
Justin Solomon

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Education

- 2010-2015 **Ph.D. in Computer Science, Stanford University** (Advisor: Leonidas Guibas) *Stanford, CA*
Geometric Computing Group, Department of Computer Science
- Dissertation: "Transportation Techniques for Geometric Data Processing"
 - Distinction in Teaching (completed 2013)
 - Hertz Foundation Graduate Fellowship, National Science Foundation (NSF) Graduate Research Fellowship, and National Defense Science & Engineering Graduate (NDSEG) Fellowship
- 2010-2012 **Master of Science in Computer Science, Stanford University** (Advisor: Leonidas Guibas) *Stanford, CA*
Qualifying exam in Computer Science Theory (topic: "PDE Approaches to Graph Analysis")
- 2006-2010 **Bachelor of Science, Stanford University** (Advisors: Leonidas Guibas and Richard Schoen) *Stanford, CA*
Double major in Computer Science (honors) and Math (honors); GPA: 4.138
- 2002-2006 **Thomas Jefferson High School for Science and Technology (TJHSST)** *Alexandria, VA*

Experience

- 2016-Present **MIT, Department of Electrical Engineering & Computer Science** *Cambridge, MA*
X-Consortium Career Development Assistant Professor: Lead the Geometric Data Processing group in MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL), studying problems processing, analysis, and editing of geometric data; teach and develop instructional material for undergraduate and graduate courses.
- 2015-2016 **Princeton University, Program in Applied & Computational Mathematics** *Princeton, NJ*
Postdoctoral fellow: Helped design optimization algorithms for cryo-electron microscopy (PI: A. Singer); research and collaboration in geometry processing, computer graphics, machine learning, and other disciplines; presented findings at academic conferences and symposia.
- 2010-2015 **Stanford University, Geometric Computing Group** *Stanford, CA*
Graduate Research Assistant: Developed algorithms for geometry processing, machine learning, and graphics using techniques from continuous differential geometry, partial differential equations, and optimization; collaborated with researchers at Stanford and other universities; presented findings at academic conferences and group meetings; led instruction and development of course materials.
- 2014 **University of Southern California, Department of Computer Science** *Los Angeles, CA*
Visiting Research Fellow: Studied numerics for Markov chain Monte Carlo (MCMC) sampling and performance capture with machine learning and graphics groups; led seminars and discussions on optimal transportation and geometric PDE; guest lecturer in introductory computer graphics course.
- 2007-2012 **Pixar Animation Studios, Tools Research Group** *Emeryville, CA*
Summer Intern (2008, 2009), Research Assistant (2008-10, 2012): Designed efficient algorithms for image processing using local histograms; examined alternatives to the bilateral filter for computational photography, stylization, and painterly rendering; implemented filters on the GPU and in Pixar's compositing software; prepared SIGGRAPH submissions and other papers.
Summer Intern (2007): Designed specialized linear solvers with fast rates of convergence for cloth simulation; demonstrated these algorithms using Pixar's physics simulation system.
- 2008-2010 **Stanford University, Geometric Computing Group** *Stanford, CA*
Research Assistant: Formulated methods for replicating regular surface features and detecting intrinsic symmetries; developed algorithms for approximating Killing vector fields to represent continuous surface self-isometries using machinery from discrete and continuous Riemannian geometry.
- 2010 **British Library Sound Archive, Edison Fellowship Program** *London, UK*
Visiting Researcher: Studied the history of Elgar's Cello Concerto using traditional and computerized techniques; developed software to visualize differences between performances of the Concerto.
- 2007-2008 **Stanford University, Fedkiw Group** *Stanford, CA*
Research Assistant: Supported research in hair simulation by implementing hair rendering and reflectance models; contributed to testing frameworks for computational geometry methods.
- 2006 **Mitsubishi Electric Research Laboratory, Computer Vision Applications & Devices** *Cambridge, MA*
Summer Intern: Designed multilinear models for representing face shape and reflectance simultaneously.

