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Education

- Ph.D. in mathematics, University of Washington, August 2001
 - Thesis: An End to End Gluing Construction for Surfaces of Constant Mean Curvature
 - Advisor: Daniel Pollack
 - B.A. in mathematics, University of California at Berkeley, May 1995
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Research Interests: geometric analysis; specifically mean curvature, scalar curvature, Q -curvature, eigenvalues of the Laplace-Beltrami operator, isoperimetric inequalities in the spirit of Pólya and Szegő

Employment:

- Permanent Lecturer, University of Cape Town, August 2010–present (this is equivalent to a tenured assistant professor position in the US)
 - Visiting Lecturer, University College Cork, Sept. 2009–June 2010
 - Postdoctoral Fellow (under B. McKay), University College Cork, Sept. 2008–Sept. 2009
 - Temporary Assistant Professor, University of Georgia, August 2007–May 2008
 - Postdoctoral Fellow, University of Connecticut, August 2004–May 2007
 - Postdoctoral Fellow, University of Utah: August 2001–May 2004
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Honors, Awards, and Funding:

- rated researcher by the National Research Foundation of South Africa, effective Jan. 1, 2013 (This entitles me to R40,000 per year towards research.)
 - Carnegie Research Development Grant, funded by the University of Cape Town
 - Postdoctoral Fellow Sept. 2008–June 2009, funded by the Science Foundation of Ireland
 - VIGRE fellow, January–June 2001, funded by the National Science Foundation of the US
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Publications:

- Monotonicity of the first Dirichlet eigenvalue of the Laplacian on manifolds with nonpositive curvature. (joint with T. Carroll), preprint, [arXiv:AP/1407.0864](https://arxiv.org/abs/1407.0864).

- A reverse Hölder inequality for extremal Sobolev functions. (joint with T. Carroll), to appear in *Potential Anal.*, [arXiv:AP/1403.7355](#).
- A numerical investigation of level sets of extremal Sobolev functions. (joint with S. Juhnke), submitted, [arXiv:NA/1401.2313](#)
- An isoperimetric inequality for extremal Sobolev functions. (joint with T. Carroll), *RIMS Kôkyûroku Bessatsu*, **B43** (2013), 1–16.
- Two isoperimetric inequalities for the Sobolev constant. (joint with T. Carroll), *Z. Angew. Math. Phys.*, **63** (2012), 855–863.
- Isoperimetric inequalities and variations on Schwarz’s lemma (joint with T. Carroll), [arXiv:SP/1006.2310](#) (subsumed by the above paper in *Z. Angew. Math. Phys.*)
- Interpolating between torsional rigidity and principal frequency (joint with T. Carroll), *J. Math. Anal. Appl.*, **379** (2011), 818–826.
- Eigenvalues of Euclidean wedge domains in higher dimensions, *Calc. Var. PDE*, **42** (2011), 93–106.
- A Payne-Weinberger estimate for wedge domains on spheres (joint with A. Treibergs), *Proc. Amer. Math. Soc.* **137** (2009), 2299–2309.
- Coplanar k -unduloids are nondegenerate (joint with K. Grosse-Brauckmann, N. Korevaar, R. Kusner, and J. Sullivan), *Int. Math. Res. Not.*, **2009** (2009), 3391–3416.
- A capture problem in Brownian motion and eigenvalues of spherical domains (joint with A. Treibergs), *Trans. Amer. Math. Soc.* **361** (2009), 391–405.
- On the Nondegeneracy of constant mean curvature surfaces (joint with N. Korevaar and R. Kusner), *Geom. Funct. Anal.* **16** (2006), 891–923.
- An end to end gluing construction for metrics of constant positive scalar curvature, *Indiana Univ. J. Math.* **52** (2003), 703–726.

