

Kara L. Maki

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Education

Ph.D. in Applied Mathematics, University of Delaware, August 2009

Dissertation: *Computational Solutions of Linear Systems and Models of the Human Tear Film*
Advisor: Richard J. Braun

M.S. in Applied Mathematics, University of Delaware, May 2006

B.S. in Mathematics, University of New Hampshire, May 2003

Research Interests

The physical systems I study pertain to flows of biological and complex fluids, coating processes, and rare events. The mathematical aspects of my research include modeling, ordinary and partial differential equations, asymptotic and perturbation methods, and scientific computing.

Research Experience

Postdoctoral Fellow, IMA, University of Minnesota–Twin Cities Campus, September 2009-present

Participated in IMA thematic program on “Complex Fluids and Complex Flows” and pursued multiple independent research interests under the mentorship of Prof. Satish Kumar from the Department of Chemical Engineering and Material Sciences at the University of Minnesota and Prof. Yuriko Renardy from the Department of Mathematics at Virginia Tech.

Research Mentor, IMA Research Experience for Undergraduates, University of Minnesota–Twin Cities Campus, Summer 2010

Co-mentored a group of three undergraduate students with Prof. Daniel Flath from the Department of Mathematics, Statistics, and Computer Science at Macalester College on long-wave models for elastohydrodynamic instabilities. The students learned fluid mechanics, linear stability analysis, a method of lines for numerical solution of partial differential equations, and how to program in Matlab. The students were chosen as Prize Winners at the 2011 Mathematical Association of America Undergraduate Poster Session at the 2011 Joint Mathematics Meetings.

Research Assistant, Department of Mathematical Sciences, University of Delaware, 2006-2009
Funded by NSF DMS-0616483, developed mathematical models and numerical methods for understanding the dynamics of human tear film under the mentorship of Prof. Richard Braun from the Department of Mathematical Sciences, and in close collaboration with optometrist Dr. P. Ewen King-Smith from The Ohio State University as well as research scientist Dr. Bill Henshaw from Lawrence Livermore National Laboratory.

Grants

K.L. Maki (PI). Association for Women in Mathematics–National Science Foundation (AWM–NSF) Mentoring Travel Grant, \$4,200, 2010.

Refereed Publications

- 1.) K.L. Maki and Y. Renardy. The dynamics of a simple model for a unified treatment of thixotropic yield stress fluids. *Journal of Non-Newtonian Fluid Mechanics* **165** (2010), 1373-1385.
- 2.) K.L. Maki, R.J. Braun, P. Ucciferro, W.D. Henshaw and P.E. King-Smith. Tear film dynamics on an eye-shaped domain II: Flux boundary conditions. *Journal of Fluid Mechanics* **647** (2010), 361-390.
- 3.) K.L. Maki, R.J. Braun, W.D. Henshaw and P.E. King-Smith. Tear film dynamics on an eye-shaped domain I: Pressure boundary conditions. *Mathematical Medicine and Biology* **27** (2010), 227-254.
- 4.) K.L. Maki, R.J. Braun, T.A. Driscoll and P.E. King-Smith. An overset grid method for the study of reflex tearing. *Mathematical Medicine and Biology* **25** (2008), 187-214.
- 5.) A. Heryudono, R.J. Braun, T.A. Driscoll, L.P. Cook, K.L. Maki and P.E. King-Smith. Single-equation models for the tear film in a blink cycle: Realistic lid motion. *Mathematical Medicine and Biology* **24** (2007), 347-377.
- 6.) T.A. Driscoll and K.L. Maki. Searching for rare growth factors using multicanonical Monte Carlo methods. *SIAM Review* **49** (2007), 673-692.

Publicity

C. Moskowitz. The Physics of Teardrops. November 20, 2008, *LiveScience*,
(<http://www.livescience.com/health/081120-teardrop-physics.html>).

