

DAVID WOLPERT

Santa Fe Institute, 1399 Hyde Park Rd., Santa Fe, NM
Arizona State University, Tempe, Arizona
Complexity Science Hub, Vienna
International Center for Theoretical Physics, Trieste, Italy
Albert Einstein Institute for Advanced Study in the Life Sciences
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RESEARCH FOCUS:

Stochastic thermodynamics of computation
Computational models of social system dynamics; Economies of AIs
Foundations of Machine Learning; Noisy deductive reasoning

WORK EXPERIENCE:

- March 2022 to present International Center for Theoretical Physics, Trieste, Research Staff Associate
- February 2019 to present Complexity Science Hub, Vienna, External professor
- February 2015 to present Arizona State University, Center for Bio-social complex systems, Adjunct Professor
- September 2013 to present Santa Fe Institute, Santa Fe, Professor.
- February 2015 to June, 2018 MIT Astronautics and Aeronautics Dept., Visiting Professor
- November 2011 to September 2013 Los Alamos National Laboratory, CCS-3. Scientist 5. Perform fundamental and applied research and provide leadership in game theory, machine learning, information theory, optimization, and the foundations of physics.
- July 2011 to September 2013 Santa Fe Institute, Santa Fe, External Faculty.
- October 2010 to September 2011 Center for Nonlinear Studies, Los Alamos. Stanislaw M. Ulam Distinguished Scholar. (See cnls.lanl.gov/external/ulam.php)

2006 to present (extended visits)	<u>Max Planck Institute</u> , <i>Visiting scholar</i>
Fall, 2007	<u>Tsinghua University</u> , Beijing, <i>Visiting Professor</i> . Taught intensive short course
June 2005 to 2007	<u>Stanford University Aeronautics and Astronautics Dept.</u> <i>Consulting Professor</i> . Supervised students in several departments doing research on adaptive distributed control and bounded rational game theory.
May 1997 to November 2011	<u>NASA Ames Research Center</u> . <i>Senior Computer Scientist</i> . Supervised a group conducting research on collective intelligence, combinatorial optimization, and machine learning.
April 1996 to May 1997	<u>IBM Almaden Research Center</u> . <i>Datamining Solutions, Research Manager</i> . Supervised and conducted product-driven and academic research on machine learning and statistics.
July 1995 to March 1996	<u>TXN Inc.</u> <i>Director of Research</i> . Conducted product-driven and academic research on machine learning. In particular developed a run-time fraud system for telecommunications networks.
November 1991 to March 1996	<u>Santa Fe Institute</u> . <i>Postdoc</i> . Conducted research on supervised learning, Bayesian statistics, and the thermodynamics of computation.
January 1994 to June 1995	<u>Pediatric Aids Foundation</u> and <u>NIH Correlates of Human Immuno-Deficiency Program</u> . <i>Research Associate</i> . With Bette Korber of Los Alamos conducted statistical analysis and research on HIV-related epidemiological datasets.
May 1993 to June 1995	<u>TXN Inc.</u> <i>Consultant</i> . Conducted product-driven research on machine learning.
March 1989	<u>Theoretical Division</u> and <u>Center For Nonlinear Studies</u> , Los Alamos National Laboratory. <i>Postdoc (Director's Fellow)</i> . Conducted research on machine

EDUCATION:

Ph.D., UNIVERSITY OF CALIFORNIA, SANTA BARBARA, Physics, 1989.

Dissertation: Neural networks and generalization theory.

SANTA FE SUMMER SCHOOL ON COMPLEX SYSTEMS, 1988.

M.A., UNIVERSITY OF CALIFORNIA, SANTA BARBARA, Physics, 1987.

B.A., PRINCETON UNIVERSITY, Physics, 1984 (Cum Laude).

Thesis: Filamentary structure of large scale galaxy distributions.

GRANTS (within last ten years, in reverse chronological order):

NSF EAGER, CCF-2221345, *Stochastic Thermodynamics of Distributed Computation*; \$299,888, **Lead PI**

NSF FET, 2145170, *The Future of Thermodynamics of Computation*; \$49,991, **Lead PI**

FQXi-RFP-IPW-1912; *The Role of Constraints in the Thermodynamics of Intelligence*; \$118,100, **Lead PI**

NSF, 2145170, *Thermodynamics and Computation: Towards a New Synthesis*; \$45,000, **Lead PI**

NSF, PHY-1741021, *Thermodynamics of Computation in Chemical and Biological Systems*; \$49,976, **co-PI**

NSF IBSS, 1620462; *Information Networks and the Evolution of Social Organizations*; \$770,000, **Lead PI**

NSF, CHE-1648973; INSPIRE: *Tradeoffs in the Thermodynamics of Computation: A New Paradigm for Biological Information-Processing*; \$999,947, **Lead PI**

FQXi, SVCF: 2016-160137 (5561)/ FQXi-RFP-1622; *Observers as self-maintaining non-equilibrium systems*; \$128,319, **Lead PI**

ARO, W911-NF-15-1-0127; *Event-driven game theory for predicting dynamics of social systems*, \$294,535, **Lead PI**

AFOSR, FA9550-15-1-0038A; *Unified and Algorithmic Framework for Managing Multiple Information Sources of Multi- Physics Systems*, \$4,298,194, **co-PI**

NASA, NNX14ZI11G; *Event-driven Game Theory for Aviation Safety*, \$900,000, **Lead PI**

NASA, 60058457-101700-C; *Modeling of Airline Behavior Using Strategic, Agent-Based Approaches*, \$281,948, **Lead PI**

Templeton World Charity Foundation, TWCF0079/ AB47; *Information Theory, Ecosystems, and Schrodinger's Paradox*, \$588,061, **Lead PI**

FQXi, SVCF: 2013-111422 (4661)/ FQXi-RFP-1349; *A Semantic Information-Theory Model of Reality*, \$50,000, **Lead PI**

REFEREED PUBLICATIONS:

Physics of Computation/

Wolpert, D.H., "Combining lower bounds on entropy production in complex systems with multiple interacting components", *Frontiers in Entropy Across the Disciplines*, Freeden, W., and Nashed, M. (Eds), in press.

Wolpert, D.H., "Strengthened second law for multi-dimensional systems coupled to multiple thermodynamic reservoirs", *Philosophical Transactions A*, 2022.

Kolchinsky, A., Wolpert, D.H., "State dependence of integrated, instantaneous, and fluctuating entropy production in quantum and classical processes", *Physical Review E*, 2021

Kolchinsky, A., Wolpert, D.H., "Entropy production given constraints on the energy functions", *Physical Review E*, 2021

Kolchinsky, A., Wolpert, D.H., "Work, entropy production, and thermodynamics of information under protocol constraints" *Physical Review X*, 2021

Korbel, J., and Wolpert, D.H., "Stochastic thermodynamics and fluctuation theorems for non-linear systems", *New Journal of Physics*, February, 2021

Wolpert, D.H. "Minimal entropy production rate of interacting systems", *New Journal of Physics*, October, 2020

Wolpert, D.H., "Uncertainty relations and fluctuation theorems for Bayes nets", *Physical Review Letters*, **125**, 200602, 2020

Kolchinsky, A., and Wolpert, D.H., "Thermodynamic costs of Turing machines", *Physical Review Research*, **2**, 033312, 2020

Wolpert, D.H., and Kolchinsky, A., "The thermodynamics of computing with circuits", *New Journal of Physics*, March, 2020

Wolpert, D.H., "The stochastic thermodynamics of computation", **Invited article**, *Journal of Physics A: Mathematical and General*, **52**, 193001, 2019.

