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EDUCATION

- Ph.D. (Mathematics), Massachusetts Institute of Technology, 1977.
Thesis: Representing Knowledge of Large-Scale Space.
- B.A. with High Honors (Mathematics), Swarthmore College, 1970.
Thesis: Topological Vector Spaces.

PROFESSIONAL EXPERIENCE

- **University of Michigan, Department of Electrical Engineering and Computer Science**
 - Professor of Computer Science and Engineering, 2009-present.
- **University of Texas at Austin, Department of Computer Sciences**
 - Endowed Professorship in Computer Sciences No. 3, 1997-2008.
Department Chair, 1997-2001.
David Bruton, Jr. Centennial Professor in Computer Sciences No. 1, 1992-97.
Associate Professor of Computer Sciences, 1985-92.
 - Professor of Electrical and Computer Engineering, UT Austin, 2001-2008.
Associate Professor of Medicine, The University of Texas Health Science Center at San Antonio (secondary appointment), 1988-91.
- **Massachusetts Institute of Technology, Laboratory for Computer Science**
 - Research Associate, Clinical Decision Making Group, 1984-85.
- **Tufts University, Department of Mathematics**
 - Assistant Professor of Mathematics, 1978-85 (on leave 1984-85).
 - Assistant Professor of Medicine, Tufts University School of Medicine, 1983-85.
Visiting Scientist, M.I.T. Laboratory for Computer Science, 1980-85.
- **Massachusetts Institute of Technology, graduate and post-doctoral work**
 - Research Associate, Division for Study and Research in Education, 1977-78.
 - Graduate Student, NSF Fellow, Danforth Fellow, Teaching Assistant and Research Assistant, Department of Mathematics and Artificial Intelligence Laboratory, 1972-77.
- **Harvard University, Department of Psychology**
 - Systems Programmer, Computer Based Laboratory, 1970-72.

PUBLICATIONS

Books

- B. J. Kuipers. 1994. *Qualitative Reasoning: Modeling and Simulation with Incomplete Knowledge*. Cambridge, MA: MIT Press. ISBN 0-262-11190-X. (pp. 414+xxvii.)
- S. Winter, M. Duckham, L. Kulik, and B. Kuipers. 2007. *Spatial Information Theory: Proc. 8th Int. Conf. COSIT 2007*. Lecture Notes in Computer Science 4736. Berlin: Springer. ISBN 3-540-74786-9. (pp. 455+xi.)

Articles

- C. Xu and B. Kuipers. Object detection using principal contour fragments. *Canadian Conference on Computer and Robot Vision (CRV-11)*, 2011.
- C. Xu, J. Liu and B. Kuipers. Motion segmentation by learning homography matrices from motor signals. *Canadian Conference on Computer and Robot Vision (CRV-11)*, 2011.
- J. Liu, M. Shah, B. Kuipers and S. Savarese. Cross-view action recognition via view knowledge transfer. *IEEE Int. Conf. on Computer Vision and Pattern Recognition (CVPR)*, 2011.
- J. Liu, B. Kuipers and S. Savarese. Recognizing human actions by attributes. *IEEE Int. Conf. on Computer Vision and Pattern Recognition (CVPR)*, 2011.
- J. J. Park and B. Kuipers. A smooth control law for graceful motion of differential wheeled mobile robots in 2D environment. *IEEE Int. Conf. on Robotics and Automation (ICRA)*, 2011.
- C. Xu and B. Kuipers. Towards the Object Semantic Hierarchy. *IEEE Int. Conf. on Development and Learning (ICDL)*, 2010.
- P. Beeson, J. Modayil and B. Kuipers. Factoring the mapping problem: Mobile robot map-building in the Hybrid Spatial Semantic Hierarchy. *International Journal of Robotics Research* **29**(4): 428–459, 2010. doi:10.1177/0278364909100586.
- J. Stober, L. Fishgold and B. Kuipers. Sensor map discovery for developing robots. *Manifold Learning and its Applications, AAAI Fall Symposium Series*, 2009.
- J. Mugan and B. Kuipers. A comparison of strategies for developmental action acquisition in QLAP. *International Conference on Epigenetic Robotics (EpiRob-09)*, 2009.
- J. Stober, L. Fishgold and B. Kuipers. Learning the sensorimotor structure of the foveated retina. *International Conference on Epigenetic Robotics (EpiRob-09)*, 2009.
- C. Xu and B. Kuipers. Construction of the Object Semantic Hierarchy. *Fifth International Cognitive Vision Workshop (ICVW-09)*, 2009.
- C. Xu, B. Kuipers, and A. Murarka. 3D pose estimation for planes. *ICCV Workshop on 3D Representation for Recognition (3dRR-09)*, 2009