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| 2005-2007 | MITRE Corporation <i>Technology Intern (part time on call):</i> Developed a framework for iris recognition using multi-camera input; presented the system to engineers consulting for the US Department of Homeland Security. | McLean, VA |
| 2005 | Massachusetts Institute of Technology (MIT), Computer Graphics Group <i>Research Mentorship (Research Science Institute):</i> Applied multilinear modeling to the estimation of face shape from reflectance and video. | Cambridge, MA |
| 2005 | Computer Science Department, George Mason University <i>Computer Vision Mentorship:</i> Implemented methods for estimating rate of approach of cameras to obstacles. | Fairfax, VA |
| 2004 | Naval Research Laboratory, Virtual Reality Department <i>Summer Intern:</i> Devised algorithms for surface analysis for face recognition from shape. | Washington, DC |

Teaching Experience

Shape Analysis (6.838) MIT
Instructor (Spring 2017): Designed, organized, and presented a new course on low- and high-dimensional geometric algorithms including topics from graphics, vision, and machine learning.

Introduction to Computer Graphics (6.837) MIT
Co-Instructor (Fall 2016): Gave half of the weekly course lectures, alternating with another MIT faculty member; managed two course assistants (64 students, with W. Matusik).

Symposium on Geometry Processing Graduate School Several locations
Lecturer (Summer 2015, 2016): Introduced modern optimization algorithms applied to shape analysis in a tutorial called "Optimization Techniques for Geometry Processing" (with D. Bommes). *Lecturer (Summer 2014):* Introduced applications of the Laplace-Beltrami operator in a tutorial entitled "Laplace-Beltrami: The Swiss Army Knife of Geometry Processing" (with K. Crane and E. Vouga). *Lecturer (Summer 2012):* Introduced shape descriptors and matching to new researchers in geometry processing.

Mathematical Methods for Computer Vision, Robotics, and Graphics (CS 205A) Stanford University
Instructor (Fall 2013, Spring 2015): Redesigned and developed new materials for a course on numerical techniques with applications focus; gave weekly lectures; managed four course assistants; wrote comprehensive course notes that have been expanded into a textbook (40+ students in 2013, 100+ students in 2015).

Differential Geometry for Computer Science (CS 468) Stanford University
Co-instructor (Spring 2013): Developed and taught a new research-level course; weekly lecturer on discrete applications of differential geometry, alternating with theoretical discussions; developed practical and written assignments and projects to accompany lecture material (15 students, with A. Butscher).

Computer Graphics: Geometric Modeling (CS 348A) Stanford University
Course assistant (Winter 2013): Led weekly section and office hours; redesigned assignments and project to reflect developments in geometry processing; guest lecture on polar forms, derivatives, and continuity.

Introduction to Computer Graphics and Imaging (CS 148) Stanford University
Instructor (Summer 2012): Reorganized course to reflect a broader view of graphics; created assignments, lectures, and exams; mentored students after end of the course in research; managed course assistants; held office hours; included speakers from industry; shared materials with colleagues seeking new graphics curriculum (32 students).

Computer Graphics: Geometric Modeling (CS 348A) Stanford University
Course assistant (Winter 2012): Led weekly section on topics from class, student questions, and related topics (e.g. shared structure between Bézier curves and elliptic curve cryptography; Plücker coordinates; subdivision); held office hours; guest lecturer on mesh parameterization.

Programming Methodology (CS 106A) Stanford University
Section leader (Winter 2009): Led weekly section (~10 students); met individually with students to discuss assignments.

Publications

Textbook

Numerical Algorithms
 Justin Solomon (published by AK Peters/CRC Press, 2015; 392 pages)

Papers and Articles

Boundary Element Octahedral Fields in Volumes
 Justin Solomon, Amir Vaxman, and David Bommes (*Transactions on Graphics*, to appear 2017)

Functional Characterization of Intrinsic and Extrinsic Geometry
 Etienne Corman,* Justin Solomon,* Mirela Ben-Chen, Leonidas Guibas, and Maks Ovsjanikov (*Transactions on Graphics* 36.2, 2017)