Manuscripts In Preparation

- 1.) K.L. Maki and Y. Renardy. The dynamics of unyielding in a simple model for a thixotropic yield stress fluid.
- 2.) K.L. Maki and S. Kumar. Drying droplets of colloidal suspensions: Role of rheology.
- 3.) K.L. Maki, D. Flath, S. Kumar, C.G. Kealey, W. Li, and C.L. Talbot. Elastohydrodynamic instabilities in gravity-driven flows revisited.
- 4.) K.L. Maki. Tear film dynamics on blinking domains.

Research Awards and Honors

7th International Congress on Industrial and Applied Mathematics (ICIAM) Travel Award, Vancouver, (July 2011)

ADVANCE Future Faculty Participant Travel Award, Virginia Tech, June 2010

Postdoctoral Fellowship Award, IMA, University of Minnesota–Twin Cities Campus, 2009-2011

Association for Women in Mathematics (AWM) Workshop at Society for Industrial and Applied Mathematics (SIAM) Annual Meeting Travel Award, Denver, July 2009

Professional Development Award, University of Delaware, November 2008

Department of Mathematical Sciences Unidel Fellowship, University of Delaware, Fall 2008

AWM Workshop at SIAM Annual Meeting Travel Award, San Diego, July 2008

The Office of Women's Affairs Travel Award, University of Delaware, November 2007

Pan-American Advanced Studies Institutes (PASI) on Interfacial Fluid Dynamics Travel Award, Mar del Plata, Argentina, August 2007

SIAM Student Annual Meeting Travel Award, Boston, July 2006

Poster Award, UD Computational Science Day, University of Delaware, February 2006

Nominated to Phi Beta Kappa and Phi Mu Epsilon, 2003

Invited Research Presentations

Searching for rare growth factors

Center for Applied Scientific Computing (CASC) Seminar, Lawrence Livermore National Laboratory, March 2007

Human tear film dynamics

The Rose Mathematics Seminar, Rose-Hulman Institute of Technology, March 2010

Microscale Flow and Transport Seminar, University of Minnesota–Twin Cities Campus, April 2009

Modeling yield stress fluids

Minisymposium on Advances in Modeling and Simulation of non-Newtonian Materials, 7th International Congress on Industrial and Applied Mathematics (ICIAM), Vancouver, (July 2011)

Drying droplets of colloidal suspensions: Role of rheology

The Society for Advancement of Chicanos and Native Americans in Science (SACNAS) Annual Conference, San Jose, California, (October 2011)

Minisymposium on Computational Fluid Mechanics for Free and Moving Boundaries, 11th US National Congress on Computational Mechanics, University of Minnesota–Twin Cities Campus, (July 2011)

Special Session on Mathematical and Computational Advances in Interfacial Fluid Dynamics, 2011 Spring Eastern Sectional Meeting, College of the Holy Cross, April 2011

School of Mathematical Sciences, Rochester Institute of Technology, March 2011

School of Natural Science, Hampshire College, December 2010

Elastohydrodynamic instabilities in gravity-driven flows

Department of Mathematics and Statistics, Mount Holyoke College, February 2011

Contributed Research Presentations

Searching for rare growth factors

IMA Postdoc Seminar, University of Minnesota–Twin Cities Campus, November 2009

SIAM Annual Meeting, Boston, July 2006

UD Computational Science Day, University of Delaware, February 2006 (poster)

An overset grid method for the study of reflex tearing

Division of Fluid Dynamics 60th Annual Meeting, Salt Lake City, November 2007

PASI on Interfacial Fluid Dynamics, Mar del Plata, Argentina, August 2007 (poster)

Frontiers in Applied Math and Computational Math, New Jersey's Science & Technology University (NJIT), May 2007 (poster)

Tear film dynamics on an eye-shaped domain I: Pressure boundary conditions

9th Symposium on Overset Composite Grid, Penn State, October 2008

AWM Workshop at SIAM Annual Meeting, San Diego, July 2008 (poster)

Tear film dynamics on an eye-shaped domain II: Flux boundary conditions

AWM Workshop at SIAM Annual Meeting, Denver, July 2009 (poster)

2009 Joint Mathematics Meetings, Washington DC, January 2009

Division of Fluid Dynamics 61st Annual Meeting, San Antonio, November 2008

Drying droplets of colloidal suspensions: Role of rheology

Industrial Partnership for Research in Interfacial and Materials Engineering (IPRIME) Annual Meeting, University of Minnesota–Twin Cities Campus, (June 2011)

