DAVID WOLPERT

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International Center for Theoretical Physics, Trieste, Italy
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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.

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 June, 2018	MIT Astronautics and Aeronautics Dept., *Visiting 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*.
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)	Max Planck Institute, *Visiting scholar*

Fall, 2007	Tsingua University, *Visiting Professor*. Taught a course in complex systems.
June 2005 to 2007 (with gaps)	Stanford University Aeronautics and Astronautics Dept. *Consulting Professor*. Supervise students in several departments on topics including adaptive distributed control and bounded rational game theory.
May 1997 to November 2011	NASA Ames Research Center. *Senior Computer Scientist*. Supervise and conduct academic research on probability collectives, combinatorial optimization, machine learning and statistics, complexity measures, and the physics of information. Supervise a group to implement collective intelligence systems inside distributed computational networks.
April 1996 to May 1997	IBM Almaden Research Center. *Datamining Solutions, Research Manager.* Supervise and conduct product-driven and academic research on machine learning and statistics.
July 1995 to March 1996	TXN Inc. *Director of Research*. Conducted product-driven and academic research on machine learning and statistics. In particular developed a run-time fraud system for telecommunications networks.
November 1991 to March 1996	Santa Fe Institute. *Postdoc*. Conducted research on supervised learning, Bayesian statistics, and the thermodynamics of computation.
January 1994 to June 1995	Pediatric Aids Foundation and NIH Correlates of Human Immuno-Deficiency Program. *Research Associate*. With Bette Korber of Los Alamos conducted statistical analysis and research on several HIV-related epidemiological datasets.
May 1993 to June 1995	TXN Inc. *Consultant*. Conducted product-driven research on machine learning and statistics.
March 1989 to November 1991	Theoretical Division and Center For Nonlinear Studies, Los Alamos National Laboratory. *Postdoc (Director's Fellow)*. Performed academic research on supervised learning, Bayesian Statistics, and the thermodynamics in J. Doyne Farmer's Complex Systems Group.
January 1988 to January 1989	University of California. Department of Computer Science, CA., *Research Assistant*. With Dr. Terrence Smith investigated connectionist models, especially as applied to path-finding.
September 1985 to December 1987	University of California, Department of Physics, Santa Barbara, CA., *Teaching Assistant*. Led discussion sections for graduate and undergraduate physics courses.
August 1984	Neurosciences Institute, Rockefeller University. *Research Associate*. Conducted Artificial Intelligence research and ran the NSI's IBM 4331, linked to IBM's research computers at Yorktown Heights.

REFEREED PUBLICATIONS:

Physics/

Wolpert, D.H., et al, "Is stochastic thermodynamics the key to understanding the energy costs of computation?", **Perspective** article, *PNAS*, 2024

Manzano, G., Roldan, E., Kardes, G., Wolpert, D.H., "Thermodynamics of computations with absolute irreversibility, unidirectional transitions, and stochastic computation times", *Physical Review X,* 2024.

Korbel, J., Wolpert, D.H., "Nonequilibrium thermodynamics of uncertain stochastic processes", *Physical Review Research,* 2024.

Ouldridge, T., Wolpert, D.H. "Thermodynamics of deterministic finite automata operating locally and periodically", *New Journal of Physics,* vol. 25, 2023.

Tasnim, F., Wolpert, D.H. "Stochastic thermodynamics of multiple co-evolving systems --- beyond multipartite processes". **Invited article** to special issue of *Entropy* on Thermodynamic Uncertainty Relations, in press.

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), 2023.

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.

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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.).

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Human Behavior and Control of Collective Systems/

Wolpert, D.H., Price, M., Crabtree S., Kohler, T.., Jost J., Evans, J., Stadler, P., Shimao, H., Laubichler, M., "The Past as a Stochastic Process" , *Journal of Computer applications in Archaeology*, 7(1): 134–152. 2024, DOI: https://doi.org/10.5334/jcaa.113

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

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

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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.), 2024

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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.

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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/

Sole, R., Kempes, C., Corominas-Murtra, B., DeDomenico M., Kolchinsky, A., Lachmann, M., Libby, E., Saavedra, S., Smith, E., and Wolpert, D.H. "Fundamental Constraints to the Logic of Living Systems", *Interface Focus*, 2024

Wolpert, D.H., Kipper, J., "Memory Systems, the Epistemic Arrow of Time, and the Second Law", *Entropy*, **Invited contribution**, 2024.

Wolpert, D.H., Kinney, D., "A Stochastic Model of Mathematics and Science", *Foundations of Physics*, **Invited contribution**, vol. 54, article 21, 2024.

Wolpert, D.H., "What can we know about that which we cannot even imagine?", to appear in *New Frontiers in Science* (Streit-Bianchi and Gorin, Ed.), **Invited contribution**, 2024.

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

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

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.

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.

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

GRANTS (within last five years, in reverse chronological order, only those for which I am PI and that are over $50,000):

NSF EAGER, CCF-2221345*, Stochastic Thermodynamics of Distributed Computation*

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

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

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

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

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

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

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

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

STUDENTS:

Co-advised PhD students: Abhishek Yadav (IISR), Farita Tasnim (MIT), Stefan Bieniawski (Stanford), Dev Rajnarayan (Stanford), Brendan Tracey (Stanford), Justin Grana (American University)

Thesis committee service for students at: Arizona State University, 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, Gülce 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.

MISCELLANEOUS:

Member of Board of Ernst Strüngmann Forum

Senior fellow of UCLA Institute for Pure and Applied Mathematics

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

Fellow of IEEE (Fewer than .1% IEEE members are elected fellows per year.)