Learning Detail Transfer based on Geometric Features

Sema Berkiten, Maciej Halber, Justin Solomon, Chongyang Ma, Hao Li, and Szymon Rusinkiewicz (Eurographics 2017, Lyon)

Shape Attributes of Brain Structures as Biomarkers for Alzheimer's Disease

Tanya Glzman, Justin Solomon, Franco Pestilli, and Leonidas Guibas (*Journal of Alzheimer's Disease*, 2016)

Entropic Metric Alignment for Correspondence Problems

Justin Solomon, Gabriel Peyré, Vladimir Kim, and Suvrit Sra (SIGGRAPH 2016, Anaheim)

Near-Isometric Level Set Tracking

Michael Tao, Justin Solomon, and Adrian Butscher (SGP 2016, Berlin)

Gromov-Wasserstein Averaging of Kernel and Distance Matrices

Gabriel Peyré, Marco Cuturi, and Justin Solomon (ICML 2016, New York City)

Continuous-Flow Graph Transportation Distances

Justin Solomon, Raif Rustamov, Leonidas Guibas, and Adrian Butsher (ArXiv Computing Research Repository abs/1603.06927, 2016)

Convolutional Wasserstein Distances: Efficient Optimal Transportation on Geometric Domains

Justin Solomon, Fernando de Goes, Gabriel Peyré, Marco Cuturi, Adrian Butscher, Andy Nguyen, Tao Du, and Leonidas Guibas (SIGGRAPH 2015, Los Angeles)

Exponential Integration for Hamiltonian Monte Carlo

Wei-Lun Chao, Justin Solomon, Dominik Michels, and Fei Sha (ICML 2015, Lille)

Earth Mover's Distances on Discrete Surfaces

Justin Solomon, Raif Rustamov, Leonidas Guibas, and Adrian Butscher (SIGGRAPH 2014, Vancouver)

Codimensional Surface Tension Flow on Simplicial Complexes

Bo Zhu, Ed Quigley, Matthew Cong, Justin Solomon, and Ron Fedkiw (SIGGRAPH 2014, Vancouver)

Wasserstein Propagation for Semi-Supervised Learning

Justin Solomon, Raif Rustamov, Leonidas Guibas, and Adrian Butscher (ICML 2014, Beijing)

Model-Based Neuroanatomy: Tractography Validation, White-Matter Connections and Geometrical Organization

Franco Pestilli, Justin Solomon, Adrian Butscher, and Brian Wandell (ISMRM 2014 accepted abstract, Milan)

A General Framework for Bilateral and Mean Shift Filtering

Justin Solomon, Keenan Crane, Adrian Butscher, and Chris Wojtan (ArXiv Computing Research Repository abs/1405.4734, 2014)

Dirichlet Energy for Analysis and Synthesis of Soft Maps

Justin Solomon, Leonidas Guibas, and Adrian Butscher (Symposium on Geometry Processing 2013, Genoa)

Soft Maps Between Surfaces

Justin Solomon, Andy Nguyen, Adrian Butscher, Mirela Ben-Chen, and Leonidas Guibas (Symposium on Geometry Processing 2012, Tallinn)

Flexible Developable Surfaces

Justin Solomon, Etienne Vouga, Max Wardetzky, and Eitan Grinspun (Symposium on Geometry Processing 2012, Tallinn)

Functional Maps: A Flexible Representation of Maps Between Shapes

Maks Ovsjanikov, Mirela Ben-Chen, Justin Solomon, Adrian Butscher and Leonidas Guibas (SIGGRAPH 2012, Los Angeles)

Fast Smoothed Shock Filtering

Antoine Vacavant, Adélaïde Albouy-Kissi, Pierre-Yves Menguy, and Justin Solomon (International Conference on Pattern Recognition 2012, Tsukuba)

As-Killing-As-Possible Vector Fields for Planar Deformation

Justin Solomon, Mirela Ben-Chen, Adrian Butscher, and Leonidas Guibas (Symposium on Geometry Processing 2011, Lausanne)

Discovery of Intrinsic Primitives on Triangle Meshes

Justin Solomon, Mirela Ben-Chen, Adrian Butscher, and Leonidas Guibas (Eurographics 2011, Llandudno)

Smoothed Local Histogram Filters

Michael Kass and Justin Solomon (SIGGRAPH 2010, Los Angeles)

On Discrete Killing Vector Fields and Patterns on Surfaces

Mirela Ben-Chen, Adrian Butscher, Justin Solomon, and Leonidas Guibas (Symposium on Geometry Processing 2010, Lyon)

Programmers, Professors, and Parasites: Credit and Co-Authorship in Computer Science

Science and Engineering Ethics 15.4 (2009): 467-489.