- J. Mugan and B. Kuipers. Skill reuse in lifelong developmental learning. *IROS-09 Workshop on Autonomous Mental Development for Intelligent Robots and Systems*, 2009.
- A. Murarka and B. Kuipers. A stereo vision based mapping algorithm for detecting inclines, drop-offs, and obstacles for safe local navigation. *IEEE/RAS Int. Conf. on Intelligent Robots and Systems (IROS-09)*, 2009.
- S. Gulati and C. Jhurani and B. Kuipers and R. Longoria. A framework for planning comfortable and customizable motion of an assistive mobile robot. *IEEE/RAS Int. Conf. on Intelligent Robots and Systems (IROS-09)*, 2009.
- J. Mugan and B. Kuipers. Autonomously learning an action hierarchy using a learned qualitative state representation. *International Joint Conference on Artificial Intelligence (IJCAI)*, 2009.
- J. Modayil and B. Kuipers. The initial development of object knowledge by a learning robot. *Robotics and Autonomous Systems* **56**: 879–890, 2008.
- B. Kuipers. Drinking from the firehose of experience. *Artificial Intelligence in Medicine* **44**: 155–170, 2008. doi:10.1016/j.artmed.2008.07.010.
- A. Murarka, M. Sridharan, and B. Kuipers. Detecting obstacles and drop-offs using stereo and motion cues for safe local motion. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS-08)*, 2008.
- J. Stober and B. Kuipers. From pixels to policies: a bootstrapping agent. *IEEE International Conference on Development and Learning (ICDL-08)*, 2008.
- J. Mugan and B. Kuipers. Towards the application of reinforcement learning to undirected developmental learning. *International Conference on Epigenetic Robotics (EpiRob-08)*, 2008.
- J. Mugan and B. Kuipers. Continuous-domain reinforcement learning using a learned qualitative state representation. *International Workshop on Qualitative Reasoning (QR-08)*, 2008.
- B. Kuipers. An intellectual history of the Spatial Semantic Hierarchy. In Margaret E. Jefferies and Wai K. Yeap (Eds.), *Robotics and Cognitive Approaches to Spatial Mapping*, Springer-Verlag, 2008.
- C. Xu, Y. J. Lee and B. Kuipers. Ray-based color image segmentation. *Canadian Conference on Computer and Robot Vision (CRV-08)*, 2008
- S. Ramamoorthy and B. J. Kuipers. Trajectory generation for dynamic bipedal walking through qualitative model based manifold learning. *IEEE Int. Conf. Robotics and Automation (ICRA-08)*, 2008. **Best Paper Award finalist** (top 4).
- S. Gulati and B. Kuipers. High performance control for graceful motion of an intelligent wheelchair. *IEEE Int. Conf. Robotics and Automation (ICRA-08)*, 2008.
- J. Provost, B. J. Kuipers and R. Miikkulainen. Self-organizing distinctive state abstraction using options. In *Proc. 7th Int. Conf. Epigenetic Robotics (EpiRob-07)*, 2007.
- J. Mugan and B. Kuipers. Learning distinctions and rules in a continuous world through active exploration. In *Proc. 7th Int. Conf. Epigenetic Robotics (EpiRob-07)*, 2007.

