Mark Huber | Curriculum Vitae

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Specialist in computational probability, with a focus on Monte Carlo simulation for statistical applications, approximation algorithms, and numerical integration in high dimensions.

Education

Harvey Mudd College
Bachelors of Science *1994*
Mathematics

Cornell University
Masters *1997*
Operations Research and Industrial Engineering

Cornell University
PhD *1999*
Operations Research and Industrial Engineering

Experience

Chemistry Animation Project **California Inst. of Technology**
Computer Animator *1991, 1992*
Created computer animated instructional videos for college chemistry.

ONR Graduate Fellowship **Naval Undersea Warfare Center**
Visiting Researcher *1995*
Developed optimization algorithms for finite element analysis output.

Data Mining Group **IBM Almaden**
Visiting Researcher *1996*
Programmer in data mining group.

School of Operations Research and Industrial Engineering **Cornell University**
Teaching Assistant *1999*
Conducted lab sessions for introductory undergraduate course in operations research.

Department of Statistics **Stanford University**
NSF Postdoc in the Mathematical Sciences *1999-2001*
Researched Markov chain Monte Carlo methods under Persi Diaconis.

Joint appointment in Mathematics Statistical Science **Duke University**
Assistant Professor *2001-2009*

Department of Mathematical Sciences **Claremont McKenna College**
Associate Professor *2009-2012*

Department of Mathematical Sciences **Claremont McKenna College**
Fletcher Jones Foundation Associate Professor of Mathematics and Statistics and George R. Roberts Fellow *2012-2018*

Department of Mathematical Sciences **Claremont McKenna College**
Chair *2016-present*

Department of Mathematical Sciences **Claremont McKenna College**
Fletcher Jones Foundation Professor of Mathematics and Statistics and George R. Roberts Fellow *2018-present*

Publications

Submitted papers

[1] M. Huber and N. Marić. Bernoulli correlations and CUT polytopes. arXiv:1706.06182, Submitted., 2017.

[2] M. Huber. Linear time perfect simulation for Markov Random Fields. Submitted, 2017.

Book length works

[3] Mark L. Huber. *Perfect Simulation*. Number 148 in Chapman & Hall/CRC Monographs on Statistics & Applied Probability. CRC Press, 2015.

[4] M. L. Huber. *Perfect Sampling with Bounding Chains*. PhD thesis, Cornell University, 1999.

Published and accepted articles

[5] M. Huber. Adaptive Markov chain Monte Carlo. In *Wiley StatsRef-Statistics Reference Online*. Wiley. to appear.

[6] M. Huber. Halving the bounds for the Markov, Chebyshev, and Chernoff inequalities through smoothing. *American Mathematical Monthly*, 2018. arXiv:1803.06361. To appear.

[7] M. Huber. An optimal (ϵ, δ)-approximation scheme for the mean of random variables with bounded relative variance. *Random Structures Algorithms*. To appear.

[8] J. Banks, S. Garrabrant, M. Huber, and A. Perizzolo. Using TPA for approximating the number of linear extensions. *J. Discrete Algorithms*, 51:1–11, 2018. arXiv:1010.4981.

[9] M. Huber. Adaptive Monte Carlo integration. In *Wiley StatsRef-Statistics Reference Online*. Wiley, 2018. doi:10.1002/9781118445112.stat08070.

[10] J. Feng, M. Huber, and Y. Ruan. Monte Carlo with user-specified relative error. In P. W. Glynn and A. Owen, editors, *Proceedings in Mathematics & Statistics: Monte Carlo and Quasi-Monte Carlo methods*, volume 241, chapter 12. Springer, 2018.

[11] M. Huber. Optimal linear Bernoulli factories for small mean problems. *Methodology and Computing in Applied Probability*, 19:631–645, 2017. arXiv:1507.00843. doi:10.1007/s11009-016-9518-3.

[12] K. Cloud and M. Huber. Fast perfect simulation of Vervaat perpetuities. *J. Complexity*, 42:19–30, 2017. arXiv:1510.01780.