Deconstructing the Definitive Recording: Elgar's Cello Concerto and the Influence of Jacqueline du Pré

The Hoefler Prizes for Excellence in Undergraduate Writing (2009)

Fast and Accurate Estimation of Principal Curvatures and Directions for Morphable Models

SIGGRAPH 2007 posters, San Diego.

Putting the Science in Computer Science: ACM Inroads Magazine 39.2 (2007): 46-49.

Programming as a Second Language: *Learning & Leading with Technology* 32.4 (2004-05), 34-39.

Ready, Set, Code (two-part series in *Learning & Leading with Technology*)

“Starting a Computer Team in Your School:” 34.7 (2007), 35-6 and “Computer Team Competitions:” 34.8 (2007), 32-3.

Articles in ACM Crossroads: Introduction for 16.1 (September 2009), 15.4 (June 2009), 15.3 (March 2009), 15.2 (December 2008), 15.1 (September 2008), 14.4 (June 2008), 14.3 (March 2008), 14.2 (December 2007); “The Science of Shape,” 13.4 (June 2007); “SIGGRAPH 2006: Exploring the Art and Science of Computer Graphics,” 13.3 (March 2007)

Patents

Painterly Filtering (US 12/493,208, filed June 28, 2009)

Michael Kass, Justin Solomon (original assignee: Pixar)

Smoothed Local Histogram Filters for Computer Graphics (US8406518 B2, filed June 28, 2009)

Michael Kass, Justin Solomon, Rick Sayre (original assignee: Pixar)

Methods and Systems of Comparing Face Models for Recognition (US 12/416,716, filed April 1, 2009)

Mark Alan Livingston, Justin M. Solomon (original assignee: The United States Of America; Secretary Of The Navy)

Invited Talks

- 2017 **Scalable Optimization Algorithms for Geometry**
Laboratoire d'Informatique (LIX), École Polytechnique
- 2017 **Algorithms for Geometrically-Structured Optimization**
Tufts Electrical and Computer Engineering Seminar & KAUST Research Conference on Visual Computing
- 2017 **Regularized Optimal Transport on Graphs: Rank-1 Hessian Updates for Quadratic Regularization**
Dagstuhl Seminar: Functoriality in Geometric Data
- 2016 **Structured Assignment: Practical Linear & Quadratic Matching**
Google Vision Group
- 2016 **Toward Quadratic Optimal Transport on Graphs**
Workshop on Computational Optimal Transportation, Centre de Recherches Mathématiques
- 2016 **Computational Spectral Geometry: Tutorial and Modern Applications**
Montréal Analysis Seminar
- 2016 **Entropic Metric Alignment for Correspondence Problems**
Tristate Workshop on Imaging and Graphics
- 2016 **Practical Tools for Applied Linear and Quadratic Matching**
Data Science Meets Optimization Workshop, RWTH Aachen
- 2016 **Optimal Transportation for Practical Geometric Problems**
NYU Applied Math Seminar & Technion CGGC Seminar
- 2015 **Convolutional Wasserstein Distances for Geometry Processing**
Geometry Workshop, Seggau, Austria
- 2014 & 15 **Transportation Techniques for Geometric Data Processing**
Several institutions
- 2014 **Embracing Uncertainty in Geometric Data Analysis**
Computer Science Colloquium, University of Southern California
- 2014 **Dual Spaces and Functional Maps**
Networks of Shapes, Images, and Programs, workshop for Stanford Computer Forum
- 2013 **Representations of Maps Between Surfaces**
Computer Science Faculty Lunch, Stanford University
- 2013 **Computing and Analyzing Soft Maps**
Geometry Workshop, Strobl, Austria
- 2012 **Coping with Symmetry in Shape Analysis**
Industrial Light and Magic, San Francisco
- 2011 **Killing Vector Fields: Infinitesimal Isometries from a Linear Solve**
Geometry Workshop, Obergurgl, Austria
Institute of Science and Technology, Klosterneuburg, Austria
- 2006 **Algorithmic Gymnastics**
National Educational Computing Conference, San Diego
- 2004 & 05 **Programming as a Second Language**
National Educational Computing Conference, New Orleans (2004) and Philadelphia (2005)