Projects in progress

- further isoperimetric and stability inequalities for the best Sobolev constant and its associated extremal functions (joint with T. Carroll).
- level sets of extremal Sobolev function (joint with T. Carroll). We conjecture that the level sets of functions which realize equality in the Sobolev inequality vary monotonically as the exponent increases.
- conformally flat, constant Q -curvature metrics with isolated singularities

Invited Lectures

- Special session in geometric variational problems at the Tenth American Institute of Mathematical Sciences conference on Dynamical Systems, Differential Equations, and Applications, July 2014, Madrid
- Workshop on Kähler geometry and geometric analysis, May 2014, Cork, Ireland
- Geometry/Topology/Analysis seminar, Univ. Mass. Amherst, April 2014, Amherst, MA, USA.
- Differential geometry seminar, CUNY Graduate Center, April 2014, New York, NY, USA

- Geometry seminar, University of Rochester, April 2014, Rochester, NY, USA
- Analysis seminar, University College Dublin, March 2014, Dublin, Ireland
- Colloquium, School of Mathematical Sciences, University College Cork, Feb. 2014, Cork, Ireland
- Special session in complex and geometric analysis at the Joint National Meeting of the American Mathematical Society and Mathematical Association of America, Jan. 2014, Baltimore
- Special session in analysis and PDE at the Joint National Meeting of the American Mathematical Society and the Mathematical Association of America, Jan. 2014, Baltimore
- Special session in geometry the the national congress of the South African Mathematical Society, Nov. 2013, Durban
- Special session in geometry and differential equations at the SAMS national congress, Dec. 2011
- Geometric Analysis Seminar, University of Helsinki, Sept. 2011
- Workshop on de Giorgi's conjecture, Banff International Research Station, Banff, Canada, Aug. 2010
- Workshop on Geometry, Analysis, and String Theory, Leibniz University, Hannover, July 2009
- Irish Geometry Conference, University College Cork, May 2009
- Geometry Day, Granada, Spain, Dec. 2008
- Geometry Seminar, Stanford University, May 2008
- 18th Southeast Geometry Conference, Columbia, SC, March 2008
- Geometry Seminar, Georgia Institute of Technology, Dec. 2007
- Oberwolfach workshop, Progress in Surface Theory, May 2007
- Differential Geometry seminar, CUNY, Oct.2006
- Differential Geometry Seminar, MIT, April 2006
- Valley Geometry Seminar, UMass, Feb. 2006
- Differential Geometry/PDE seminar, Univ. Washington, May 2005
- 16th Southeast Geometry Conference, March 2005
- Geomtry, Analyis, Numerics, and Graphics seminar, Univ. Mass. at Amherst, April 2001, Feb. 2002, October/November 2004, April 2005
- Geometry seminar, Idaho State University, June 2004
- Special session in nonlinear PDE, National meeting of the American Mathematical Society, Phoenix, AZ, Jan. 2004
- Topology seminar, Georgia Tech, Dec. 2002
- Special session in the Winter Meeting of the Canadian Mathematical Society, Dec. 2001

Contributed Talks

- Conference on Teaching and Learning, University of Cape Town, Oct. 2013
- Conference in Geometric Analysis, Universidad Autònoma de Barcelona, July 2013.
- Queen Dido Conference on Isoperimetry, Carthage, Tunisia, May 2010
- Summer School in Conformal Geometry, Potential Theory, and Applications, NUI Maynooth, Ireland, June 2009
- Lehigh University Geometry and Topology Conference, Oct. 2007

Student Supervision

- Murray Christian, PhD at the University of Cape Town, May 2011-present. Topic: constant mean curvature surfaces in $\mathbf{H}^2 \times \mathbf{R}$.
- Mogtaba Mohammed, AIMS postgraduate diploma, Feb.–June 2011. Topic: Weyl's asymptotic formula for eigenvalues of the Laplacian.
- Humphrey Marufu, honours project at the University of Cape Town, March–Nov. 2012. Topic: extremal domains for three variational problems.
- Stefan Juhnke, honours project at the University of Cape Town, Feb 2013-present. Topic: geometry of level sets of extremal Sobolev functions.
- 8 final year capstone projects in topics including the maximum principle for elliptic PDE, the classical isoperimetric inequality, maximal surfaces in Minkowski space, classification of hyperbolic isometries, and groups & three-dimensional manifolds.

Teaching Experience

I have been the sole instructor or course leader (which includes writing syllabi and exams) for the following courses.

