A Conceptual Approach to Limiting Reagent Problems", The 243rd American Chemical Society Meeting, San Diego, CA, March 2012 (talk).

"In the Blink of an Eye: Seeing Mathematics Through High-Speed Imagery", Faculty Colloquium, Monmouth College, Monmouth, IL, November 2011 (talk).

"Mathematical Modeling with High-Speed Imagery", MAA MathFest, Lexington, KY, August 2011 (talk).

"Mathematical Modeling with High-Speed Imagery", Illinois Sectional Meeting of the Mathematical Association of America, North Central College, Naperville, IL, April 2011 (talk).

"A Network Model for College Football Rankings", Illinois Sectional Meeting of the Mathematical Association of America, Augustana College, Rock Island, IL, April 2010 (talk).

"GPS Tracking of a Roller Coaster", AMS Special Session on Mathematics and Physical Experiments, Joint Mathematics Meetings, San Francisco, CA, January 2010 (invited contributed talk; Dr. Roger Thelwell).

"Mathematical Amusements: Roller Coasters and the Ranking of College Football Teams", Faculty Colloquium, Monmouth College, Monmouth, IL, December 2009 (talk).

"GPS Tracking of a Roller Coaster", Illinois Sectional Meeting of the Mathematical Association of America, Bradley University, Peoria, IL, April 2009 (talk).

"Supplementing Calculus with Mathematica", International Mathematica User Conference 2008, Wolfram Research, Inc., Champaign, IL, October 2008 (invited contributed talk; Cliff Hastings).

"Infusing Mathematics into Biology as well as the Inverse", HHMI Conference on Interdisciplinarity in Science and Mathematics, Howard Hughes Medical Institute, Trinity University, San Antonio, TX, October 2008 (co-talk with Dr. James Godde).

"Applications of Calculus: Refinancing, Chemical Reactions, and Roller Coasters", Faculty Colloquium, Monmouth College, Monmouth, IL, April 2008 (talk).

"Research in Applied Mathematics: Viscoelastic Drops and Chemical Oscillations", Mathematics Colloquium, Department of Mathematics and Computer Science, Monmouth College, Monmouth, IL, January 2008 (invited talk; Dr. Marjorie Bond).

"Motion and shape of a falling polymer drop", Mathematics Colloquium, Mathematics Department, Penn State Erie – The Behrend College, Erie, PA, December 2007 (invited talk; Dr. Joseph E. Paullet).

"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).

"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).

PROFESSIONAL SOCIETIES

American Physical Society
Mathematical Association of America

SERVICE

2017 – present	Education Subcommittee
2017 – 2020	Assessment Committee
2017 – 2018	Awards Committee Chair, Illinois Section of the Mathematical Association of America
2015 – present	Awards Committee, Illinois Section of the Mathematical Association of America
2015 – 2018	Director at Large, Illinois Section of the Mathematical Association of America
2014 – 2017	Personnel Committee
2012 – 2013	Secretary, Faculty and Institutional Development Committee
2010 – 2012	Chair, Public Affairs Committee
2010 – present	Adviser, Table Top Gaming Club
2008 – 2012	Public Affairs Committee
2008 – present	Wolfram Site Administrator for Monmouth College
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:

Applied Mathematics and Computation
Physics of Fluids
Experiments in Fluids
Journal of
Midwest Journal for Undergraduate Research
SIAM: Society for Industrial and Applied Mathematics