Professional Activities

Organization and Service

- Organizer, Banff International Research Station (BIRS) 2018 workshop on Spectral Geometry: Theory, Numerical Analysis and Applications (with I. Polterovich and N. Nigam)
- Organizing committee, Geometry of Redistricting Summer School 2017
- Co-Chair, Symposium on Geometry Processing Graduate School 2017
- Organizer and creator, New England Symposium on Graphics 2017
- Technical papers program committee, SIGGRAPH 2017
- NSF AF Small Panel, February 2017
- Program committee, Geometric Modeling and Processing (GMP) 2017
- International Program Committee (IPC), Eurographics 2017
- NDSEG PhD Fellowship Scholarship Evaluation Panel, 2017
- Program committee, Shape Modeling International (SMI) 2016
- Program committee, Symposium on Geometry Processing (SGP) 2016
- Technical papers program committee, SIGGRAPH 2016
- Organizer, NIPS 2014 Workshop on Optimal Transport & Machine Learning (with M. Cuturi and G. Peyré)

Reviewer

- ACM Transactions on Graphics
- AISTATS
- Applied & Computational Harmonic Analysis
- Communications on Pure & Applied Mathematics
- Computers & Graphics
- Information Sciences
- International Conference on Machine Learning (ICML)
- J. of Computational Geometry & Applications
- J. of Mathematical Analysis and Applications
- J. of Mathematical Imaging & Vision
- Medical Image Analysis
- NIPS
- Pacific Graphics
- SIAM J. Mathematical Analysis
- SIGGRAPH
- SIGGRAPH Asia
- Transactions on Biomedical Engineering
- Transactions on Circuits and Systems for Video Technology
- Transactions on Image Processing
- Transactions on Pattern Analysis & Machine Intelligence
- Transactions on Signal Processing
- Transactions on Visualization & Computer Graphics
- The Visual Computer

Membership

- Sigma Xi, Scientific Research Honor Society (full member)
- Association for Computing Machinery
- Computer Science Teachers Association

Honors and Awards

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| 2017 | ACM Future of Computing Academy |
| 2017 | Army Young Investigator Award (proposal: "Smooth Modeling of Flows on Graphs") |
| 2017 | Forbes 30 Under 30: Science |
| 2015-2016 | NSF Mathematical Sciences Postdoctoral Research Fellowship |
| 2011 & 16 | U.S. Junior Oberwolfach Fellow, National Science Foundation |
| 2014 | George E. Forsythe Memorial Award for Excellence in Student Teaching |
| 2010-2015 | Hertz Foundation Fellowship (inaugural Hertz-Google Fellow) |
| 2010-2015 | National Science Foundation (NSF) Graduate Research Fellowship |
| 2011-14 | Bio-X Travel Subsidy Awardee, Stanford Bio-X Interdisciplinary Program |
| 2010-14 | Stanford Applied Music Scholarship |
| 2010-13 | National Defense Science and Engineering Graduate (NDSEG) Fellowship |
| 2010 | Second Place, Symposium on Geometry Processing (SGP) Best Paper Awards |
| 2010 | Edison Visiting Fellowship, British Library |
| 2010 | Frederick E. Terman Award for Scholastic Achievement in Engineering, Stanford University |
| 2010 | J.E. Wallace Sterling Award for Scholastic Achievement, Stanford University |
| 2010 | Outstanding Summerfield Scholar, Phi Kappa Psi Foundation |
| 2010 | Firestone Medal for Excellence in Undergraduate Research |
| 2010 | Undergraduate of the Year, Phi Kappa Psi National |
| 2009 | Pixar Animation Studios Inventor Recognition Award |
| 2009 | Hoefer Prize for Excellence in Undergraduate Writing, Stanford University |
| 2008 | Tau Beta Pi Engineering Honor Society |
| 2008 | Barry M. Goldwater Scholarship |
| 2007 | Boothe Prize for Excellence in Writing, Stanford University |
| 2007 | Finalist, Stanford CS 248 Video Game Design Competition (Project: "Paper Airplane 3D") |
| 2007 | Student Research Competition Finalist and poster presenter, SIGGRAPH 2007 |
| 2007 | President's Award for Academic Excellence in the Freshman Year, Stanford University |