- at the University of Cape Town:
 - first year course for applied mathematics (MAM1044, 2011)
 - fourth year (honors) course in PDE (2011, 2012, and 2013)
 - second year linear algebra (MAM2000-2LA, 2012, 2013)
 - second year differential equations (MAM2000-2DE, 2013)
- at University College Cork:
 - real analysis II (undergraduate, fall 2009)
 - introductory mathematics (fall 2009 and spring 2010)
 - topology and metric spaces (spring 2010)
- at the University of Georgia:
 - abstract algebra (undergraduate, fall 2007)
 - single-variable calculus (fall 2007)
 - multi-variable calculus (spring 2008)
 - Euclidean geometry (spring 2008)
- at the University of Connecticut:

- single-variable calculus (fall 2004, fall 2006)
- geometry (fall 2004, spring 2005),
- multi-variable calculus (spring 2005, fall 2005, fall 2006)
- ordinary differential equations (spring 2006, spring 2007)
- complex analysis (spring 2006)
- writing in mathematics (spring 2007)
- at the University of Utah:
 - partial differential equations for engineers (fall 2003)
 - topics in Riemannian geometry: the Yamabe problem (spring 2003)
 - trigonometry (fall 2002)
 - linear algebra (spring 2002)
 - ordinary differential equations (fall 2001, spring 2004)
- at the University of Washington:
 - multivariable calculus (summer 2000, spring 1999)
 - ordinary differential equations (summer 1999)
 - first year calculus (summer 1997)
 - remedial algebra (winter 1997)

I was a part of the lecturing team for the standard first year mathematics course at the University of Cape Town, July-Nov. 2012.

I have also assisted in teaching classes ranging from freshman calculus to graduate geometry and topology, led discussion sections, staffed drop-in tutoring centers, and graded for a variety of courses.

Academic and Professional Service:

- I have chaired a committee to reorganize the second and third year courses in pure and applied mathematics at the University of Cape Town. This proposal is currently under review by the science faculty.
- I was a member of a search committee to find a new head of the mathematics department at the University of Cape Town.
- I introduced and pioneered the use of WebWork, an online homework tool, for first and second year mathematics courses at the University of Cape Town.
- In a joint project with Rob Martin and Julian Gordon (the departmental IT officer), I overhauled the University of Cape Town mathematics and applied mathematics department webpage.
- referee for *Inventiones Mathematicae*, *Experimental Mathematics*, *Annales des Sciences de Toulouse*, *Colloquium Mathematicum*
- reviewer for *Math Reviews*
- organizer for a workshop in geometric analysis at the African Institute of Mathematical Sciences, Dec. 2012
- organizer for a special session in geometric differential equations at the 2011 South African Mathematical Society national congress in Port Elizabeth

- co-organizer for a special session in the fall 2006 American Mathematical Society northeastern sectional meeting
- co-organizer of research level Geometry seminar at U. Connecticut, September 2004–May 2007
- organizer for the spring 2004 meeting of the Pacific Northwest Geometry Seminar
- co-organizer of research level PDE/Differential Geometry seminar at U. Utah, August 2003–May 2004
- assisted with a VIGRE Minicourse in nonlinear wave phenomena, August 2003
- faculty advisor for the graduate student geometry seminar, August–December, 2002
- assisted with a VIGRE Minicourse in variation methods and nonlinear PDE, particularly in organizing a series of lectures on minimal surfaces, May 2002
- organizer of graduate student geometry seminar, 1998–2000

Outreach and Community Service:

- guest lecturer in mathematical enrichment sessions for secondary school students in Cape Town, South Africa, March 2012 and August 2011 (three lectures, one each on the isoperimetric inequality, knots, and coloring of graphs)
- led mathematical enrichment sessions for secondary school students in Cork, Ireland, February 2010 (two sessions, one each on inequalities and a discrete model for heat flow)
- led a series of three lectures on fractals in the University of Utah Math Circle, a high school outreach program, April 2003
- assisted with the Math Circle program, September 2002–May 2004
- co-founder, board of directors (2003-4) of the Salt Lake City Bicycle Collective
- volunteer mechanic, Bicycle Recycling Program, Athens, GA, US, 2007-2008

Preprints and references available upon request.