Wolpert, D.H., Kolchinsky, A., and Owen, J., "A space/time tradeoff for implementing a function with master equation dynamics", *Nature Communications*, **10**, 1727, 2019.

Owen, J., Kolchinsky, A., and Wolpert, D.H., "Number of hidden states needed to physically implement a given conditional distribution", *New Journal of Physics*, December, 2018.

Kolchinsky, A., and Wolpert, D.H., "Semantic information, agency and nonequilibrium statistical physics", *Interface Focus*, doi.org/10.1098/rsfs.2018.0041, 2018.

Grochow J., and Wolpert, D.H., "Beyond number of bit erasures: New complexity questions raised by recently discovered thermodynamic costs of computation", *SIGACT News* June, 33-56, 2018.

Kolchinsky, A., and Wolpert, D.H., "Dependence of dissipation on the initial distribution over states" *Journal of Statistical Mechanics: Theory and Experiment*, 083202, 2017

Kempes, C., Wolpert, D.H., Cohen, Z., Perez-Mercador, J. "Energetic efficiency of computations made across the diversity of life", in *Phil. Trans. A, Theme issue on Re-Conceptualizing the Origin of Life from a Physical Science Perspective*, S. Walker (Ed.), 2017.

Wolpert, D.H., "The free energy requirements of biological organisms; implications for evolution", *Entropy* 18(4), 138, 2016 (*special issue on Information and Entropy in Biological Systems*, J. Baez (Ed.).

(Erratum at *Entropy*, 18(6), 219, 2016; doi: 10.3390/e18060219)

Wolpert, D.H., "Information Width: a way for the second law to increase complexity", in *The Self-Organizing Universe: Cosmology, Biology, and the Rise of Complexity*, C. Lineweaver, P. Davies, and M. Ruse (Ed.'s), Cambridge University Press, 2013.

Wolpert, D.H. and Benford, G., "The Lesson of Newcomb's Paradox", *Synthese*, 2011.

Wolpert, D.H., "Inference concerning physical systems", Proc. of CiE 2010, Fernando Ferreira, Benedikt Lowe, Elvira Mayordomo, Luis Mendes Gomes (Eds.), Springer, 2010

Wolpert, D.H., "Physical limits of inference", *Physica D*, **237** (2008) 1257-1281.

See also Binder, P., "Theories of almost everything", *Nature*, **455** (2008), 884-885

Wolpert, D.H., "Computational Capabilities of Physical Systems", *Physical Review E*, Vol. 65, 016128, Dec. 20, 2001.

Wolpert, D.H., "The Second Law, Computation, and the Temporal (A)symmetry of Memory", in *Advances in the Physics of Computation*, Ed. D. Matzke, IEEE press, 1993.

Wolpert, D.H. "Memory Systems, Computation, and The Second Law of Thermodynamics", *International Journal of Theoretical Physics*, **31**, 743-785, 1992.

Wolpert, D.H., "Reversible Computing and Physical Law", *PHYSICS TODAY*, 98-99 (March 1992).

Wolpert, D.H., "Chaos of the Brussels School is not irreversible", *Nature*, **335**, 595, 1988.

Human Behavior and Control of Collective Systems/

Kahneman, D.; Krakauer, D.; Sibony, O.; Sunstein, C and Wolpert, D.H. "An exchange of letters on the role of noise in collective intelligence", *Collective Computation*, 2022

Bird, D., Kohler, T., and Wolpert, D.H. "Social Scale and Collective Computation: Does Information Processing Limit Rate of Growth in Scale?", *Journal of Social Computing*, 2022

Bird, D., Kohler, T., and Wolpert, D.H., Editors of special issue of *Journal of Social Computing* on "The Evolution of Collective Computation within (Pre)historic Societies", 2022

Wolpert, D.H., "The (NOT) shortcomings of modern game theory", in *Proceedings of the Santa Fe Institute's 2019 Fall symposium*", B. Arthur et al., (Ed.), SFI Press, 2020

Shin, J., Price, M., Wolpert, D.H., H. Shima, B. Tracey, and T. Kohler, "Scale and Information-Processing Thresholds in Holocene Social Evolution", *Nature Communications*, May, 2020

Wolpert, D.H., and Grana, J., "How Much Would You Pay to Change a Game before Playing It?", *Entropy*, number **21**, 2019.

Grana, J., Bono, J., and Wolpert, D.H. "Reasoning About 'When' Instead of 'What' : Collusive Equilibria with Stochastic Timing in Repeated Oligopoly", *Berkeley Electronic Journal of Theoretical Economics*, 20180038, 2019.

K. Mendal, Y. Chen, J. Grana, J. Bono, B. Tracey, M. Kochenderfer, D.H. Wolpert, "Deep Reinforcement Learning for Event-Driven Multi-Agent Decision Processes", *Transactions on Intelligent Transportation Systems*, Volume 20, Issue 4, April 2019.

J. Jost, N. Bertschinger, E. Olbrich, and D. Wolpert, "Information geometry and game theory", in *Information Geometry and Its Applications IV*, N. Ay, P. Gibilisco, F. Matus (eds.), Springer Proceedings in Mathematics & Statistics, 2018.

Y. Kim, M. J. Kochenderfer, J. Grana, J. Bono, and D. Wolpert, "Optimal Lost-Link Policies for Unmanned Aircraft," in *IEEE/AIAA Digital Avionics Systems Conference*, 2015.

Wolpert D.H., and Bono, J., "Distribution-valued solution concepts", *Reviews of Behavioral Economics*, 2015.

Wolpert, D.H., "The gaping holes in social science", *Reviews of Behavioral Economics*, 2: 203–210 (2015)

Bono, J., Wolpert, D., Xie, D. and Grana J., "Decision-Theoretic Prediction and Policy Design of GDP Slot Auctions", *American Institute of Aeronautics and Astronautics* 2014-2163, June 2014.

Backhaus, S., Bent, R., Bono, J., Lee, R, Tracey, B., Wolpert, D.h., Xie, D. and Yildiz, Y. "Cyber-Physical Security: A Game Theory Model of Humans Interacting over Control Systems", *IEEE Transactions on Smart Grid*, 2014.

Bono, J.W., and Wolpert, D.H., "Game Mining: How to Make Money from those about to Play a Game", in *Entangled Political Economy*, Horwitz, Steven and Roger Koppl (Eds.), *Advances in Austrian Economics*, Vol. 18, Bingley, UK: JAI Press, 2014

Bono, J.W., Alonso, J., Bonnefoy, P., Fan, A. McConnachie, B., Tracey B., Wolpert, D., Xie, D.P., "Application of game theoretic models to evaluate airline equipage dynamics of Nextgen technologies", *2013 Aviation, Technology, Integration and Operations Conference*.

Wolpert, D.H., and Bono, J.W., "A theory of unstructured bargaining using distribution-valued solution concepts", *Journal of Artificial Intelligence Research*, **46**, 2013.

