DEREK E. MOULTON

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PROFESSIONAL PREPARATION

Associate Professor in Mathematical Biology, University of Oxford — April 2013 -present
Mathematical Institute
Tutorial Fellow, Balliol College

Postdoctoral Researcher, University of Oxford — June 2010 - March 2013
OCCAM, Mathematical Institute
Millard and Lee Alexander Postdoctoral Fellow, Christ Church

Hanno Rund Postdoctoral Fellow, University of Arizona — 2008 - 2010
Department of Mathematics

Ph.D. Applied Mathematics, University of Delaware — May 2008
Dissertation: Mathematical modeling of Field Driven Mean Curvature Surfaces
Advisor: John A. Pelesko

M.S. Applied Mathematics, University of Delaware — January 2006
GPA 3.95

B.A. Mathematics, University of Denver — June 2003
Magna Cum Laude, minor in Computer Science and English

RESEARCH EXPERIENCE

I am interested in the development and analysis of mathematical models for problems arising in the natural sciences, in particular questions of continuum mechanics in biology. Recent subject areas and particular problems include:

- **Growth and morphology:** geometry and continuum mechanics based models for growing structures; morphology of seashells; growth of slender elastic bodies.
- **Nonlinear elasticity, physiology:** mechanics of wound healing, cell mechanics in bladder wall; projection mechanism of chameleon tongue; buckling of tubular structures; mechanical properties of airways and arteries; formation and collapse of voids in soft tissues.
- **Fluid dynamics:** analysis and experiments of a draining thin-film with colloid suspension of magnetic nanoparticles.
- **Granular media:** modelling and experimentation with sand morphology and pattern formation in sand.
- **Electrostatics:** analysis and experiments involving interaction of electric fields with elastic membranes.

PUBLICATIONS

· Bowden, L. G., Maini, P. K., Moulton, D. E., Tang, J. B., Wang, X. T., Liu, P. Y., & Byrne, H. M., "An ordinary differential equation model for full thickness wounds and the effects of diabetes", *J Theor Biology.* **361(C)**, 87-100 (2014).

· Pandey, A., Moulton, D. E., Vella, D., & Holmes, D. P., "Dynamics of snapping beams and jumping poppers," *Europhys. Lett. (EPL)* (2014)

