

# David Bachman

Professor, Pitzer College

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## ACADEMIC APPOINTMENTS

Professor, <i>Pitzer College</i>	2013-present
Associate Professor, <i>Pitzer College</i>	AY 2008-2013
Assistant Professor, <i>Pitzer College</i>	AY 2004-08
Assistant Professor, <i>California Polytechnic State University at San Luis Obispo</i>	AY 2002-04
Research Assistant Professor, <i>The University of Illinois at Chicago</i>	AY 2000-02
Assistant Professor, <i>Portland State University</i>	AY 1999-2000

## EDUCATION

Ph.D., Mathematics, <i>The University of Texas at Austin</i>	May 1999
Dissertation: <i>A Piecewise-Linear Theory of Minimal Surfaces of Non-Zero Index</i>	
Advisor: C. McA. Gordon	
B.S., Mathematics, <i>State University of New York at Binghamton</i>	June 1993

## RESEARCH INTERESTS

Computer Science: *discrete differential geometry, machine learning, reinforcement learning*  
Knot theory and 3-Manifold Topology: *normal surfaces, Heegaard splittings.*  
Geometry: *hyperbolic geometry, minimal surfaces, surface modeling.*

## COURSES TAUGHT

Computer Science: *Intro to Computer Science, Machine Learning, Foundations of Data Science in R, Foundations of Data Science in Python, Discrete Differential Geometry, Reinforcement Learning, Algorithms*

Mathematics: *College Algebra, Pre-Calculus, Calculus I-III, Linear Algebra, Differential Equations, Discrete Math, Topology I,II, Set Theory, Dynamical Systems, Differential Forms, Graph Theory, Combinatorial Group Theory, Differential Geometry, Combinatorial Game Theory, Mathematics of Cartography, Mathematics of Poker, Mathematics and 3D-Printing, Geometric Modeling*

## GRANTS AND AWARDS

Pitzer College, <i>Scholar in Residence</i>	Fall 2020
NSF Research Grant (PI, DMS-1207804), "Applications of Topologically Minimal Surfaces"	2012-15
NSF Research Grant (PI, DMS-0906151), "Topologically Minimal Surfaces in 3-Manifolds"	2009-12
Math Circle mini-grant (PI)	2010-11
Support for the "Gateway to Exploring the Mathematical Sciences Program."	
MAA Tensor-SUMMA Grant (PI)	2010-11
Support for the "Gateway to Exploring the Mathematical Sciences Program."	
State Faculty Support Grant, <i>California Polytechnic State University, San Luis Obispo</i>	Winter 2003
Outstanding Teaching Award nomination, <i>Portland State University</i>	June 2000
Continuing Fellowship, <i>University of Texas at Austin</i>	Spring 1999, Fall 1998
David Bruton Jr. Graduate Fellowship, <i>University of Texas at Austin</i>	Fall 1997, Summer 1995

## PUBLICATIONS

Books

1. “Grasshopper: Visual Scripting for Rhinoceros 3D,” Industrial Press (2017).
2. “A Geometric Approach to Differential Forms,” Birkhäuser, Boston (1st edition, 2006; 2nd edition, 2012).
3. “Advanced Calculus DeMYSTiFieD,” McGraw-Hill (2007).