Yan, G., Lee, R., Kent, A, Wolpert, D., "Towards a Bayesian network game framework for evaluating DDoS attacks and defense", *Proceedings of 2012 ACM Conference on Computer and Communications Security*, 2013.

Schlicht E., Lee R., Tracey B., Wolpert, D., Kochenderfer M., "Predicting the behavior of interacting humans by fusing data from multiple sources", *Uncertainty in Artificial Intelligence 2012*, K. Murphy (Ed.), 2012.

Lee, R., Wolpert, D.H., Backhaus, S. Bent, R., Bono, J., Tracey, B., "Counter-Factual Reinforcement Learning: How to Model Decision-Makers That Anticipate the Future", *Decision-Making with Imperfect Decision Makers 2012*, T. Guy, M. Karny and D.H.Wolpert (Ed.'s), Springer, 2012.

Wolpert, D.H., and Harre, M., and Bertschinger, N., and Olbrich, E., and Jost, J., "Hysteresis effects of changing parameters of noncooperative games", *Physical Review E*, **85**, 036102, 2012.

Wolpert, D. H. and Leslie, D. "Information Theory and Observational Limitations in Decision Making", *Berkeley Electronic Journal of Theoretical Economics*, 2011.

Wolpert, D. H. and Jamison, J. "The Strategic Choice of Preferences: the Persona Model", *Berkeley Electronic Journal of Theoretical Economics*, 2011.

Lee, R. and Wolpert, D.H., "Game-Theoretic Modeling of Human Behavior in Mid-Air Collisions", *Decision-Making with Imperfect Decision Makers 2011*, T. Guy, M. Karny and D.H.Wolpert (Ed.'s), Springer.

Wolpert, D. H. and Jamison, J. "Schelling Formalized: Strategic Choices of Non-Rational Behavior", *Evolution and Rationality: Decisions, Cooperation, and Strategic Behavior*, K. Binmore and S. Okasha (Ed.'s), Cambridge University Press, in press.

Wolpert, David H. and Bono, J. W. "PGT: A Statistical Approach to Prediction and Mechanism Design", *Proc. of SBP 2010*, Sun-Ki Chai, John Salerno, and Patricia Mabry (Eds.), Springer 2010.

Wolpert, D.H., "Why Income Comparison is Rational", *Games and Economic Behavior*, **69**, issue 2, 458-474, 2010.

Wolpert, D.H., "Trembling Hand Perfection for mixed Quantal / Best Response Equilibria", *International Journal of Game Theory*, **8**, Issue 4, Page 539, 2009.

Wolpert, D.H. and Kulkarni, N., "Game-theoretic Management of Interacting Adaptive Systems", *Proc. 2008 NASA/ESA Conference on Adaptive Hardware and Systems*.

Wolpert, D.H., Strauss, C.E.M., Rajnarayan, D., "Advances in Distributed Optimization using Probability Collectives", *Advances in Complex Systems*, **9**, 2006.

Lawson, J and Wolpert, D.H., "Adaptive Programming of Unconventional Nano-Architectures", *Journal of Computational and Theoretical Nanoscience*, **3**, 272-279, 2006.

Bieniawski, S., Kroo, I., and Wolpert, D.H. "Flight Control with Distributed Effectors," AIAA Paper 2005-6074, Proceedings of the 2005 *AIAA Guidance, Navigation, and Control Conference*, San Francisco, CA, August 15-18, 2005.

Wolpert, D.H., Bieniawski, S.R., "Distributed Control by Lagrangian Steepest Descent", in *Proceedings of IEEE Conference on Decision and Control*, 2004.

Wolpert, D.H., Huang, C.F, Bieniawski, S. and Strauss, C.E.M., "A comparative study of Probability Collectives-based Multi-agent Systems and Genetic Algorithms", *Proceedings of 2005 GECCO conference*.

Bieniawski, S., Kroo, I., and Wolpert, D. H., "Discrete, Continuous, and Constrained Optimization Using Collectives," AIAA Paper 2004-4580, 10th *AIAA/ISSMO Multi-disciplinary Analysis and Optimization Conference*, Albany, NY, August 30-September 1, 2004.

Wolpert, D.H., Bieniawski, S., "Distributed Adaptive Control: Beyond Single-Instant, Discrete Variables", in *MSRAS 04*, Springer-Verlag, 2004.

Wolpert, D.H., "What Information Theory says about Bounded Rational Best Response", in *WEHIA 04*, A. Namatame (Ed.), Springer-Verlag, 2004.

Bieniawski, S.R., Wolpert, D.H., "Adaptive, distributed control of constrained multi-agent systems", in *Autonomous Agents and Multi-Agent Systems 2004*, 2004.

Lee, C.F., Wolpert, D.H., "Product distribution theory for control of multi-agent systems", in *Autonomous Agents and Multi-Agent Systems 2004*, 2004.

Wolpert, D.H., Lee, C.F., "Adaptive Metropolis Sampling with Product Distributions", in *International Conference on Complex Systems 2004*, Y. Bar-Yam (Ed.), Perseus books, 2004.

Bieniawski, S.R., Wolpert, D.H., "Product Distributions for Distributed Optimization", in *International Conference on Complex Systems 2004*, Y. Bar-Yam (Ed.), Perseus books, 2004.

Macready, W., Wolpert, D.H., "Distributed Constrained Optimization", in *International Conference on Complex Systems 2004*, Y. Bar-Yam (Ed.), Perseus books, 2004.

Wolpert, D.H., "Information theory - the bridge connecting bounded rational game theory and statistical physics", in *Complex Engineering Systems*, D. Braha and Y. Bar-Yam (Ed.'s), Perseus books, 2004.

Tumer, K., Wolpert, D.H., "Coordination in Large Collectives", in *International Conference on Complex Systems 2004*, Y. Bar-Yam (Ed.), Perseus books, 2004.

Antoine, N.E., Bieniawski, S.R., Kroo, I.M., Wolpert, D.H., "Fleet Assignment using collective intelligence", AIAA-2004-0622, Presented at the 42nd Aerospace Sciences Meeting, 2004.

Wolpert, D.H., Tumer, K., Bandari, E. "Improving search algorithms by using intelligent coordinates", *Physical Review E (Brief Communications)*, **69**, 017701, 2004.

Tumer, K., Wolpert, D.H., "A Survey of Collective Intelligence", in Tumer, K., and Wolpert, D.H. (Ed.'s) *Collectives and the Design of Complex Systems*, Springer-Verlag, 2004.

Wolpert, D.H., "The Theory of Collectives", in Tumer, K., and Wolpert, D.H. (Ed.'s) *Collectives and the Design of Complex Systems*, Springer-Verlag, 2004.

Airiau, S., Wolpert, D.H., Sen, S., and Tumer, K., "Providing effective access to shared resources: a COIN approach", *Proceedings of ESOA '03*, A. Karageorgos et al., 2003.

Wolpert, D.H., and Tumer, K., "Beyond Mechanism Design", *International Congress of Mathematicians 2002 Proceedings*, H. Gao et al. (Ed.s), Qingdao Publishing, 2002.

Lawson, J., and Wolpert D. H., "The Design of Collectives of Agents to Control Non-Markovian Systems", *Proceedings of American Association of Artificial Intelligence Conference 2002*, 2002.

Wolpert, D.H, and Lawson, J., "Designing Agent Collectives For Systems With Markovian Dynamics", in *Proceedings of First International Joint Conference on Autonomous Agents and Multi-Agent Systems*, 2002.