[13] M. Huber. A Bernoulli mean estimate with known relative error distribution. *Random Structures Algorithms*, 50:173–182, 2017. arXiv:1309.5413.

[14] M. Huber. Nearly optimal Bernoulli factories for linear functions. *Combin. Probab. Comput.*, 25(4):577–591, 2016. arXiv:1308.1562.

[15] M. Huber and N. Marić. Simulation of multivariate distributions with fixed marginals and correlations. *J. Appl. Probab.*, 52(2):602–608, 2015. arXiv:1311.2002.

[16] M. Huber. Approximation algorithms for the normalizing constant of Gibbs distributions. *Ann. Appl. Probab.*, 51(1):92–105, 2015. arXiv:1206.2689.

[17] M. L. Huber and S. Schott. Random construction of interpolating sets for high dimensional integration. *Journal of Applied Probability*, 51(1):92–105, 2014. arXiv:1112.3692.

[18] Mark Huber. Near-linear time simulation of linear extensions of a height-2 poset with bounded interaction. *Chic. J. Theoret. Comput. Sci.*, 2014.

[19] M. Huber and N. Marić. Minimum correlation for any bivariate Geometric distribution. *ALEA Lat. Am. J. Probab. Math. Stat.*, pages 459–470, 2014. arXiv:1406.1779.

[20] M. Huber, E. Villella, D. Rozenfeld, and J. Xu. Bounds on the artificial phase transition for perfect simulation of the hard core Gibbs processes. *Involve*, 5(3):247–255, 2012.

[21] M. Huber. Spatial birth-death swap chains. *Bernoulli*, 18(3):1031–1041, 2012. arXiv:1006.5934.

[22] M. L. Huber and J. Law. Simulation reduction of the Ising model to general matchings. *Electronic Journal of Probability*, 17:1–15, 2012. Article 33, arXiv:0907.0477v1.

[23] M. L. Huber. Simulation reductions for the Ising model. *J. Stat. Theory Pract.*, 5(3):413–424, 2011. arXiv:0908.2151v1.

[24] Faheem Mitha and Mark L. Huber. Monotonic multigamma coupling for perfect sampling. *Journal of Statistical Computation and Simulation*, 82(4):603–622, 2012.

[25] M. Huber. Spatial point processes. In S. Brooks, A. Gelman, G. Jones, and X. Meng, editors, *Handbook of MCMC*, pages 227–252. Chapman & Hall/CRC Press, 2011.

[26] J. Møller, M. L. Huber, and R. L. Wolpert. The stationary Matérn hard core process of type III. *Stochastic Process. Appl.*, 120:2142–2158, 2010.

[27] M. L. Huber and S. Schott. Using TPA for Bayesian inference. *Bayesian Statistics 9*, pages 257–282, 2010.

[28] J. A. Fill and M. L. Huber. Perfect simulation of Vervaat perpetuities. *Electron. J. Probab.*, 15:96–109, 2010.

[29] D. B. Woodward, S. C. Schmidler, and M. Huber. Conditions for rapid mixing of parallel and simulated tempering on multimodel distributions. *Ann. of Appl. Prob.*, 19(2):617–640, 2009.

[30] D. B. Woodward, S. C. Schmidler, and M. Huber. Sufficient conditions for torpid mixing of parallel and simulated tempering. *Electron. J. Probab.*, 14:780–804, 2009.

[31] M. L. Huber and R. L. Wolpert. Likelihood-based inference for Matérn type-III repulsive point processes. *Adv. Appl. Prob.*, 41(4):958–977, 2009.

[32] M. Huber. Perfect simulation with exponential tails. *Random Structures Algorithms*, 33(1):29–43, 2008.

[33] M. Huber and J. Law. Fast approximation of the permanent for very dense problems. In *Proc. of 19th ACM-SIAM Symp. on Discrete Alg.*, pages 681–689, 2008.

[34] M. Huber. Perfect simulation for image restoration. *Stochastic Models*, 23(3):475–487, 2007.

