

Ken Goldberg Research Summary

(Fall 2016)

Faculty Appointments in 5 UC Departments: IEOB (Home Dept), EECS, School of Information, Art Practice, all at UC Berkeley and Radiation Oncology at UCSF Medical School.

Over 200 peer-reviewed papers (h-index = 56), 8 US Patents, 48 Awards (including 13 Best Paper awards and nominations), 70 Art Exhibits (11 solo), over 450 Invited Lectures (30 Keynotes):

<http://goldberg.berkeley.edu/cv.html>

Director of UC Berkeley's AUTOLAB where 2 postdocs, 8 PhD students and 20+ Masters and undergrads pursue research in geometric algorithms and machine learning for Robotics and Automation. Co-Founder of the Berkeley Center for New Media (BCNM), the African Robotics Network (AFRON), the Center for Automation and Learning for Medical Robotics (CAL-MR), the CITRIS Data and Democracy Initiative (DDI), Hybrid Wisdom Labs (acquired by Survey Monkey), and Moxie Institute Film Studio.

Research funded by NSF, Google, Intel, craigslist, Knight Foundation, GM, Ford, Cisco, Siemens, Fujitsu, Humana, Panasonic, Bayer, and Unilever.

1995: NSF PECASE (Presidential Faculty Fellowship) from NSF and President Bill Clinton.

2005: Elected IEEE Fellow: "For contributions to networked telerobotics and geometric algorithms for automation."

2016: IEEE George Saridis Leadership Award, Robotics and Automation Society, "For exceptional leadership, innovations and contributions to advancing Automation Science and Engineering, particularly in public outreach and archival publications."

2009-2014. craigslist Distinguished Chair in New Media (5-year rotating Chair).

2011-2016: Editor-in-Chief of the IEEE Transactions on Automation Science and Engineering (T-ASE). Co-Founder, increased annual submissions by 500% and doubled Impact Factor to exceed that of the two major Robotics Journals (T-RO and IJRR).

1990: First Provably Complete Algorithm for Part Feeding. Proved that for any polygonal part, his algorithm is guaranteed to produce a plan to orient the part up to symmetry using a sequence of open-loop parallel-jaw grasping motions. *Orienting Polygonal Parts Without Sensors*. K. Goldberg. *Algorithmica*. Volume 10(3), 201-225, August, 1993. Combined geometric characterization of push mechanics with a design for a zero-friction "kinematically yielding gripper" using linear bearings (U.S. Patent 5,098,145). Subsequently extended the result with PhD students and collaborators to any part with algebraic boundaries, related plan complexity to the geometric eccentricity of the part, and applied the algorithm to problems with fences on conveyor belts, vibratory feeding, and micro-scale parts.

1994: First Robot on the Internet.

1995-2004: The "Telegarden", operated by over 100,000 people, "more than any other robot in history."

1996: First Complete Algorithm for Modular Fixturing. A Complete Algorithm for Designing Planar Fixtures using Modular Components, R. C. Brost and K. Y. Goldberg, IEEE Transactions on Robotics and Automation. 12(1), Feb. 1996 Page(s):31 - 46.

2000: Selected for the Whitney Biennial of American Artists, NY, NY.

2001: First Constant-Time Collaborative Filtering Algorithm. A $O(1)$ algorithm using dimensionality reduction. Based on experience with Jester, our joke recommendation system (online for 20 years) with a public dataset of over 6.3 million ratings (cited over 1000 times: Eigentaste: A Constant-Time Collaborative Filtering Algorithm, Ken Goldberg, Theresa Roeder, Dhruv Gupta, and Chris Perkins, Information Retrieval, 4(2), 133-151. July 2001.)

2003: Algorithm for Collaborative control of pan-tilt-zoom cameras.

2004: Unilateral Fixtures for Sheet Metal Parts with Holes.

2005: D-Space and Deform Closure for Holding Deformable Parts.

2006: Optimization of HDR Brachytherapy Dose Distributions.

2007: Stochastic Motion Roadmap: A Sampling Framework for Planning with Markov Motion Uncertainty. R Alterovitz, T Siméon, K Y Goldberg Robotics: Science and Systems 3, 233-241. 2007.

2009: Three-dimensional Motion Planning Algorithms for Steerable Needles Using Inverse Kinematics.

2010: Opinion Space: A Scalable Tool for Browsing Online Comments. Using dimensionality reduction and visualization. Used by the US State Department, General Motors, Unilever, Fujitsu, Humana, the State of California (California Report Card).

2010: Steerable Needles: US Patent 7,822,458. Licensed for \$1M.

2010: Superhuman Performance of Surgical Knot Tying. Using Kalman smoother to infer policy from noisy human demonstrations and iterative learning to speed performance. Superhuman Performance of Surgical Tasks by Robots using Iterative Learning from Human-Guided Demonstrations. Jur van den Berg, Stephen Miller, Daniel Duckworth, Humphrey Hu, Andrew Wan, Xiao-Yu Fu, Ken Goldberg, Pieter Abbeel. IEEE International Conference on Robotics and Automation (ICRA). Anchorage, AL. May 2010. Recipient of Best Medical Robotics Paper Award.

2011: LQG-MP: Optimized Path Planning for Robots with Motion Uncertainty and Imperfect State Information.

2012: Skew-Line Needle Optimization for HDR Brachytherapy.

2012: Cloud-Based Grasping with Uncertainty in Shape: Estimating Lower Bounds on Achieving Force Closure with Zero-Slip Push Grasps.

2012: Visual Tracking of Human Visitors under Variable-Lighting Conditions for a Responsive Audio Art Installation

2013: Distributed Spectral Dimensionality Reduction for Visualizing Textual Data.

2014: The "SampleClean" Framework for Fast and Accurate Query Processing on Dirty Data.

2014: Nominated for an Emmy Award for short documentary film "Why We Love Robots" (co-directed with Tiffany Shlain).

2015: Efficient Proximity Probing Algorithms for Metrology.

2015: Planning Curvature and Torsion Constrained Ribbons in 3D with Application to Intracavitary Brachytherapy.

2015: Learning by Observation for Surgical Subtasks: Multilateral Cutting of 3D Viscoelastic and 2D Orthotropic Tissue Phantoms.

2015: MCAFE 1.0: Motivating and Prioritizing Ongoing Student Feedback During MOOCs and Large on-Campus Courses using Collaborative Filtering.

2015: A Survey of Research on Cloud Robotics and Automation.

2016: Multi-Arm Bandit Models for 2D Sample Based Grasp Planning with Uncertainty.

2016: Reducing Supervisor Burden in DAgger using Support Vectors for Efficient Learning from Demonstrations in High Dimensional State Spaces.

2016: SC-DL: Unsupervised Trajectory Segmentation of Multi-Modal Surgical Demonstrations with Deep Learning.

2016: Energy-Bounded Caging: Formal Definition and 2D Energy Lower Bound Algorithm Based on Weighted Alpha Shapes.

2016: Dex-Net 1.0: A Cloud-Based Network of 3D Objects for Robust Grasp Planning Using a Multi-Armed Bandit Model with Correlated Rewards. (Nominated for Best Manipulation Paper, IEEE ICRA).