Tumer, K., Agogino, A, and Wolpert, D.H., "Learning Sequences of Actions in Collectives of Autonomous Agents", in *Proceedings of First International Joint Conference on Autonomous Agents and Multi-Agent Systems*, 2002.

Wolpert, D.H., and Tumer, K., "Optimal Reward Functions in Distributed Reinforcement Learning", *Intelligent Agent Technology 2001*, 2002.

Wolpert, D.H., Tumer, K. "Collective Intelligence, Data Routing, and Braess' Paradox", *Journal of Artificial Intelligence Research*, 2002.

Wolpert, D.H., "Collective Intelligence", in *Computational Intelligence Beyond 2001: Real and Imagined*, D. Fogel and D. Robinson (Ed.), Wiley, 2001.

Wolpert, D., and Tumer, K., "Optimal Payoff Functions for Members of Collectives", *Advances in Complex Systems*, Vol. 4, pp. 265-280, 2001.

Wolpert, D.H., Sill, J., and Tumer, K., "Using Collective Intelligence to Control Data Flow Across a Constellation of Satellites", *Proceedings International Joint Conference on AI 2001*, Morgan Kauffman, 2001.

Wolpert, D.H., and Tumer, K., "An Illustration of the COIN Approach to Design of Multi-Agent Systems", *Proceedings of the Agents 00 and ECML 00 Workshop on Learning in Agents*, Sen. S et al. (Ed.'s), 2000.

Tumer, K., and Wolpert, D.H. "Collective Intelligence and Braess' Paradox", in *Proceedings of AAAI 2000*, Morgan Kauffman, 2000.

Wolpert, D.H., Tumer, K., "Collective Intelligence for Optimization", in "Statistical Machine Learning for Large-Scale Optimization", J. Boyan, et al. (Ed.'s), *Neural Computing Surveys*, 2000.

Wolpert, D.H., Kirshner, S., Tumer, K., Merz, C., "Adaptivity in Agent-Based Routing for Data Networks", in *Proceedings of Agents 00*, Sierra, C., et al, (Ed.s), 2000.

Wolpert, D.H., Wheeler, K., Tumer, K., "Collective Intelligence for Control of Distributed Dynamical Systems", *Europhysics Letters*, vol. 49 issue 6, 708-714, 2000.

Wolpert, D.H., Wheeler, K., Tumer, K., "General Principles of Learning-based Multi-Agent Systems", *Third International Conference of Autonomous Agents*, J.E. Bradshaw (Ed.), ACM Press, 77-83, 1999.

Wolpert, D.H., Tumer, K., Frank, J. "Using collective intelligence to route internet traffic", *Neural Information Processing Systems 11*, Kearns et al. (Eds), MIT Press, 952-958, 1999.

Statistical Inference and information theory/

Wolpert, D.H., "The Implications of the No-Free-Lunch Theorems for Meta-induction", Special Issue of *J. General Philosophy of Science* on "The Problem of Induction: Meta-Inductive Approaches", P. Thorn and S. Psillos, (Ed.), in press

Wolpert, D.H., "What is important about the No Free Lunch theorems?", in *Black Box Optimization, Machine Learning and No-Free Lunch Theorems*, P. Pardalos, V. Rasskazova, M.N. Vrahatis, Ed., Springer 2021

Kolchinsky, A., Tracey, B., and Wolpert, D.H., "Nonlinear Information Bottleneck", *Entropy*, 2019; **Selected for journal cover; Won Entropy best paper of year award 2021**

Tracey, B., and Wolpert, D. "Upgrading from Gaussian Processes to Student's-T Processes", *2018 AIAA Non-Deterministic Approaches Conference*, AIAA SciTech Forum, (AIAA 2018-1659), 2018

Rauh, J., Banerjee, P., Olbrich, E., Jost, J., Bertschinger, N., and Wolpert, D.H., "Coarse-Graining and the Blackwell Order", *Entropy*, 2017

Grana, J., Wolpert, D.H., Neil, J., Xie, D., Bhattachaya, T., Bent, R., "A Likelihood Ratio Anomaly Detector for Identifying Within-Perimeter Computer Network Attacks", *Journal of Network and Computer Applications*, 2016

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Smyth, P. and Wolpert, D. H., "Linearly Combining Density Estimators via Stacking", *Machine Learning Journal*, **36**, 59-83, 1999.

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Smyth, P. and Wolpert, D. H., "Stacked Density Estimation", *Neural Information Processing Systems 10*, MIT Press, 1998.

Wolpert, D.H., Knill, E., and Grossman, T., "Some results concerning off-training-set and IID error for the Gibbs and Bayes optimal generalizers", *Statistics and Computing*, **8**(1), March 1998, pp. 35-54.

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Smyth, P. and Wolpert, D. H., "Anytime Exploratory Data Analysis for Massive Data Sets", *The Third International Conference on Knowledge Discovery and Data Mining*, AAAI Press, 1997.

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Wolpert, D.H., "The Existence of A Priori Distinctions between Learning Algorithms", *Neural Computation*, **8**, 1996.

Wolpert, D.H., "Determining Whether Two Data Sets are from the Same Distribution", in *Maximum Entropy and Bayesian Methods 1995*, Ed. K. Hanson and R. Silver, Kluwer Academic press, 1996.

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Wolpert, D.H., "The Bootstrap is Inconsistent with Probability Theory", in *Maximum Entropy and Bayesian Methods 1995*, Ed. K. Hanson and R. Silver, Kluwer Academic press, 1996.

Wolpert, D.H., Strauss, C.E., "What Bayes has to say about the evidence procedure", in *Maximum Entropy and Bayesian Methods 1993*, Ed. G. Heidbreder, Kluwer Academic press, 1996.

Wolpert, D.H., "Reconciling Bayesian and non-Bayesian analysis", in *Maximum Entropy and Bayesian Methods 1993*, Ed. G. Heidbreder, Kluwer Academic press, 1996.

Kohavi, R., and Wolpert, D.H., "Bias Plus Variance Decomposition for Zero-One Loss Functions", *Proceedings of the International Machine Learning Conference 13*, Ed. Lorenza and Saiita, Morgan Kauffman, 1996.

Wolpert, D.H., and Wolf, D.R., "Estimating Functions of Probability Distributions from a Finite Set of Samples", *Physical Review E*, **52**, p. 6841, 1995. (Note subsequent erratum: *Physical Review E*, **54**, p. 6973, 1996.)

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This work was the basis of both winning entries in the 2009 netflix competition. See J. Sill, G. Takacs, L. Mackey, and D. Lin, "Feature-Weighted Linear Stacking", 2009, <https://arxiv.org/abs/0911.0460> for details.

Wolpert, D.H., "On the Connection Between In-Sample Testing and Generalization Error", *Complex Systems*, **6**, 47-94, 1992.

Wolpert, D.H., "The Relationship Between Occam's Razor and Convergent Guessing", *Complex Systems*, **4**, 319-368, 1990.

Wolpert, D.H., "Using a Mathematical Theory of Generalization to Construct a Generalizer Superior to NETalk", *Neural Networks*, **3**, 445-452, 1990.

Wolpert, D.H., "A mathematical Theory of Generalization: part I, part II", *Complex Systems*, **4**, 151-200, 201-249, 1990.