[35] D. Hearn and M. Huber. The ancestral distance test: A topdown approach to detect correlated evolution in large lineages with missing character data and incomplete phylogenies. *Systematic Biology*, 55(5):803–817, 2006.

[36] M. Huber, Y. Chen, I. Dinwoodie, A. Dobra, and M. Nicholas. Monte Carlo algorithms for Hardy-Weinberg proportions. *Biometrics*, 62:49–53, Mar 2006.

[37] M. Huber. Fast perfect sampling from linear extensions. *Discrete Mathematics*, 306:420–428, 2006.

[38] M. Huber. Exact sampling from perfect matchings of dense regular bipartite graphs. *Algorithmica*, 44:183–193, 2006.

[39] B.P. Tighe, J.E.S. Socolar, D.G. Schaeffer, W.G. Mitchener, and M.L. Huber. Force distributions in a trigonal lattice of rigid bars. *Physical Review E*, 72(031306), 2005.

[40] Y. Chen, I. Dinwoodie, A. Dobra, and M. Huber. Lattice points, contingency tables, and sampling. *Contemporary Mathematics*, 374:65–78, 2005.

[41] M. Huber and G. Reinert. The stationary distribution in the Antivoter model: exact sampling and approximations. In *Stein's Method: Expository Lectures and Applications*, pages 79–94. IMS Lecture Notes 46, 2004.

[42]   M. Huber. Perfect sampling using bounding chains. *Annals of Applied Probability*, 14(2):734–753, 2004.

[43]   M. L. Huber. A bounding chain for Swendsen-Wang. *Random Structures Algorithms*, 22(1):43–59, 2003.

[44]   A. T. Benjamin, M. T. Fluet, and M. L. Huber. Optimal token allocations in Solitaire Knock 'm Down. *The Electronic Journal of Combinatorics*, 8(2):1–8, 2001.

[45]   J. A. Fill and M. L. Huber. The Randomness Recycler approach to perfect sampling. In *Proc. 53rd Session of the ISI*, pages 69–72, 2001.

[46]   J. A. Fill and M. L. Huber. The Randomness Recycler: A new approach to perfect sampling. In *Proc. 41st Sympos. on Foundations of Comp. Sci.*, pages 503–511, 2000.

[47]   M. L. Huber. A faster method for sampling independent sets. In *Proc. 11th ACM-SIAM Sympos. on Discrete Algorithms*, pages 625–626, 2000.

[48]   M. L. Huber. Exact sampling and approximate counting techniques. In *Proc. 30th Sympos. on the Theory of Computing*, pages 31–40, 1998.

[49]   M. L. Huber. Exact sampling using Swendsen-Wang. In *Proc. 10th Sympos. on Discrete Algorithms*, pages 921–922, 1999.

Preprints and Technical Reports

[50]   S. R. Garcia, M. Huber, and B. Lutz. Algebraic properties of Heilbronn's exponential sum: supercharacters, Fermat congruences, and Heath-Brown's bound. arXiv:1312.1034v2, 2015.

[51]   M. Huber. Partially recursive acceptance rejection. arXiv:1701.00821, 2016.

[52]   M. Huber. An estimator for Poisson means whose relative error distribution is known. arXiv:1605.09445., 2016.

[53]   M. Huber. The Fundamental Theorem of perfect simulation. arXiv:1704.03561., 2017.

[54]   C. Evans, J. Hardin, M. Huber, D. Stoebel, and G. Wong. Differential expression analysis for multiple conditions. arXiv:1410.3370., 2014.