2007 Team Finalist, ACM Intercollegiate Programming Contest (ICPC), Tokyo, Japan
 2006 Finalist, Intel Science Talent Search (Project: *Three-Dimensional Face Recognition from Video*)
 2004-2006 Scholarships: National Merit, Naval Research, Micron Science & Tech., Intel Excellence in CS
 2006 Awards: Mu Alpha Theta Award; USA Today All-USA High School First Academic Team (5/18/06)
 2006 Third Place (National) and First Place (State), Math/CS, Junior Science and Humanities Symposium
 2005 & 06 First (05) and Second (06) Grand Prize, Computer Science, International Science and Engineering Fair
 2005 Research Science Institute, Massachusetts Institute of Technology (Top Project Presentation Award)
 2005 Fellowships: Davidson Institute for Talent Development, Department of Homeland Security
 2004 Outstanding Intern Award, Naval Science & Engineering Apprenticeship Program (SEAP)

Other Activities

2015-2016 Cellist, Bravura Philharmonic Orchestra & Westminster Community Orchestra
 2015 Attendee, Fall NSF Grants Conference
 2010-2015 Cellist, Stanford University chamber music program
 2010-2014 Cellist (symphony and chamber music), Palo Alto Philharmonic (principal, 2013-2014)
 2006-2014 Applied Music Lessons, Stanford Department of Music (cello 2006-2014; piano 2006-2010)
 2013 Cellist, Stanford Symphony Summer Tour "In Beethoven's Footsteps"
 2012, 13 Mentor, Stanford CS Undergraduate Research Internship (CURIS)
 2010 Organizer, "A Taste of Palo Alto" (to benefit Ecumenical Hunger Program, East Palo Alto)
 2009-2010 Treasurer and Financial Manager (2009-10), Phi Kappa Psi Fraternity, Stanford University
 2009-2010 Undergraduate Representative, Department of Computer Science Curriculum Committee
 2006-2010 Cello Tutor, Tutti Program, Stanford Alliance for Service Through the Arts
 2009 Student Presenter, Stanford Music Symposium 2009: Reactions to the Record II
 2008-2009 Head Peer Academic Coordinator, Otero House, Stanford Residential Education
 2006-2009 Managing Editor (2007-2009), Associate Editor (2006-2007), *ACM Crossroads Magazine*
 2006-2009 Associate Editor (2006-07), Section Editor (2007-08), Editor in Chief (2008-09),
Stanford Undergraduate Research Journal
 2008 Speaker and Panelist, Scout Entrepreneurship Seminar, Kauffman Foundation, Kansas City
 2007, 08 Cellist, UC Berkeley Summer Symphony
 2007 Stanford Freshman Peer Mentor Program
 2006 Cellist, MIT Summer Philharmonic Orchestra
 2004-2006 Cellist, Washington Metropolitan Philharmonic Orchestra (piano finalist, 2005 Concerto Competition)
 2002-2006 TJ Computer Team (Freshman Capt. 02-03; Senior Capt. 05-06; Invitational Computing Olympiad 05)
 2005 Presenter, Interservice/Industry Training, Simulation and Education Conference (I/ITSEC), Orlando
 1999-2005 Boy Scout Troop 152 (Eagle, Philmont Venture Crew, Order of the Arrow), Vienna VA