#### Papers

1. “Heegaard Splittings with Boundary and Almost Normal Surfaces,” *Topology and its applications* 116 (2001) 153-184.
2. “Critical Heegaard Surfaces and Index 2 Minimal Surfaces,” *Proceedings of the Conference on Heegaard splittings and Dehn surgeries of 3-manifolds, Kyoto (Japan), July, 2001*.
3. “Critical Heegaard Surfaces,” *Transactions of the American Mathematical Society* 354 (2002), 4015-4042.
4. “Thin position for tangles,” (with S. Schleimer) *Journal of Knot Theory and its Ramifications* 12, No. 1 (2003) 117-122.
5. “A note on Kneser-Haken finiteness,” *Proceedings of the American Mathematical Society* 132 (2004) 899-902.
6. “Large embedded balls and Heegaard genus in negative curvature,” (with D. Cooper and M. White) *Algebraic & Geometric Topology* 4, No. 3 (2004) 31-47.
7. “Distance and bridge position,” (with S. Schleimer) *Pacific Journal of Mathematics*. **219** (2005), no. 2, 221-235.
8. “Surface Bundles versus Heegaard Splittings,” (with S. Schleimer) *Communications in Analysis and Geometry* 13, No. 5 (2005) 1-26.
9. “Sweepouts of amalgamated 3-manifolds,” (with S. Schleimer and E. Sedgwick) *Algebraic & Geometric Topology* 6(2006) 171-194.
10. “Non-isotopic Heegaard splittings of Seifert fibered spaces,” (with R. Derby-Talbot) *Algebraic & Geometric Topology* 6(2006) 351-372.
11. “Degeneration of Heegaard genus, a survey,” (with R. Derby-Talbot), Workshop on Heegaard Splittings, *G & T Monographs* **12** (2007) 1-15.
12. “Connected sums of unstabilized Heegaard splittings are unstabilized,” *Geometry & Topology* 12 (2008), no. 4, 2327-2378.
13. “Topological Index Theory for Surfaces in 3-Manifolds,” *Geometry & Topology* 14 (2010) 585-609.
14. “On the existence of high index topologically minimal surfaces,” (with Jesse Johnson), *Mathematical Research Letters* 17 (2010), no. 3, 389-394.
15. “Stabilizing and Destabilizing Heegaard Splittings of Sufficiently Complicated 3-Manifolds,” *Mathematische Annalen* 355 (2013), no. 2, 697-728.
16. “Almost normal surfaces with boundary,” (with R. Derby-Talbot and E. Sedgwick), *Contemporary Mathematics*, **597** (2013), 177-194.
17. “Surfaces that become isotopic after Dehn filling,” (with R. Derby-Talbot and E. Sedgwick), *Communications in Analysis and Geometry*, **23** (2015) no. 2, 363-376.
18. “Heegaard structure respects complicated JSJ-decompositions,” (with R. Derby-Talbot and E. Sedgwick), *Mathematische Annalen* online (2015), 1-18.
19. “Computing Heegaard Genus is NP-Hard,” (with R. Derby-Talbot and E. Sedgwick), in “A Journey through Discrete Mathematics. A Tribute to Jiří Matoušek” edited by Martin Loeb, Jaroslav Nešetřil and Robin Thomas, Springer (2017).
20. “Visualizing Mathematics with 3D printing (Book Review),” *Journal of Mathematics and the Arts*, **11** (2017) no. 1, 59-61.
21. “Locally Helical Surfaces have Bounded Twisting,” (with R. Derby-Talbot and E. Sedgwick), *Pacific Journal of Mathematics* 292 (2018), no. 2, 257-272.
22. “From the Golden Ratio to Fibonacci Phyllotaxis Spirals,” *Math Horizons* 26 (2018), no. 3, 18-21.
23. “Procedural Organic Modeling,” *ACM SIGGRAPH '19 Educator's Forum* (proceedings). Los Angeles, CA 2019.

24. “Cohomology fractals, Cannon-Thurston maps, and the geodesic flow,” (with M. Goerner, S. Schleimer, and H. Segerman) *Experimental Mathematics* 31 (2022) no. 4, 1047–1085.

#### PROFESSIONAL EXPERIENCE

##### Journal Referee

*Proceedings of the AMS, Geometry & Topology, Memoirs of the AMS, Topology and its Applications, Experimental Mathematics, Boletín of the Mexican Mathematical Society, Science in China, Series A: Mathematics, Algebraic & Geometric Topology, Journal of Knot Theory and its Ramifications, Transactions of the AMS, Frontiers of Mathematics in China*

##### Reviewer

*Zentralblatt MATH, Mathematical Reviews Database, Addison-Wesley Publishing, National Science Foundation, Israel Science Foundation*