Wolpert, D.H., "A benchmark for how well neural nets generalize", *Biological Cybernetics*, **61** 303-313, 1989.

Optimization and Search/

Lam, R., Willcox, K., Wolpert, D.H., "Bayesian Optimization with a Finite Budget: An Approximate Dynamic Programming Approach", *Proceedings Neural Information Processing Systems*, 2016

Tracey, B. Wolpert, D.H., and Alonso, J.J., "Using Supervised Learning to Improve Monte Carlo Integral Estimation", *AIAA Journal*, 2013.

Wolpert, D. H. and Rajnarayan, D. "Using machine learning to improve Stochastic Optimization", *Proc. AAAI 2013*.

Wolpert, D.H., "What the no free lunch theorems really mean; how to improve search algorithms", *Ubiquity Symposium on Evolutionary Computation and the Processes of Life*, ACM, ubiquity.acm.org/symposia.cfm, Dec. 2013.

Nadiga, B. and Wolpert, D.H., "Exploiting models of different complexities for state and parameter estimation", *Geophysical Research Abstracts*, Vol. 15, EGU2013-3480, 2013

Tracey, B. Wolpert, D.H., and Alonso, J.J., "Using Supervised Learning to Improve Monte Carlo Integral Estimation", *13th AIAA Non-Deterministic Approaches Conference, Denver, CO, April 2011*, AIAA Paper 2011-1843.

Wolpert, D. H., Rajnarayan, D., and Bieniawski S., "Probability Collectives in Optimization", *Handbook of Statistics*, C.R. Rao and V. Govindaraju (Ed.'s), Vol. 31, 2013, 61–99

Rajnarayan, D., and Wolpert, D. H. "Bias-Variance trade-offs: Novel Applications", *Encyclopedia of Machine Learning*, Claude Sammut, Geoffrey I. Webb (Ed.'s), Springer, 2011.

Rajnarayan, D. and Wolpert, D.H., "Bias-Variance Techniques for Monte Carlo Optimization: Cross-validation for the CE Method", arXiv:0810.0877v1, 2008.

Rajnarayan, D. and Wolpert, D.H., "Exploiting Parametric Learning to Improve Black-Box Optimization", *Proc. ECCS 2007*, J. Jost et al. (Ed.)

Rajnarayan, D., Wolpert, D.H., Kroo, I. "Optimization Under Uncertainty Using Probability Collectives", *Proc. 11 AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference*, Portsmouth, VA, AIAA-2006-7033, 2006.

Wolpert, D.H., and Lee, C.F., "An adaptive Metropolis-Hastings scheme: sampling and optimization", *Europhysics Letters*, **76**, 353-359, 2006.

Wolpert, D.H., and Macready, W.G., "Coevolutionary Free Lunches", *IEEE Transactions on Evolutionary Computation*, **9**, 721-735, 2005.

Koeppen, M., Wolpert, D. H., Macready, W. G., "Remarks on a Recent Paper on the 'No Free Lunch' Theorems", *IEEE Transactions on Evolutionary Computation*, **5**, pp. 295-296, June 2001.

Macready, W.G., and Wolpert, D.H., "Bandit Problems and the Exploration/Exploitation Tradeoff", *IEEE Transactions on Evolutionary Computation*, **2**, 2-22, 1998.

Wolpert, D.H., and Macready, W.G., "No Free Lunch Theorems for Optimization", *IEEE Transactions on Evolutionary Computation*, **1**, 1997.

Macready, W.G., and Wolpert, D.H. "What Makes an Optimization Problem Hard?", *Complexity*, **5**, 1996.

Other topics/

Wolpert, D.H., Flack, J., Editors of special issue of *Entropy*, "Foundations of Biological Computation", 2022.

Wolpert, D.H., Kinney, D., "Noisy Deductive Reasoning: How Humans Construct Math, and How Math Constructs Universes", in *Undecidability, Uncomputability, and Unpredictability*, A. Aguirre et al. (Ed.'s), Springer, 2021.

Wolpert, D.H., "Theories of knowledge and theories of everything", in *The Map and the Territory*, Shyam Wuppuluri and Francisco Antonio Doria (Ed.'s), Springer, 2019.

Kempes, C.P., Van Bodegom, P., Wolpert, D., Libby, E., Amend, J., Hoehler, "Drivers of bacterial maintenance and minimal energy requirements", *Frontiers in Microbiology*, 2019

Wolpert, D.H., J. Grochow, E. Libby, S. DeDeo, "The many faces of state space compression" in *From Matter to Life: Information and Causality*, Walker, Ellis and Davies (Ed.'s), Cambridge University Press, 2017, 199-243.

Wolpert, D.H., Macready, W., "Using Self-dissimilarity to Quantify Complexity", *Complexity*, **12**, 2007.

Wolpert, D.H., Macready, W., "Self-dissimilarity as a high dimensional complexity measure", in *International Conference on Complex Systems 2004*, Y. Bar-Yam (Ed.), Perseus books, 2004.

Wolpert, D.H., "Metrics for more than two points at once", in *International Conference on Complex Systems 2004*, Y. Bar-Yam (Ed.), Perseus books, 2004.

Wolpert, D.H., MacLennan, B. J., "A Computationally Universal Field Computer with Linear Dynamics", *Neural Computation*.

Wolpert, D.H., and Macready, W.G., "Self-Dissimilarity: An Empirically Observable Measure of Complexity", in *Unifying Themes in Complex Systems*", Y. Bar-Yam (Ed.), Perseus books, 2000.

Wolpert, D.H., and Maclennan, B., "A Computationally Universal Field Computer that is Purely Linear", in *Proceedings of the 5th Joint Conference on Information Sciences*", (Atlantic City, NJ, Feb. 27 - Mar. 3, 2000), **I**, pp. 782-5, Paul P. Wang (Ed.), ACM Press, 2000.

BOOKS:

Bird, D., Kohler, T., and Wolpert, D.H., (Ed.), *Evolution of Collective Computational Abilities of (Pre)historic Societies*, special issue of *Journal of Social Computing*, in press

Wolpert, D., Kempes, C., Stadler, P., Grochow, J. (Ed.), *The Energetics of Computing in Life and Machines*, Santa Fe Institute Press, 2019.

Guy, T., Karny, N. and Wolpert, D.H., (Ed.), *Proceedings of ECML 2013 workshop on "Scalable decision making: Uncertainty, Imperfection, Deliberation"*, Springer, 2015.

Guy, T., Karny, N. and Wolpert, D.H., (Ed.), *Proceedings of NIPS 2011 workshop on "Decision Making and Imperfection"*, Springer, 2013.

Guy, T., Karny, N. and Wolpert, D.H., (Ed.), *Proceedings of NIPS 2010 workshop on "Decision Making with Imperfect Decision Makers"*, Springer, 2012.

Tumer, K. and Wolpert, D.H. (Ed.), *Collectives and the Design of Complex Systems*, Springer, 2004.

Wolpert, D.H. (Ed.), *The Mathematics of Generalization*, Addison-Wesley, 1994.