- R. Chirat, D.E. Moulton, and A. Goriely, "Mechanical basis of morphogenesis and convergent evolution of spiny seashells," *PNAS*, (2013) doi: 10.1073/pnas.1220443110[1].
- S. O'Keefe, D.E. Moulton, S. Waters, and A. Goriely, "Growth-induced axial buckling of a slender elastic filament embedded in an isotropic elastic matrix", *Int. J. Nonlinear Mech* (2013)
- D.E. Moulton, T. Lessinnes, and A. Goriely, "Morphoelastic rods Part I: A single growing elastic rod," *J. Mech. Phys. Solids*, **61**:2 (2013) 398–427.
- D.E. Moulton, J. Lega, "Effect of disjoining pressure in thin film equations with non-uniform forcing," *Eur. J. Appl. Math*, **24**, (2013) 887-920.
- D.E. Moulton, A. Goriely, "Surface growth kinematics via local curve evolution," *J. Math Biol.*, (2012), doi: 10.1007/s00285-012-0625-7.
- D.E. Moulton, A. Goriely, "Mechanical growth and morphogenesis of seashells," *J. Theor. Biol.*, **311** (2012), pp. 69–79.
- D.E. Moulton, A. Goriely, "Possible role of differential growth in airway wall remodeling in asthma," *J. Appl. Physiology*, **110**:4. (2011), pp. 1003-12.
- D.E. Moulton, A. Goriely, "Circumferential buckling instability of a growing cylindrical tube," *J. Mech. and Phys. of Solids*, **59** (2011) 525–537.
- D.E. Moulton, A. Goriely, "Anticavitation and differential growth in elastic shells," *J. Elasticity*, **102**:2, (2011), pp. 117–132.
- A. Goriely, D.E. Moulton, and R. Vandiver, "Elastic cavitation, tube hollowing, and differential growth in plants and biological tissues," *Euro. Phys. Lett.*, **91** (2010), 18001.
- A. Goriely, D. E. Moulton, New Trends in the Physics and Mechanics of Biological Systems: Lecture Notes of the Les Houches Summer Schools, volume 92, chapter *Morphoelasticity - A theory of elastic growth* (M. Ben Amar, A. Goriely, M. Mueller, Editors) Oxford University Press, 2010.
- J.M. Restrepo, D.E. Moulton, and H. Uys, "Precessive Sand Ripples in Intense Steady Shear Flows," *Phys. Rev. E*, **83** (2011), 031305.
- D.E. Moulton, J.A. Pelesko, "Reverse Draining of a Magnetic Soap-Film," *Phys. Rev. E*, **81** (2010), 046320.
- D.E. Moulton, J. Lega, "Reverse draining of a magnetic soap film - Analysis and simulation of thin film equation with non-uniform forcing," *Physica D*, **238** (2009), pp. 2153–2165.
- D.E. Moulton, J.A. Pelesko, "Catenoid in an Electric Field," *SIAM J. Appl. Math*, **70** No. 1 (2009), pp. 212–232.
- D.E. Moulton, J.A. Pelesko, "Theory and Experiment for Soap-Film Bridge in an Electric Field," *J. Colloid Interface Sci.*, **322** No. 1 (2008), pp. 252–62.
- D. Moulton, J.A. Pelesko, "Thermal Boundary Condition - an Asymptotic Analysis," *Heat and Mass Transfer* **44** No. 7 (2008), pp. 795–803.

SUPERVISION

Doctoral students

- Stephen O'Keeffe, *The mechanics of growth and muscle contraction in soft tissues*, Oct 2011 – present
- Lucie Bowden, *Mathematical modelling of full thickness wounds and the effects of diabetes*, Oct 2012 – present

Masters students

- Claudiu Antonovici, *Modelling the growth of tumour spheroids*, Summer 2014
- Michael Gomez, *Flow induced snap-through*, Summer 2014

Undergraduate projects

- Valentin Sulzer, *Modelling umbrella cells in bladder*, Summer 2014
- Valentin Brunck, *Modelling the optimal geometry of seashells*, Summer 2014

[1]Highlighted in Nature magazine, week of April 1, 2013

SERVICE

Workshops, conferences, seminars

- Supervisor in European Summer School in Industrial Mathematics Modelling Week, Milan Italy, July 2011.
- Organiser of Modeling and Computation Seminar, Applied Mathematics, University of Arizona, 2009-2010.
- Organiser of Graduate Student Seminar for math department, 2006 - 2007.

Admissions, hiring

- Hiring panel for JRF, Balliol College, March 2014
- Undergraduate admissions exercise, University of Oxford, 2011-2014

Other

- Mathematics consultant for Warner Bros. major motion picture *Sherlock Holmes 2*, 2010-2011.
- Reviewer for: Proc. Royal Soc. A, Phys. Rev. E, J. Math Biology, SIAM J. Applied Math, European J. Applied Math, J. of Microelectromechanical Systems, J. of Electrostatics, J. of Micromech. and Microeng., and Int. J. of Solids and Structures.
- Speaker during 'Research Careers' session of Careers Event, Mathematical Institute, University of Oxford, January 2013
- Group mentor for undergraduate modeling course at the University of Arizona, spring 2009.
- Treasurer of University of Delaware chapter of SIAM, 2006 - 2008.
- President of Pi Mu Epsilon, University of Denver, 2002 - 2003.