##### Organizer/Coordinator

Semester Program on “Illustrating Mathematics” <i>Institute Henri Poincaré</i>	Jan-March 2026
Reunion/expansion conference on “Illustrating Mathematics” <i>Institute for Computational and Experimental Mathematics</i>	August 2025
Workshop on “Illustrating Mathematics” <i>Park City Mathematics Institute</i>	July 2021
Semester Program on “Illustrating Mathematics” <i>Institute for Computational and Experimental Mathematics</i>	Sep-Dec 2019
Southern California Topology Conference in honor of the retirement of Jim Hoste <i>Claremont Colleges Consortium</i>	April 2018
Gateway to Exploring the Mathematical Sciences program (Claremont Math Circle) <i>Claremont Colleges Consortium</i>	AY 2009-11
Southern California Topology Colloquium <i>Claremont Colleges Consortium</i>	March 2011
Southern California Topology Colloquium <i>Claremont Colleges Consortium</i>	February 2010
AMS sectional meeting special session in Topology <i>Claremont McKenna College</i>	May 2008
Geometry, Topology & Dynamical Systems seminar <i>University of Illinois at Chicago</i>	AY 2000-01
Cascade Topology Conference <i>Portland State University</i>	May 2000
Saturday Morning Math Group <i>University of Texas, Dept. of Mathematics</i>	Spring 1996

#### INVITED CONFERENCE TALKS

AMS Section Meeting, San Luis Obispo, CA Title: <i>Learning Optimal Knot Projections</i>	May 3, 2025
AMS Section Meeting, Fresno, CA Title: <i>Discrete Mean curvature for Hyperbolic Surfaces</i>	May 6, 2023
AMS Section Meeting, Riverside, CA Title: <i>Visualizing Cannon-Thurston Maps</i>	November 9, 2019

AMS Section Meeting, Riverside, CA	November 9, 2019
Title: <i>All odd length polygonal knots are strip knots</i>	
SIGGRAPH Educator Workshop, Los Angeles, CA	July 29, 2019
Title: <i>Procedural Organic Modeling</i>	
Mathematical Congress of the Americas, Guanajuato, Mexico	August 5-9, 2013
Title: <i>Normalizing Topologically Minimal surfaces</i>	
Low-dimensional Topology and Geometry in Toulouse ,Toulouse, France	June 24-28, 2013
Title: <i>Normalizing Topologically Minimal surfaces</i>	
AMS Section Meeting, Ames, IA	April 27, 2013
Title: <i>Normalizing Topologically Minimal surfaces</i>	
Workshop on Minimal Surfaces, 3-Manifold Topology and Related Topics, Boston, MA	April 28, 2013
Title: <i>Parallels between Geometrically Minimal and Topologically Minimal surfaces</i>	
46th Spring Topology and Dynamics Conferences (semi-plenary speaker), Mexico City, Mexico	
Title: <i>Topological, PL, and geometric minimal surfaces</i>	
	March 22-24, 2012
The 8th East Asian School of Knots and Related Topics (plenary speaker), Daejeon, Korea	
Title: <i>Topological, PL, and geometric minimal surfaces</i>	
	January 9-12, 2012
AMS Section Meeting, Iowa City, IA	March 20, 2011
Title: <i>Normalizing Topologically Minimal Surfaces</i>	
MAA Mathfest, Portland, OR	August 7, 2009
Title: <i>Convergence of Discrete Poker Models</i>	
Geometric Topology in 3 and 4 Dimensions, in honor of Martin Scharlemann, Davis, CA	
Title: <i>Topologically Minimal Surface in 3-Manifolds</i>	
	June 23-26, 2009
Joint AMS/MAA meeting, Washington, DC	January 6, 2009
Title: <i>Topological Index Theory for Surfaces in 3-Manifolds</i>	
Cascade Topology Conference, Portland, OR	November 8-9, 2008
Title: <i>Topological Index Theory for Surfaces in 3-Manifolds</i>	
Joint AMS/MAA meeting, San Diego, CA	January 9, 2008
Title: <i>Counter-examples to the Stabilization Conjecture</i>	
Conference on Heegaard splittings of 3-Manifolds, Haifa, Israel	July 10-20, 2005
Title: <i>Gordon's Conjecture</i>	
AMS meeting, Santa Barbara, CA	April 16-17, 2005
Title: <i>Heegaard splittings and connected sums</i>	
Complex of Curves Fest, Caltech	January 7-9, 2005
Title: <i>Waldhausen's converse</i>	
Joint AMS/MAA meeting, San Diego, CA	January 5-9, 2002
Title: <i>A machine for constructing almost normal surfaces</i>	
Conference on Heegaard splittings and Dehn surgeries of 3-manifolds, Kyoto, Japan	July 5-12, 2001
Title: <i>Critical Heegaard Surfaces</i>	
AMS meeting, New York, New York	November 4-5, 2000
Title: <i>A new class of useful surfaces in 3-manifolds</i>	
AMS meeting, Santa Barbara, CA	February 12-13, 2000
Title: <i>Piecewise-Linear Index 2 minimal surfaces.</i>	