ARTICLES WRITTEN FOR POPULAR PRESS:

Wolpert, D.H., "A sliver of reality", *Aeon magazine*, Sept., 2022

Wolpert, D.H., "Why do computers take so much energy?", *Scientific American*, Oct. 4, 2018

STUDENTS:

Currently the primary supervisor of a graduate student officially enrolled at MIT

Co-advised PhD students: Stefan Bieniawski (Stanford), Dev Rajnarayan (Stanford), Brendan Tracey (Stanford), Justin Grana (American University)

Thesis reviewer for students at: UC-Irvine, University of Waterloo, University of Pretoria, University of Leipzig, University of Luxembourg, Imperial College London, Columbia University, International Center for Theoretical Physics

REU / UCR advisor of 6 interns including four minorities and two women (Jaewon Shin, Edward Chang, Gulce Kardes, Jin Hong Kuan, Milo Trujillo, Eliana Krakovsky)

Co-authored 26 papers with 13 students. In 16 of the papers the student was first author.

Participated in many years of Omidyar postdoctoral fellow application reviews at SFI.

TEACHING:

International Center for Theoretical Physics, Trieste, February 2022. Taught intensive graduate course (18 hours of lectures with two exams and several homeworks) on "Thermodynamics and computation".

Center of Excellence Cognitive Interaction Technology, Bielefeld, September 2010, Summer school lecturer (5 hours of lectures).

Tsinghua University, Center for Intelligent Networked Systems, Beijing, October 2005. Visiting professor. Taught intensive graduate course (10 hours of lectures and an exam) on "Advances in Complex Systems".

Santa Fe Institute, multiple years. Taught in Complex Systems Summer school (3 hours of lectures on average).

MISCELLANEOUS:

Fellow of IEEE

Member of FQXi

Research Associate of *Info-metrics Institute, American University*

Collaborator of *Purdue Center for Sciences of Information*

Associate Editor (current only):

Advances in Complex Systems

IEEE Transactions on Evolutionary Computation

ACM Transactions on Autonomous and Adaptive Systems

Theory in Biosciences

Journal of Social Computing

Entropy

Member of Editorial Board (current only):

Journal of Physics: Complexity

Journal of Artificial Intelligence Research

Journal of Economic Interaction and Coordination

Reviews of Behavioral Economics

Cancer Convergence

Collective Intelligence

Member of council (current only):

The Socio-Economic Science with Heterogeneous Interacting Agents Society

Member of Advisory Board (current only):

Handbook of Natural Computing, Springer

Sci, MDPI

Santa Fe Institute Press

Virtual Faculty (current only):

Bielefeld University Cluster on Cognitive Interaction Technology

Bios Fellow.

Member of multiple NSF panels. Member of NCI panel. Reviewer for multiple Belgium FRS-FNRS grants. Reviewer for multiple ERC grants. Reviewer for Dutch Research Council grant.

US Patent 5,535,301 on Stacked Generalization.
US patent 09/160,828 (1998) for Surfaid Predictor.
US patent (1999) for Masked Proportional Routing.

Top two winners of 2009 Netflix competition made extensive use of my patented Stacked Generalization technique. (See Sill, J. and Takacs, G. and Mackey L. and Lin D, "Feature-Weighted Linear Stacking", at arXiv:0911.0460.)

Second place in 2020 FQXi essay contest (\$5000 prize)

CO-ORGANIZED:

- 2022 International Center for Theoretical Physics meeting on *The adjacent possible fields of stochastic thermodynamics*
- 2022 SFI / NSF working conference on *The Future of the thermodynamics of computation*
- 2022 American Physical Society March meeting, two focus sessions
- 2022 *Workshop on Stochastic Thermodynamics III*
- 2021 SFI / NSF working conference on *The Future of the thermodynamics of computation*
- 2021 SFI working group on *Dynamics of the off-equilibrium brain: information processing and energy flows*
- 2021 *Workshop on Stochastic Thermodynamics: Junior Women's Caucus* (hosted this workshop at SFI)
- 2021 American Physical Society March meeting, 2 focus sessions
- 2021 *Workshop on Stochastic Thermodynamics II* (hosted at SFI)
- 2020 SFI workshop on *Evolution of Collective Computational Abilities of (Pre)Historic Societies*
- 2020 *Workshop on Stochastic Thermodynamics in Complex Systems* (With Jan Korbel created the WOST annual series of workshops, which now has over a thousand participants per year.)
- 2020 American Physical Society March meeting, 2 focus sessions
- 2020 SFI working group on *The Interplay of Large-Scale Impersonal Trends, Big Ideas, and Great Leaders in History*
- 2019 SFI workshop on *What is Biological Computation?*
- 2019 SFI working group on *Thermodynamic and Computational Efficiency in Cellular Chemical Reaction Networks*
- 2018 SFI working group on *Lookahead Optimization*
- 2017 SFI workshop on *Information Networks and the Evolution of Social Organization*

2017 SFI workshop on *Thermodynamics and Computation: toward a new synthesis*

2017 SFI workshop on *Thermodynamics of Computation in Chemical and Biological Systems*

2016 NIPS workshop on *Imperfect Decision Makers: Admitting Real-World Rationality*

2016 SFI workshop on *Statistical Physics, Information Processing and Biology*

2014 SFI working group on *Major Transitions in Natural, Synthetic, and Artificial Evolution*

2014 SFI working group on *Information Theory, Ecosystems, and Schrodinger's Paradox*

2013 SFI / LANL working group on *Multi-Information Source Optimization*

2012 SFI / LANL working group on *Multi-Information Source Optimization*

2012 SFI / LANL Theme week on *Combining Information Theory and Game Theory*

2011 NIPS workshop on *Decision Making with Multiple Imperfect Decision Makers*

2010 NIPS workshop on *Decision Making with Multiple Imperfect Decision Makers*

2010 Santa Fe Institute / Center for Nonlinear Studies workshop and mini-program on *Decentralized control of strategic agents*

2010 Perimeter Institute workshop on the *Foundations of physics*

2009 Oxford-Man Institute workshop, *From Game Theory to Game Engineering*

2008 Beyond Institute workshop on *The Nature of the Laws of Physics*

2005 NIPS workshop on *Game Theory, Machine Learning and Reasoning under Uncertainty*

2005 Center for Nonlinear Studies workshop on *Collectives*

2004 Special Session on *Product Distribution Theory* at The 2004 International Conference on Complex Systems (invited organizer)

2003 Stanford/NASA workshop on *Collective Intelligence*

2002 NASA workshop on *Collective Intelligence*

2001 Santa Fe Institute / NASA workshop on *Collective Intelligence*

2002 WCCI Special Track on *Distributed Learning for Optimization*

NIPS-98 Workshop on *Turnkey Algorithms for Improving Generalizers*

The AAAI-96 Workshop on *Integrating Multiple Learning Methods*. Co-edited the associated special issue of *Machine Learning Journal*

Spring 1996 AAAI Symposium on *Computational Issues in Learning Models of Dynamical Systems*

1992 Center for Nonlinear Studies / Santa Fe Institute workshop on *Mathematics of Generalization*

REVIEWED FOR:

ACM Transactions on Autonomous and Adaptive Systems
AIAA journal
Air Force Office of Scientific Research
AISTATS 2023
Artificial General Intelligence 2010, 2011
Artificial Intelligence and Statistics 2011
Artificial Life
American Control Conference 2011, 2012, 2018, 2022
The American Statistician
American Association for Artificial Intelligence Conferences
American Association for Artificial Intelligence Symposia
American Journal of Epidemiology
Annals of Mathematics and Artificial Intelligence
Annals of Operations Research
Annals of Physics
Annals of Statistics
Arabian Journal for Science and Engineering
Army Research Office
Artificial Intelligence
Artificial Intelligence and Mathematics
Asia-Pacific Conference on Intelligent Agent Technology 2001
Automatica
Autonomous Agents and Multi-agent systems '03
Autonomous Agents and Multi-agent systems '04
Autonomous Agents and Multi-agent systems '05
Journal of Autonomous Agents and Multi-agent systems
Axioms
Axios
Bayesian Analysis
Belgium, Fund for Scientific Research – FRNS
Bernoulli Journal
Big Data and Society
Biological Theory
Biophysical Journal
Brain Research Bulletin
Brain Sciences
Briefings in Bioinformatics
British Journal for the Philosophy of Science
Cambridge University Press
Cell Reports Physical Science
Center for Sciences of Information
Center for Nonlinear Studies

Chaos
Cognitive Information Processing 2008
Collective Intelligence
Communication Physics Nature
Complexity
Complexus
Complexis conference 2016
Complex Systems
Computers and Operations Research
Connection Science
Conference on Decision and Control 2001
Congress on Evolutionary Computation 2004
Congress on Evolutionary Computation 2009
Czech Science Foundation
The Open Cybernetics and Systemics Journal
Decision Support Systems
DOE office of Basic Science
Dutch Research Council
Econometrica
Engineering self-organizing applications 2003
Engineering and Physical Sciences Research Council
Engineering Societies in the Agents World, 2008
Entertainment Computing
Entropy
EURASIP Journal on Applied Signal Processing
European Conference on Complex Systems
EPL
European Physical Journal Plus
European Research Council Advanced Grant Call
European Research Council Europa Consolidator Grant 2021
Europhysics Letters
Evolutionary Computation
Foundations of Evolutionary Algorithms 2000
Foundations of Physics
Foundations of Science
Fund for Scientific Research (Belgium)
FQXi
Frontiers in Evolutionary Algorithms 2000
Frontiers in Physics
Games and Economic Behavior
Global Environmental Change
Handbook of Natural Computing
Human Movement Review
Human Movement Science

IBM Journal of Research and Development
ICML 2015
ICML 2019
ICPRAM 2011
IEEE Communications Letters
IEEE Control Systems Conference 2011
IEEE International Symposium on Cluster Computing and the Grid 2001
IEEE Intelligent Systems
IEEE Transactions on Evolutionary Computation
IEEE Transactions on Knowledge and Data Engineering
IEEE Transactions on Neural Networks
IEEE Transactions on Neural Networks and Learning Systems
IEEE Transactions on Pattern Analysis and Machine Intelligence
IEEE Transactions on Systems, Man and Cybernetics, A and B
Infometrics Institute 2011 workshop on Philosophy of Information
Information
Information Fusion
Information Geometry
Information Processing Letters
Information Sciences
INFORMS Journal on Computing
Israeli Research Foundation
Intelligent Agent Technology 2001
Intl. symposium on Innovations in Intelligent Systems and Applications 2007
International Conf. Complex Systems 2011
International Journal of Business Intelligence and Data Mining
INISTA 2007
Institute for Mathematics and its Applications
Interdisciplinary Science Reviews
International Center for Theoretical Physics
International Joint Conference on Artificial Intelligence
International Conference on Complex Systems 2004
International Conference on Machine Learning and Applications
International Joint Conference on Neural Networks
International Workshop on Multiple Classifier Systems
Iranian Journal of Management Studies
Isaac Newton Institute for Mathematical Sciences
Israeli Science Foundation
John Templeton Foundation
Joint Conference on Intelligent Systems
Journal of Aerospace Engineering
Journal of Artificial Intelligence Research
Journal of Autonomous Agents and Multi-Agent Systems
Journal of Biological Physics

Journal of Chemical Information and Modeling
Journal of Chemical Physics
Journal of Combinatorial Optimization
Journal of Computational and Graphical Statistics
Journal of Computer Science Applications and Information Technology
Journal of Heuristics
Journal of General Philosophy of Science
Journal of History of Economic Thought
Journal of Machine Learning Research
Journal of Neural Networks
Journal of Optimization
Journal of the Royal Society, Interface
Journal of the Royal Statistical Society, B
Journal of Statistical Physics
Journal of Theoretical Biology
Keck Foundation
Knowledge Discovery and Data Mining Conference
Machine Learning
The Marsden Fund of The Royal Society of NZ
Mathematics
Mathematical Reviews
Max Planck Institute for Intelligent Systems, Search committee for Director
Maximum Entropy and Bayesian Methods Conference
MCS 2000
MIND
NASA Astrobiology Institute
National Science Foundation
Nature
Nature Communications
Nature Physics
Nature Scientific Reports
National Cancer Institute
National Science Foundation (more than half a dozen divisions)
Netherlands Organization for Scientific Research
Neural Computation
Neural Networks
Neural Information Processing Systems Conference
Oxford University Press
Philosophical Transactions A
Philosophy of Science
Physica A
Physica D
Physical Review E
Physical Review Letters

Physical Review Research
Physical Review X
Physics Essays
Physics Letters A
PLoS One
PLoS Computational Biology
Proceedings of the National Academy of Sciences (PNAS)
Proceedings of the Royal Society A
Progress in Biophysics and Molecular Biology
Journal of the Royal Statistical Society B
Recent Patents on Engineering
Remote Sensing
Research Foundation Flanders
Reviews of Behavioral Economics
Royal Society Wolfson Research Merit Award
Royal Society Leverhulme Trust Award
Science
Science Advances
Scientific Reports
SIAM Review
Society for Economics and Heterogeneous Interacting agents
Soft Computing
Sustainability
Swiss National Science Foundation
Synthese
Theoretical Computer Science
Theory in Biosciences
Templeton World Charity Foundation
1999 Workshop on Economics with Heterogeneous Interacting Agents
First International Workshop on Theory and practice of open computational
systems
WCCI 2008

INVITED PRESENTATIONS AND DISCUSSION PANELS:

Agents '00 "Infrastructure for Scalable Multi-Agent Systems" workshop.
American Assoc. for Advancement of Science 1995 Panel on Artificial Life
American Mathematical Society Mt. Holyoke 1996 Workshop on Statistics
American Physical Society March 2021 meeting
Arizona State University, Mathematics and Cognition Seminar
Arizona State University, Biosocial Complexity Initiative
Arris Corporation