External funding and awards

Postdoctoral Fellow in the Mathematical Sciences
National Science Foundation 1999–2001
Perfect simulation techniques

CAREER award
National Science Foundation 2005–2011
Perfect sampling techniques for high-dimensional integration

DMS grant
National Science Foundation 2014-2018
Improved Monte Carlo methods for high dimensional sums and integrals

Book Reviews

Ten great ideas about chance   **P. Diaconis and B. Skyrms**
M. Huber, AMS Notices, to appear

An Introduction to Optimization (3rd ed.)   **E. K. P. Chong and S. H. Zak**
M. Huber, JASA, 104:421, 2009

Introduction to Stochastic Calculus Applied to Finance (2nd ed.)   **D. Lamberton and B. Lapeyre**
M. Huber, JASA, 104:1726, 2009

Monte Carlo and Quasi-Monte Carlo Sampling   **C. Lemieux**
M. Huber, JASA, 105:876, 2010

Probability Theory: An Analytic View (2nd ed.)   **D. W. Stroock**
M. Huber, JASA, 107:853, 2012

Selected Videos

The Alternating Series Test   https://www.youtube.com/watch?v=svPB4L__EC8&t=85s
M. Huber   *Dec 2016*

Properties of expected value   https://www.youtube.com/watch?v=XuAzQZ66TpM&t=21s
M. Huber   *Oct 2016*

Convergence of random variables   https://www.youtube.com/watch?v=XuAzQZ66TpM&t=21s
M. Huber   *Oct 2016*

Swapping limits and expectation   https://www.youtube.com/watch?v=jpxBJITM9i4&t=2s
M. Huber   *Oct 2016*

Rigorous limits   https://www.youtube.com/watch?v=vmSyC33jRbE
M. Huber   *Oct 2016*

Sets, logic, and proofs   https://www.youtube.com/watch?v=Oya83f_kfRU&t=21s
M. Huber   *Oct 2016*

Antidifferentiation of Linear Over Quadratic   https://www.youtube.com/watch?v=7FSsUZJ4xVY
M. Huber   *Apr 2014*

Factorials   https://www.youtube.com/watch?v=BuaUQrRHOTc
M. Huber   *Apr 2014*

Exponential Growth and Separation of Variables https://www.youtube.com/watch?v=KB2iHuoqpB8
M. Huber   *Feb 2014*

For all and there exists   https://www.youtube.com/watch?v=qni0TKd0DgU
M. Huber   *Feb 2014*

Supremum and Infimum   https://www.youtube.com/watch?v=Bl2G6ZGsBvk&t=1s
M. Huber   *Feb 2014*

Six Derivatives to Memorize   https://www.youtube.com/watch?v=lRyrewyC2xs
M. Huber   *Mar 2013*

Antidifferentiation of a function of a line   https://www.youtube.com/watch?v=qm-tXwmQpKQ
M. Huber   *Mar 2013*

Probability for continuous random variables   https://www.youtube.com/watch?v=rBRkEuU4SNI
M. Huber   *Feb 2013*

Indicator Functions   https://www.youtube.com/watch?v=V3pnr5gmJC8&t=35s
M. Huber   *Feb 2013*

Antidifferentiation with the Chain Rule   https://www.youtube.com/watch?v=9-ftis8vrXg
M. Huber   *Dec 2012*

Integration by Parts   https://www.youtube.com/watch?v=NkAkVWtbRZw
M. Huber   *Nov 2012*

Selected invited and contributed talks

13th International Conference on Monte Carlo and Quasi Monte Carlo Methods   **Rennes, France**
Improved light tailed sample averages for robust estimation of the mean   *July 2018*

LMS Invited Lecture Series on Computational Statistics   **University of Warwick, UK**
Perfect Simulation Short course   *July 2018*

The 2017 IISA International Conference on Statistics Hyderabad, India
Estimates for Monte Carlo data with user-specified error bounds Dec 2017

LMS-EPSRC Symp. on Markov Processes, Mixing Times, and Cutoff University of Durham, UK
Cutoff phenomena in perfect simulation Aug 2017

International Statistical Institute World Congress Marrakech, Morocco
Linear time perfect simulation for Markov random fields Jul 2017

Monte Carlo Methods and Applications (MCM 2017) Montréal, Canada
Faster estimates with user-specified error for $[0,1]$ random variables Jul 2017

Southern California Applied Mathematics Symposium UC Irvine, USA
Faster Monte Carlo with fewer samples (Plenary Speaker) Jun 2017