- B. Kuipers. Sneaking up on the hard problem of consciousness. In *AI and Consciousness: Theoretical Foundations and Current Approaches*. AAAI Fall Symposium Series, 2007.
- J. Mugan and B. Kuipers. Learning to predict the effects of actions: Synergy between rules and landmarks. *International Conference on Development and Learning (ICDL-07)*, 2007.
- J. Modayil and B. Kuipers. Autonomous development of a grounded object ontology by a learning robot. *National Conference on Artificial Intelligence (AAAI-07)*, 2007.
- S. Ramamoorthy and B. J. Kuipers. Qualitative hybrid control of dynamic bipedal walking. In G. S. Sukhatme, S. Schaal, W. Burgard and D. Fox (Eds.), *Robotics: Science and Systems II*, MIT Press, 2007.
- J. Modayil and B. Kuipers. Where do actions come from? Autonomous robot learning of objects and actions. In *Interaction Challenges for Intelligent Assistants*, AAAI Spring Symposium Series, 2007.
- P. Beeson, M. MacMahon, J. Modayil, A. Murarka, B. Kuipers & B. Stankiewicz. Integrating multiple representations of spatial knowledge for mapping, navigation, and communication. In *Interaction Challenges for Intelligent Assistants*, AAAI Spring Symposium Series, 2007.
- B. Kuipers. 2006. Essays on terrorism. *Law Enforcement Executive Forum* **6**(5): 189–198, 2006.
- S. Ramamoorthy, B. Kuipers and L. Wenzel. 2006. Parametrization and computations in shape spaces with area and boundary invariants. *Proc. 16th Fall Workshop on Computational and Combinatorial Geometry*, Northampton MA, 10-11 November 2006.
- H. Subramanian, S. Ramamoorthy, P. Stone and B. J. Kuipers. Designing safe, profitable automated trading agents using evolutionary algorithms. In *Proc. Genetic and Evolutionary Computation Conference (GECCO-06)*, 2006, pages 1777–1784.
- M. MacMahon, B. Stankiewicz and B. Kuipers. 2006. Walk the talk: connecting language, knowledge, action in route instructions. *National Conference on Artificial Intelligence (AAAI-06)*, Boston, MA, 16-20 July 2006.
- B. J. Oommen, G. Raghunath and B. Kuipers. 2006. Learning from stochastic teachers and stochastic compulsive liars. *IEEE Trans. Systems, Man and Cybernetics, Part B: Cybernetics* **36**(4): 820–834.
- A. Murarka, J. Modayil and B. Kuipers. 2006. Building local safety maps for a wheelchair robot using vision and lasers. *Third Canadian Conference on Computer and Robot Vision*, Quebec City, Canada, 7-9 June 2006. (Best Student Paper Award)
- P. Beeson, A. Murarka and B. Kuipers. 2006. Adapting proposal distributions for accurate, efficient mobile robot localization. *IEEE Int. Conf. on Robotics and Automation (ICRA-06)*.
- J. Modayil and B. Kuipers. 2006. Autonomous shape model learning for object localization and recognition. *IEEE Int. Conf. on Robotics and Automation (ICRA-06)*.
- B. Kuipers, P. Beeson, J. Modayil and J. Provost. 2006. Bootstrap learning of foundational representations. *Connection Science* **18**(2): 145–158, special issue on Developmental Robotics.