Aladdin Project Review (**keynote speech**) 2009
 Beilstein-Bozen symposium, 2018
 Beyond Institute on General Principles of Increasing Complexity
 Bremen University
 Brigham Young University, Computer Science Dept.
 Bristol University, Computer Science Dept.
 Brookings Inst. Workshop on Multi-Agent Comp. in Economies 2002
 Brown University Chemistry Department
 Cal State Fresno, Business School
 Cal State Fresno, Physics Dept.
 Cal State Fresno, Computer Science Dept.
 Cal Tech, Center for Neuromorphic Systems Engineering
 Cal Tech, Control and Dynamical Systems
 Cal Tech, Physics Research Conference (**sole speaker**)
 Cambridge University, Newton Institute of Mathematics
 Center for Nonlinear Studies (Los Alamos)
 CNLS conference: Unconventional Computation: Quo Vadis? 2007
 Centro de Ciencias de la Complejidad
 Complexity Science Hub, Vienna
 Cognitive Computing 2018 (Hanover), (**keynote speech**)
 Conference on Complex Systems (three talks) 2015
 Conference on Complex Systems (**invited speaker**) 2017
 Complexity, Criticality and Computation 2017 (**keynote speech**)
 Computation in Natural Systems 2018 (**keynote speech**)
 Computability in Europe 2010 (**plenary speaker**)
 Conferences on Computational Learning Theory and Natural Learning
 Systems (several)
 Conference on Cognitive Computing - Merging Concepts with Hardware
 2018 (**plenary speaker**)
 Conference on Control and Decision Theory 2004
 Control Mechanisms for Complex Systems 1996 International Workshop
 Conference in honor of Reuven Rubinstein 2008
 Conference on Evolutionary Computation 2000 (**banquet speech**)
 Conference on Evolutionary Computation 2005 (**keynote speech**)
 Courant Institute
 Cowles Foundation 2009 workshop on simplicity and likelihood
 Dynamics of multilevel systems 2015 workshop
 Dynamics of multilevel systems 2015 (**summer school lecturer**)
 Entropy 2018 (**keynote speech**)
 Evolution, Cooperation and Rationality workshop, 2009 (Bristol, UK)
 European Conference on Complex Systems, Future of Complex
 Transportation Systems workshop, 2011
 Guided self-organization 2018 (**keynote speech**)
 IEEE Symposium on Foundations of Computational Intelligence '07

(keynote speech)

IEEE Beijing Frontiers of Machine Intelligence 2016 **(keynote speech)**
FQXi biannual conference, 2016
Fusion Engineering and Design
Workshop on High Performance Object Databases, Cardiff '00
HP Research Labs (Palo Alto)
IBM Yorktown Heights Research Center
IBM Informational Lens Workshop
ICML 2000 workshop on What Works Well Where
ICML 2000 workshop on multi-agent systems
Imperial College London, Statistics Department
Infometrics conference (multiple meetings)
Information Engines at the Frontiers of Nanoscale Thermodynamics, 2016
Institute for Human and Machine Cognition
Institute for New Economic Thinking (Oxford)
Workshop on Intelligent Agents for Imagery & Geospatial Analysis 2000
Institute of Science and Technology Austria, Physics Department, 2019
International Center for Theoretical Physics
International Conference of Social Computing, Tsinghua university, 2020
International Conference for Learning Representations 2022, **(invited)**
The International Computer Science Institute
Jet Propulsion Laboratory
Keio university, Physics Dept.
Likelihood and Simplicity, Bar-Ilan University,
London School of Economics, Mathematics Dept.
Luxembourg University, Physics Dept.
Max Planck Institute for Mathematics in the Natural Sciences
Max Planck Institute "Math Concepts in Sciences and Humanities" **(invited)**
Maximum entropy and Bayesian Analysis conference, 2016

(keynote speech)

Microsoft Corporation
Modeling Complex Systems '02
Monitoring, security, and rescue tasks in multi-agent systems

(keynote speech)

MIT Artificial Intelligence Lab
MIT Lincoln Laboratories
NASA Center for Computational Astrobiology kickoff panel discussion
Nanyang Technical University, Physics Department
NEC Corporate Research Lab
New England Complex Systems Institute
Neural Information Processing Systems main conference
Neural Information Processing Systems workshop on Combining
generalizers
Neural Information Processing Systems workshop on Occam's Razor

Neural Information Processing Systems workshop on Electronic Commerce
 NIMBioS workshop on *Information and Entropy in Biological Systems*, 2015
 NORDITA workshop on "Statistical Physics of Complex Systems", 2019
 Complexity Science Hub Vienna, "Information-theoretic Methods for
 Complexity Science", 2019
 Oxford University, Applied Mathematics Dept.
 Oxford University, Computer Science Dept.
 Oxford - Man Institute
 Parmenides Foundation, *Re-Thinking Matter, Life, Mind* 2018
 (**plenary speech**)
 Perimeter Institute
 Princeton Center for Physics of Biological Function
 Purdue University, Computer Science Dept
 Pyeongchang forum, 2019, (**keynote speech**)
 RAND, Santa Monica, 2015
 RAVE 2009, Barcelona (**keynote speech**)
 Workshop on Re-conceptualizing the Origin of Life, Carnegie Institute, 2016
 Rocky Mountain Conference on Artificial Intelligence
 Rome 2010 Science Festival (**plenary speech**)
 Royal Statistical Society
 Sandia Complex Systems Department (**distinguished lecturer**)
 San Jose State University physics department
 ScienceFoo 2009
 Seoul National University, Physics Dept., 2019
 Snowbird conference on neural computing
 SIAM 2013 mini-symposium on Multi-information source optimization
 SIAM 2014 mini-symposium on Multi-fidelity optimization
 Siemens Corporate Research
 Self Optimizing Systems NSF workshop (**keynote speech**)
 Solvay workshop on Nonequilibrium and nonlinear phenomena in
 statistical mechanics
 SPIE 2008 (**keynote speech**)
 Stanford, Aeronautics and Aerospace Dept.
 Stanford, Computer Science Dept.
 Stanford, Psychology Dept.
 Stanford, Statistics Dept.
 Statistical Mechanics Workshop, 2016
 "Strategies for Implementing Large Scale Emergent Systems" Workshop
 SUNY Albany Physics Dept.
 Symposium on Understanding Complex Systems 2005 (**keynote speech**)
 Symposium on Frontiers of Machine Intelligence 2016 (**keynote speech**)
 Theory and practice of open computational systems 2003
Thermodynamic Computing workshop, 2019
 Tsinghua university computer science and physics departments, 2016

UC Berkeley, Statistics Dept.
UC Davis, Computer Science Dept.
UC Irvine, Institute for Mathematical Behavioral Sciences
UCLA, Aerospace Dept.
UCLA, Statistics Dept.
UC San Diego, Politics Dept.
UC Santa Cruz, Computer Science Dept.
UC Santa Cruz, Applied Math Dept.
USC, Computer Science Dept.
University of Georgia, Dept. of Physics and Astronomy
University of Luxembourg, Physics Dept.
University of New Mexico, Physics Dept.
University of New Mexico, Computer Science Dept.
University of Tokyo, Physics Dept.
University of Warwick, Economics Dept.
UT Austin, Physics Dept.
World Conference on Soft Computing (**plenary speech**) 2002
World Congress on Computational Intelligence (**plenary speech**) 2002
Workshop on Econ. and Heterog. Interactive Agents (**plenary speech**) 2004
Wright-Patterson AFRL Technical Interchange Meeting on multi-fidelity
optimization 2013
Yale University Physics Department

PEER-REVIEWED AWARDS:

Best Paper Award for IEEE Trans. Evolutionary Computation, Vol. 1
Best Paper Award for IEEE Trans. Evolutionary Computation, Vol. 2
Superior Accomplishment Award for NASA Code IC for 1999
TXN fellow
NIH Postdoctoral Fellowship
LANL Director's Postdoctoral Fellowship
UC DuPont Fellowship
UC Regent's Fellowship
Princeton University Physics Department Kusaka Prize