Statistics Seminar Duke University Durham, USA
Fast user-specified relative error estimates Mar 2017

Atul Vyas Memorial Lecture Claremont, USA
How to roll a five sided die Nov 2016

Monte Carlo and Quasi-Monte Carlo Methods in Scientific Computing Stanford University, USA
Monte Carlo with user-specified error Aug 2016

Retrospective Monte Carlo Workshop University of Warwick, UK
A Bernoulli Factory using the Fundamental Theorem of Perfect Simulation Jul 2016

Statistics Seminar Technische Universität Dortmund, Germany
The Fundamental Theorem of Perfect Simulation Jun 2016

CPET Landscape of Educational Technology for Liberal Arts Education Claremont, USA
Using video for classes Feb 2016

Claremont Colleges Library Discourse Series Claremont, USA
Humanistic Mathematics: A Philsophy, a Journal, and a Community Nov 2015

George Mason University Statistics Colloquium Fairfax, USA
Bounded variance Monte Carlo estimates Oct 2015

AMS Fall Western Sectional Meeting Fullerton, USA
Fast approximation algorithms for partition functions of Gibbs distributions Oct 2015

Stochastic Processes and their Applications Oxford, UK
Better rigorous tail bounds for general Monte Carlo estimation Jul 2015

CRISM Seminar University of Warwick, UK
Optimal linear Bernoulli factories for small mean problems Jul 2015

Statistics Seminar University of Minnesota, USA
Bounding relative error of Monte Carlo estimates Mar 2015

Mathematics Seminar University of Wisconsin, USA
Understanding relative error in Monte Carlo simulations Mar 2015

UFL Statistics Colloquium Gainesville, USA
Obtaining relative error of estimates without the Central Limit Theorem Oct 2014

USC Mathematics Colloquium Los Angeles, USA
Building a better Bernoulli Factory Sep 2014

Strategic Educational Technology Summit Claremont, USA
Using Instructional Videos in and out of the classroom Apr 2014

Fifth IMS-ISBA joint meeting: MCMSki IV Chamonix, France
Perfect simulation for image analysis Jan 2014

Gateways to Exploring Mathematical Sciences (GEMS) Claremont, USA
The Monty Hall Problem Nov 2013

AMS Western Sectional Meeting — **Riverside, USA**
Fast approximation algorithms for partition functions of Gibbs distributions — *Nov 2013*

Statistics Seminar — **University of Kentucky, USA**
An unbiased estimator heads with relative error independent of p — *Oct 2013*

JSM 2013 Annual Meeting — **Montreal, Canada**
Controlling error for combinatorial structures — *Aug 2013*

ISBA 2012 World Meeting — **Kyoto, Japan**
Fast approximation algorithms for partition functions of Gibbs distributions — *June 2012*

Department of Statistics Seminar — **The Ohio State UniversityUSA**
Fast approximation algorithms for Gibbs partition functions — *May 2012*

Statistics Speakers Series — **UCLA Department of Statistics**
Perfect Simulation of Repulsive Point Processes — *Nov 2011*

Mathematical and Computer Science Colloquium — **University of Missouri-St. Louis**
Partially Recursive Acceptance Rejection — *Oct 2011*

Greek stochastics γ — **Crete, Greece**
The Paired Product Estimator for normalizing constants of Gibbs distributions — *June 2011*

Natural Science Colloquium — **Pepperdine University**
Adative Monte Carlo Methods for Numerical Integration — *Mar 2011*

Fall Western Sectional AMS meeting — **UCLA**
Near linear time perfect simulation of corrugated surfaces — *Oct 2010*

Monte Carlo and Quasi-Monte Carlo Methods — **Warsaw, Poland**
Using TPA for Monte Carlo Integration — *Aug 2010*

9th Valencia International Meeting on Bayesian Statistics, (invited talk) — **Alicante, Spain**
Using TPA for Bayesian Inference — *Jun 2010*