SCIENTIFIC ACTIVITIES

Presentations on topic:
Seashell growth, morphogenesis, pattern formation

- Math Bio Meeting, Osaka Japan — July 2014
- Euro Evo Devo Meeting, Vienna — July 2014
- University of Pierre Marie Curie Applied Maths Seminar — April 2014
- University of Glasgow Applied Maths Seminar — May 2013
- British Applied Mathematics Colloquium, University College London — March 2012
- Christ Church Trinity Term Mathematics Lecture, University of Oxford — May 2012
- Mathematical Institute Garden Party, University of Oxford — July 2012
- Univ. of Bristol ACCIS Seminar — July 2011
- (poster) Mathematical Frontiers in the Life Sciences Conference, Univ. of Limerick — July 2011
- Oxford Solid Mechanics Graduate Seminar — June 2011

Presentation on topic:
Mucosal folding in growing elastic tubes

- Mathematical Foundations of Mechanical Biology workshop, BIRS — Sept. 2010

Presentation on topic:
Cavitation and Anticavitation in Growing Elastic Materials

- US National Congress Theor and Appl Mechanics, Penn State University — June 2010

Presentation on topic:
Role of differential growth in asthma — *(poster)*

- OCCAM Biology conference, University of Oxford — June 2010

Presentations on topic:
Thin magnetic films

· Los Alamos Days, Arizona State University — January 2009
· PS Annual Division of Fluid Dynamics Meeting, San Antonio TX — November 2008
· (poster) Dynamics Days, San Diego, CA — January 2009

Presentations on topic:
Modelling with soap films and electrostatics

· SIAM Annual Meeting, San Diego CA — July 2008
· Frontiers in Applied and Computational Mathematics (FACM), NJIT — May 2008
· University of Maryland PDEs and Applied Mathematics Seminar — March 2008
· Dynamics Days Conference, Boston, MA — January 2007

Study groups attended

· MBI Biosciences Problem Solving Workshop, Ohio State University — July 2012
Problem: *Magnetic force for scaffold colonisation by stem cells*
· Malaysian Mathematics in Industry Study Group, Universiti Teknologi Malaysia — March 2011
Problem: *Optimal placement of security cameras*
· 1st Russian Interdisciplinary Mathematical Modelling Study Group with Industry — Oct. 2010
Problem: *Crack propagation in electron beam irradiated turbine blades*

AWARDS AND HONOURS

· Millard and Lee Alexander Postdoctoral Fellowship, Christ Church College, University of Oxford, Oct. 2011 - present.
· Presented talk for winning team in Wooly Owl competition - Oxford/Cambridge Applied Mathematics meeting, Oxford, June 2011.
· Travel award to attend US Congress on Theoretical and Applied Mechanics, Penn State University, June 2010.
· Fellowship to attend "New trends in the physics and mechanics of biological systems," summer school at Ecole de Physique in Les Houches, France, July 2009.
· SIAM Student Representative at Annual Meeting for University of Delaware, San Diego CA, July 2008.
· University of Delaware SIAM Student Chapter Certificate of Recognition, May 2008.
· Unidel Fellowship, University of Delaware, Spring 2008, Spring 2006.
· Travel grant, Pan American Advanced Study Institutes, Mar del Plata, Argentina, August 2007.
· Travel grant, Dynamics Days, Boston, MA, January 2007.
· NSF Summer Institute Fellowship to attend Nano Materials and Mechanics Course, Northwestern University, August 2006.
· Baxter-Sloyer Graduate Teaching Award, University of Delaware, March 2004.
· Top Mathematics Student Award, University of Denver, March 2003.
· Honors Program, University of Denver, 1999-2003.

TEACHING

Techniques of Applied Mathematics
University of Oxford — *2013,14*

· Lecturer

1st year Applied Mathematics course
University of Oxford — *2013-present*

· College Tutor

Solid mechanics
University of Oxford *2012*

· Tutor

Elasticity and plasticity
University of Oxford *2012*

· Tutor

Mathematical modelling
University of Oxford *2012*

· Supervisor

Differential equations
University of Delaware *2007, 08*

· Lecturer

Calculus courses
University of Arizona, University of Delaware *2004-2010*

· Lecturer