International workshop on Geometry and Topology, Haifa, Israel Title: <i>Minimizing Morse functions transverse to boundaries</i>	January 5-12, 1999
AMS meeting, Winston-Salem, NC Title: <i>Minimizing Morse functions transverse to boundaries</i>	October 9-10, 1998
AMS meeting, Louisville, KY Title: <i>Boundary Heegaard Splittings</i>	March 20-21, 1998
Georgia Topology Conference, Athens, GA Title: <i>Immersed Foliations and Normal Surfaces</i>	July 30-August 3, 1997
Workshop on Low Dimensional Topology and Geometric Group Theory, Canberra, Australia Title: <i>Isotopic Normal Surfaces</i>	June 25-27, 1997
Dehn Surgery Conference, Fayetteville, Arkansas Title: <i>Isotopic Normal Surfaces</i>	April 10-12, 1997
Workshop on Computation and Algorithmic Methods in Three Dimensional Topology, Mathematical Sciences Research Institute, Berkeley, CA Title: <i>Isotopic Normal Surfaces</i>	March 10-14, 1997
Low Dimensional Topology Seminar, Mathematical Sciences Research Institute, Berkeley, CA Title: <i>Isotopic Normal surfaces</i>	December 12, 1996
AMS meeting, Iowa City, IA Title: <i>Recognizing Lens Spaces</i>	March 22-23, 1996

#### SEMINAR AND COLLOQUIA TALKS

MIT, Yale, Princeton, UC Bekeley, Caltech, Columbia, UCLA, UCSD, UCSB, UC Davis, UC Riverside, University of Melbourne, Rutgers Newark, American Institute of Mathematics, Boston College, UIC, UT Austin, Cal Poly SLO, Portland State University, Kansas State University, U Penn, Claremont, USC, Georgia tech, UGA, Cal State Channel Islands, Cal Poly Pomona, U of Arkansas, Cal State Fullerton, Cal State Long Beach, Oklahoma State.

#### COMMITTEES/SERVICE

Budget Implementation Committee (chair)	AY 2023-24, 2024-25
Academic Planning Committee	AY 2022-23
Admissions Liaison Committee	AY 2022-23
Academic Planning Committee, chair	AY 2021-22
Facilities & IT Committee	AY 2019-20
Data Science Curricular Coherence Committee	AY 2018-20
Computer Science Task Force	AY 2018-20
Claremont Center for the Mathematical Sciences Executive Committee	AY 2018-20
Campus Life Committee	AY 2015-16
Appointments, Promotion and Tenure Committee	AY 2014-15
Claremont Center for the Mathematical Sciences Executive Committee, Director	AY 2012-14
Academic Planning Committee, chair	AY 2013-14
Academic Planning Committee	AY 2012-13
IT director search committee	Summer 2012
Faculty liaison for external review of Pitzer IT	Fall 2011
Claremont Center for the Mathematical Sciences Executive Committee	AY 2009-14
Faculty Executive Committee, Chair	Fall 2010
Faculty Executive Committee	AY 2009-11
Budget Implementation Committee	AY 2009-10
Personnel Review Committee	Spring 2009

Alumni Board

Personnel Review Committee

Research and Awards Committee

Personnel Review Committee

AY 2007-08, 2008-09

Spring 2008

2006-07

Fall 2005