IPRIME Annual Meeting, University of Minnesota–Twin Cities Campus, (June 2011) (poster)

2011 Joint Mathematics Meetings, New Orleans, January 2011

IPRIME Annual Meeting, University of Minnesota–Twin Cities Campus, June 2010

IPRIME Annual Meeting, University of Minnesota–Twin Cities Campus, June 2010 (poster)

Teaching Experience

Guest Lecturer, MATH 312: Differential Equations, Macalester College, October 2010

Developed an interactive ninety minute lecture studying one phenomenon due to capillary forces. A mathematical model was constructed from ideas of multivariable calculus and solved using calculus of variations.

Instructor, MATH 230: Finite mathematics with applications, University of Delaware, Winter 2005

Full course responsibilities for one section of thirty students. An undergraduate course in set theory, probability, linear programming, and matrix methods for non-majors.

Teaching Assistant, MATH 221: Calculus I, University of Delaware, 2005-2006

Duties included leading discussion sections, holding office hours, writing quizzes, grading, and proctoring exams. MATH 221 is part one of an undergraduate calculus series for non-science students.

Teaching Assistant, MATH 243: Analytic Geometry and Calculus C, University of Delaware, Spring 2005

Duties included leading discussion sections and holding office hours. MATH 243 is an undergraduate vector calculus course.

Teaching Assistant, MATH 222: Calculus II, University of Delaware, Fall 2004

Duties included holding office hours and grading. MATH 222 is part two of an undergraduate calculus series for non-science students.

Instructor, MATH 111: Precalculus, University of Rhode Island, 2003-2004

Full course responsibilities, excluding the writing of common exams, for one section of thirty students. An undergraduate course designed to strengthen background in mathematics below calculus.

Teaching Award

Department of Mathematical Sciences Baxter-Sloyer Graduate Teaching Award, University of Delaware, May 2006

Teaching Development

Completed GRAD 8101: Teaching in Higher Education, University of Minnesota–Twin Cities Campus, Fall 2010

The course is designed to help graduate students and postdoctoral fellows become responsive and reflective teachers.

Service

University of Minnesota–Twin Cities Campus

Volunteer speaker at the Undergraduate Math Club Lunch, October 2010

Volunteer speaker at the Undergraduate Math Club Lunch, March 2010

Volunteer speaker at the Women in Mathematics Lunch, February 2010

University of Delaware

Founder and officer of the AWM Student Chapter, 2008-2009

Teaching Assistant Fellow for the University Annual Conference for Graduate Teaching Assistants, August 2008

Co-organizer of the weekly Department of Mathematical Sciences Graduate Student Seminar, 2006-2008

Journal Referee

SIAM Review, SIAM Journal of Applied Mathematics, and Chemical Engineering Science

Professional Membership

Society for Industrial and Applied Mathematics, Association for Women in Mathematics, American Physical Society, and Society of Rheology

Workshop Participation

Small Scale Hydrodynamics: Microfluidics and Thin Films Workshop Banff International Research Station, Alberta, Canada, February 2010

The Inaugural ADVANCE Future Faculty Program, Virginia Tech, March 2010

AWM Workshop for Women Graduate Students and Recent PhDs at SIAM Annual Meeting, Denver, July 2009

IMA Special Workshop on Career Options for Women in Mathematical Sciences, University of Minnesota–Twin Cities Campus, April 2009

AWM Workshop for Women Graduate Students and Recent PhDs at SIAM Annual Meeting, San Diego, July 2008

PASI on Interfacial Fluid Dynamics: From Theory to Applications, Mar del Plata, Argentina, August 2007

The Mathematical Problems in Industry Workshop, University of Delaware, June 2007

The Mathematical Problems in Industry Workshop, Olin College, June 2006

The Graduate Student Mathematical Modeling Camp, Rensselaer Polytechnic Institute, June 2006

Computer Skills

Programming languages and software packages

Matlab, C/C++, Maple, Mathematica, Latex, Overture