Applied Mathematics and Statistics Department Seminar — **UC Santa Cruz**
Approximation of Normalizing Constants Using Random Cooling Schedules — *Apr 2010*

Statistics Department Seminar — **UC Riverside, CA, USA**
Approximation of Normalizing Constants Using Random Cooling Schedules — *Feb 2010*

Joint Mathematics Meetings — **San Francisco, CA, USA**
Spatial Birth-Death-Swap Chains — *Jan 2010*

Claremont Colleges Mathematics Colloquium — **Claremont, CA, USA**
Better numerical integration through randomness — *Nov 2009*

AMS Fall Western Meeting (invited talk) — **UC Riverside, CA, USA**
Simulation reductions for the Ising model — *Nov 2009*

Joint Statistical Meetings (invited talk) — **Washington D.C.**
Speeding up the product estimator using random temperatures — *Aug 2009*

Department of Statistics Colloquium — **University of Aalborg, Denmark**
Perfect simulation of repulsive point processes — *May 2009*

EPSRC Symposium Workshop on Markov Chain-Monte Carlo — **Warwick, UK**
Perfect simulation of Matérn type III processes — *Mar 2009*

Computational Algebraic Statistics, Theories and Applications — **Kyoto, Japan**
Sampling linear extensions for inference — *Dec 2008*

Department of Applied Mathematics and Statistics Seminar — **The Johns Hopkins University**
Perfect simulation of Matérn type III point processes — *Oct 2008*

Department of Mathematics Probability Seminar — **Duke University**
Conditions for Parallel and Simulated Tempering to be fast or slow — *Oct 2008*

Stochastics Seminar, School of Mathematics **Georgia Institute of Technology, USA**
Perfect simulation of Matérn type III point processes *Oct 2008*

School of Operations Research and Industrial Engineering Colloquium **Cornell University**
Dealing with Matérn type III point processes *Sep 2008*

Advances in Analysis of Monte Carlo Methods workshop (invited talk) **Harvard University**
An Overview of Perfect Sampling Methods *Dec 2007*

School of Statistics Seminar **University of Minnesota**
Perfect simulation of repulsive point processes *Oct 2007*

New Developments in MCMC (invited talk) **Warwick, UK**
Perfect simulation with the Randomness Recycler for arbitrary state spaces *Aug 2006*

Department of Mathematics **UC Davis**
Advanced Acceptance/Rejection Methods for Monte Carlo Algorithms *Mar 2006*

Joint Statistical Meetings (contributed talk) **Toronto, Canada**
Time Dependent Update Functions for Perfect Sampling *Aug 2004*

IMS meeting (invited talk) **Singapore**
Time dependent update functions for perfect sampling *Mar 2004*

Mathematics Colloquium **University of Ulm, Germany**
Perfect Sampling: techniques and challenges *Dec 2003*

Mathematisches Forschungsinstitut Oberwolfach (plenary lecture) **Oberwolfach, Germany**
Perfect sampling *Dec 2003*

Opening conference Stochastic Computation program SAMSI (contributed talk) **Durham, NC**
Perfect sampling for some mixtures of distributions *Sep 2003*

Electrical and Computer Engineering Seminar **NC State**
Bounding chain techniques for perfect sampling *Feb 2003*

Undergraduate workshop in the Stochastic Computation Program, SAMSI **Durham, NC**
Stochastic Computation Techniques *Feb 2003*

First Cape Cod workshop on Monte Carlo methods (invited talk) **Cape Cod, MA**
Introduction to the Randomness Recycler *Sep 2002*

Statistics Colloquium **University of North Carolina at Chapel Hill**
Using the Randomness Recycler *Feb 2002*

53rd Annual Meeting of the International Statistical Institute (invited talk) **Seoul, South Korea**
The Randomness Recycler approach to perfect simulation *Aug 2001*

Seminar **IBM Research-Almaden**
A new approach to perfect sampling from nasty distributions *Sep 2000*

Department of Statistics Colloquium **Stanford University**
A new approach to perfect sampling from nasty distributions *Jul 2000*