Fellow of Asia-Pacific Artificial Intelligence Association

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 Social Computing
Reviews of Behavioral Economics
Collective Intelligence

Member of Advisory Board (current only):

Handbook of Natural Computing, Springer
Sci, MDPI

Santa Fe Institute Press

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 ICMS initiative on Mathematics for Humanity.

Nominator for Kyoto Prize

Member of American Physical Society GSNP Fellowship Committee

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.)

International Center for Theoretical Physics, Trieste, February 2022. Taught an intensive graduate course on "Thermodynamics and computation"

Tsinghua University, Center for Intelligent Networked Systems, Beijing, October 2005. Visiting professor. Taught an intensive graduate course on "Advances in Complex Systems".

Max Planck Institute, Mathematics in the Physical Sciences, Leipzig, June 2006, October 2007, March 2009, January 2011, May 2013, October 2013. Visiting scholar.

Center of Excellence Cognitive Interaction Technology, Bielefeld, September 2010, Summer school lecturer.

Co-founded and have helped run the annual Workshop on Stochastic Thermodynamics, which is fully online, now in its sixth year.

Participated in many years of reviewing candidates for Omidyar postdoctoral fellowships and Complexity postdoctoral fellowships at the Santa Fe Institute.

Running Omidyar postdoctoral fellowship search program, 2024 -

Co-organized:

2024 Complexity Science Hub meeting on *Trade-offs between thermodynamic cost, intelligence, and fitness in living organisms*
2024 SFI workshop on *Investigating Reality – A mathematical, Philosophical, and Scientific Exploration*
2024 SFI workshop on *Stochastic Thermodynamics and Computer Science Theory*
2024 *Workshop on Stochastic Thermodynamics V*
2024 SFI working group on *Computation and Growth In Human History*
2024 *Neuromorphic Computing Meets Quantum Mechanics*, Univ. of Georgia
2023 SFI working group on *Energy, Information, Culture: Growth In Human History*
2023 SFI working group on *Computation and Growth In Human History*
2023 Complexity Science Hub workshop on *Computation in dynamical Systems*
2023 SFI working group on *The Interactions of Information and Energy Propelling Human History*
2023 *Workshop on Stochastic Thermodynamics IV*
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 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 I ssue 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

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 Archaeological Journal

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
Department of Energy 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 Physical Journal
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 Computer Science

Games and Economic Behavior
Global Environmental Change
GSNP section of American Physics Society, Fellowship selection committee
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 Mobile Computing
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
Frontiers in Complex Systems
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
Intern. Symp. 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
International Journal of Quantum Chemistry

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 Society, Proceedings A
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
PNAS
PNAS Nexus
Proceedings of the Royal Society A
Progress in Biophysics and Molecular Biology
Open Computer Science
Quaternary Science Reviews
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
Thermo
Templeton World Charity Foundation
Transaction on mobile computing
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
Aladdin Project Review (**keynote speech**) 2009
Am. Assoc. for Advancement of Science 1995 Panel on Artificial Life
American Mathematical Society Mt. Holyoke 1996 Workshop on Statistics
American Physical Society March 2023 meeting
American Physical Society March 2021 meeting
Arizona State University, Mathematics and Cognition Seminar
Arizona State University, Biosocial Complexity Initiative
Arris Corporation
Arrow of Time, 2024
Artificial Life (**keynote speech**) 2023
Beilstein-Bozen symposium, 2018
Beyond Institute on General Principles of Increasing Complexity
Bremen University, 2022
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**)
Complexity Science Hub Vienna, "Information-theoretic Methods for Complexity Science", 2019

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
Diverse Intelligences Summer Institute (**summer school lecturer**)
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 Symp. on Found. 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 2023 Distinguished Speaker Series
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 Cross-Disciplinary Physics and Complex Systems, 2023
Institute for Human and Machine Cognition
Institute for New Economic Thinking (Oxford)
Institute for Pure and Applied Math, workshop on "Naturalistic Approaches to Artificial Intelligence", 2024 (**invited**)
Workshop on Intell. Agent Support for Imagery & Geospatial Analysis 2000
Institute of Science and Technology Austria, Physics Department, 2019
International Center for Theoretical Physics, 2022, 2023
International Conference of Social Computing, Tsinghua university, 2020

International Conference for Learning Representations 2022 **(invited)**
The International Computer Science Institute
Jaynes Centennial Symposium (**keynote speaker**)
Jet Propulsion Laboratory
Keio university, Physics Dept.
Conference on *Likelihood and Simplicity*, Bar-Ilan University,
London School of Economics, Mathematics Dept.
Los Alamos *Conclave on Complexity in Interacting Systems*, 2023
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 conf., 2016 (**keynote speech**)
Microsoft Corporation
Modeling Complex Systems '02
Monitoring, security, and rescue in multi-agent systems (**keynote speaker**)
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 WS 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
Oxford University, Applied Mathematics Dept.
Oxford University, Computer Science Dept.
Oxford - Man Institute
Parmenides Found., *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
Rochester University Physics Department, 2024
Rochester University, Information-Driven States of Matter, 2024
Rocky Mountain Conference on Artificial Intelligence
Rome 2010 Science Festival (**plenary speaker)**
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**)
Society for Multidisciplinary and Fundamental Research (**keynote speech**)
Solvay WS on Noneq. 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, 2022
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 speaker**) 2002
World Congress on Computational Intelligence (**plenary speaker**) 2002
Workshop on Limits to collective agency, 2024
Workshop on Econ. and Heterog. Interactive Agents (**plenary speaker**) 2004
Workshop on *Limits to Collective Agency*, ICTP (**invited speaker**) 2024

Wright-Patterson AFRL Technical Interchange Meeting on multi-fidelity optimization 2013
Yale University Physics Department
Yamada Science Foundation 45th Anniversary Symposium 2023

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