- J. Provost, B. Kuipers, and R. Miikkulainen. 2006. Developing navigation behavior through self-organizing distinctive state abstraction. *Connection Science* **18**(2): 159–172, special issue on Developmental Robotics.
- B. Kuipers. 2005. Consciousness: Drinking from the firehose of experience. *National Conference on Artificial Intelligence (AAAI-05)*.
- B. Kuipers, P. Beeson, J. Modayil and J. Provost. 2005. Bootstrap learning of foundational representations. In *Developmental Robotics*, AAAI Spring Symposium Series.
- D. Clancy and B. Kuipers. 2005. Time in qualitative simulation. In M. Fisher, D. Gabbay, & L. Vila (Eds.), *Handbook of Temporal Reasoning in Artificial Intelligence*, Elsevier Science, pages 655–664.
- P. Beeson, N. K. Jong, and B. Kuipers. 2005. Towards autonomous topological place detection using the extended Voronoi graph. *IEEE Int. Conf. on Robotics and Automation (ICRA-05)*.
- B. Kuipers, A. X. Liu, A. Gautam, and M. G. Gouda. 2005. Zmail: Zero-sum free market control of spam. *4th International Workshop on Assurance in Distributed Systems and Networks (ASDN 2005)*. Columbus, Ohio, June 6, 2005.
- G. Sakellariou, M. Shanahan and B. Kuipers. 2004. Skeletonization as mobile robot navigation. *Proc. Towards Autonomic Robotic Systems (TAROS-04)*, pages 149–155.
- J. Modayil and B. Kuipers. 2004. Bootstrap learning for object discovery. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS-04)*.
- J. Modayil, P. Beeson and B. Kuipers. 2004. Using the topological skeleton for scalable global metrical map-building. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS-04)*.
- F. Savelli and B. Kuipers. 2004. Loop closing and planarity in topological map building. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS-04)*.
- J. Provost, B. J. Kuipers, and R. Miikkulainen. 2004. Self-organizing perceptual and temporal abstraction for robot reinforcement learning. In *AAAI-04 Workshop on Learning and Planning in Markov Processes*. San Jose, CA, 2004.
- S. Ramamoorthy and B. Kuipers. 2004. Controller synthesis using qualitative models and constraints. *International Workshop on Qualitative Reasoning (QR-2004)*, Evanston, Illinois.
- B. Kuipers, J. Modayil, P. Beeson, M. MacMahon, and F. Savelli. 2004. Local metrical and global topological maps in the hybrid spatial semantic hierarchy. *IEEE International Conference on Robotics and Automation (ICRA-04)*.
- E. Remolina and B. Kuipers. 2004. Towards a general theory of topological maps. *Artificial Intelligence* **152**: 47–104.
- H. H. Chaput, B. Kuipers and R. Miikkulainen. 2003. Constructivist learning: A neural implementation of the schema mechanism. In *Proceedings of Workshop on Self-Organizing Maps (WSOM'03)*, Kitakyushu, Japan.

- S. Ramamoorthy and B. Kuipers. Qualitative heterogeneous control of higher order systems. In A. Pnueli and O. Maler (Eds.), *Hybrid Systems: Computation and Control*, Lecture Notes in Computer Science (LNCS 2623), Springer Verlag, 2003, pages 417–434.
- B. Kuipers, D. Tecuci, and B. Stankiewicz. 2003. The skeleton in the cognitive map: a computational and empirical exploration. *Environment and Behavior* **35**(1): 80–106.
- B. Kuipers and P. Beeson. 2002. Bootstrap learning for place recognition. *Proceedings of the National Conference on Artificial Intelligence (AAAI-2002)*, AAAI/MIT Press, 2002, pages 174–180.
- B. Kuipers and S. Ramamoorthy. 2002. Qualitative modeling and heterogeneous control of global system behavior. In C. J. Tomlin and M. R. Greenstreet (Eds.), *Hybrid Systems: Computation and Control*, Lecture Notes in Computer Science (LNCS 2289), Springer Verlag, 2002, pages 294–307.
- A. Murarka and B. Kuipers. 2001. Using CAD drawings for robot navigation. *IEEE Systems, Man, and Cybernetics Conference*, Tucson, AZ.
- B. Kuipers. 2001. Cognitive maps for planetary rovers. *Autonomous Robots* **11**: 325–331.
- B. Kuipers. 2001. Qualitative simulation. In R. A. Meyers (Ed.), *Encyclopedia of Physical Science and Technology, Third Edition, volume 13*. NY: Academic Press, pages 287–300.
- E. Remolina and B. Kuipers. 2001. A logical account of causal and topological maps. In *Proceedings of the Seventeenth International Joint Conference on Artificial Intelligence (IJCAI-2001)*, Seattle, Washington.
- B. Kuipers. 2001. The skeleton in the cognitive map: a computational hypothesis. In J. Peponis, J. Wineman and S. Bafna (Eds.), *Space Syntax: Proceedings of the 3rd International Symposium*, Ann Arbor: A. Alfred Taubman College of Architecture and Urban Planning, University of Michigan, pages 10.1–10.7.
- B. Kuipers, P. Beeson, J. Modayil and J. Provost. Learning from uninterpreted experience in the SSH. *Learning Grounded Representations: Working Notes of the AAAI Spring Symposium*, Stanford, CA, 26-28 March 2001, pages 37-38.
- J. Provost, P. Beeson and B. Kuipers. 2001. Toward learning the causal layer of the spatial semantic hierarchy using SOMs. *Learning Grounded Representations: Working Notes of the AAAI Spring Symposium*, Stanford, CA, 26-28 March 2001, pages 63-68.
- B. Kuipers. The Spatial Semantic Hierarchy. 2000. *Artificial Intelligence* **119**: 191–233.
- H. Kay, B. Rinner and B. Kuipers. 2000. Semi-quantitative system identification. *Artificial Intelligence* **119**: 103–140.
- E. Remolina, J. A. Fernandez, B. Kuipers and J. Gonzalez. 1999. Formalizing regions in the spatial semantic hierarchy: an AH-graphs implementation approach. In *Conference on Spatial Information Theory (COSIT-99)*, pages 109–124, Hamburg, Germany, August 1999.
- B. Rinner and B. Kuipers. 1999. Monitoring piecewise continuous behaviors by refining semi-quantitative trackers. In *Proceedings of the Sixteenth International Joint Conference on Artificial Intelligence (IJCAI-99)*, Stockholm, Sweden, August 1999.

- W. S. Gribble, R. L. Browning, M. Hewett, E. Remolina and B. J. Kuipers. 1998. Integrating vision and spatial reasoning for assistive navigation. In V. Mittal, H. Yanco, J. Aronis and R. Simpson (Eds.), *Assistive Technology and Artificial Intelligence*, Lecture Notes in Computer Science, Springer Verlag, New York, 1998, pages 179–193.
- D. J. Clancy and B. J. Kuipers. 1998. Qualitative simulation as a temporally-extended constraint satisfaction problem. *Proceedings of the 15th National Conference on Artificial Intelligence (AAAI-98)*, AAAI/MIT Press, 1998.
- Sebastian Thrun, Steffen Gutmann, Dieter Fox, Wolfram Burgard, and B. J. Kuipers. 1998. Integrating topological and metric maps for mobile robot navigation: A statistical approach. *Proceedings of the 15th National Conference on Artificial Intelligence (AAAI-98)*, AAAI/MIT Press, 1998, pages 989–995.
- Emilio Remolina and B. Kuipers. 1998. Towards a formalization of the Spatial Semantic Hierarchy. *Fourth Symposium on Logical Formalizations of Commonsense Reasoning (Common Sense 98)*, pages 126–137. London, England, 7-9 January 1998.
- D. Berleant and B. Kuipers. 1997. Qualitative and quantitative simulation: bridging the gap. *Artificial Intelligence* **95**(2): 215–255.
- D. J. Clancy and B. Kuipers. 1997. Model decomposition and simulation: a component based qualitative simulation algorithm. *Proceedings of the 14th National Conference on Artificial Intelligence (AAAI-97)*, AAAI/MIT Press, 1997.
- D. J. Clancy and B. Kuipers. 1997. Static and dynamic abstraction solves the problem of chatter in qualitative simulation. *Proceedings of the 14th National Conference on Artificial Intelligence (AAAI-97)*, AAAI/MIT Press, 1997.
- David M. Pierce and B. Kuipers. 1997. Map learning with uninterpreted sensors and effectors. *Artificial Intelligence* **92**: 169–227.
- B. Shults and B. Kuipers. 1997. Proving properties of continuous systems: qualitative simulation and temporal logic. *Artificial Intelligence* **92**: 91–129.
- E. Gazi, L. H. Ungar, W. D. Seider and B. J. Kuipers. 1996. Automatic analysis of Monte-Carlo simulations of dynamic chemical plants. *Proceedings of the ESCAPE 6 Symposium*, Rhodes, Greece. Pergamon Press, 1996.
- B. J. Kuipers. 1996. A hierarchy of qualitative representations for space. In *Working Papers of the Tenth International Workshop on Qualitative Reasoning about Physical Systems (QR-96)*, Fallen Leaf Lake, California. AAAI Technical Report WS-96-01, AAAI Press, May 1996.
Reprinted in Christian Freksa, Christopher Habel, Karl F. Wender (Eds.), *Spatial Cognition - An interdisciplinary approach to representation and processing of spatial knowledge*, Lecture Notes in Artificial Intelligence 1404, Springer, Berlin, 1998, pages 337–350.
- D. Pierce & B. Kuipers. 1994. Learning to explore and build maps. *Proceedings of the National Conference on Artificial Intelligence (AAAI-94)*, AAAI/MIT Press, 1994.

- B. J. Kuipers and B. Shults. 1994. Reasoning in logic about continuous systems. In J. Doyle, E. Sandewall, and P. Torasso, editors, *Principles of Knowledge Representation and Reasoning: Proceedings of the Fourth International Conference (KR-94)*, Morgan Kaufmann, San Mateo, CA.
- R. Rajagopalan and B. Kuipers. 1994. The Figure Understander: a system for integrating text and diagram input to a knowledge base. In *Proceedings of the Industrial and Engineering Applications of Artificial Intelligence and Expert Systems (IEA/AIE-94)*, Austin, TX: May 31–June 3, 1994. Best paper award in the area of Machine Reasoning.
- R. Rajagopalan and B. Kuipers. 1994. Qualitative spatial reasoning about objects in motion: application to physics problem solving. In *IEEE International Conference on Artificial Intelligence Applications (CAIA-94)*.
- B. J. Kuipers and K. Åström. 1994. The composition and validation of heterogeneous control laws. *Automatica* **30**(2): 233–249.
Reprinted in R. Murray-Smith and T. A. Johansen (Eds.), *Multiple Model Approaches to Nonlinear Modeling and Control*, Taylor & Francis, London, 1997, pages 231–255.
- A. D. Bailey, Jr., Y. Kiang, B. Kuipers, and A. B. Whinston. 1993. Qualitative and causal reasoning in auditing. In Yuji Ijiri (Ed.), *Creative and Innovative Approaches to the Science of Management*, Quorum Books, Westport, CT, pp. 67-113.
- B. Kuipers. 1993. Self-calibrating models for dynamic monitoring and diagnosis. In *Proceedings of the Space Operations and Research Symposium (SOAR'93)*. NASA Johnson Space Center, Houston, Texas, 3-5 August 1993.
- H. Kay & B. Kuipers. 1993. Numerical behavior envelopes for qualitative simulation. *Proceedings of the National Conference on Artificial Intelligence (AAAI-93)*, AAAI/MIT Press, 1993.
- W. W. Lee & B. Kuipers. 1993. A qualitative method to construct phase portraits. *Proceedings of the National Conference on Artificial Intelligence (AAAI-93)*, AAAI/MIT Press, 1993.
- B. Kuipers, R. Froom, W.-Y. Lee & D. Pierce. 1993. The semantic hierarchy in robot learning. In J. Connell and S. Mahadevan (Eds.), *Robot Learning*. Kluwer Academic Publishers, 1993, pages 141-170.
- Marsha E. Fonteyn, B. Kuipers and Susan J. Grobe. 1993. A description of think aloud method and protocol analysis. *Qualitative Health Research* **3**(4): 430-441.
- B. J. Kuipers. Reasoning with qualitative models. 1993. *Artificial Intelligence* **59**: 125-132.
- B. J. Kuipers. Qualitative simulation: then and now. 1993. *Artificial Intelligence* **59**: 133-140.
- B. Kuipers and J. Crawford. 1992. Guaranteed coverage vs intelligent sampling: a reply to Sacks and Doyle. *Computational Intelligence* **8**(2): 289-294.
- Akira Hayashi and B. Kuipers. 1992. A continuous approach to robot motion planning with many degrees of freedom. In *Proceedings of the 1992 IEEE International Conference on Intelligent Robots and Systems (IROS'92)*.

- Bradley L. Richards, Ina Kraan and B. J. Kuipers. 1992. Automatic abduction of qualitative models. *Proceedings of the National Conference on Artificial Intelligence (AAAI-92)*, AAAI/MIT Press, 1992.
- Pierre Fouché & B. Kuipers. 1992. Reasoning about energy in qualitative simulation. *IEEE Transactions on Systems, Man, and Cybernetics* **22**(1): 47-63.
- D. Berleant & B. Kuipers. 1992. Qualitative-numeric simulation with Q3. In Boi Faltings and Peter Struss (Eds.), *Recent Advances in Qualitative Physics*, MIT Press, 1992, pages 3–16.
- C. Chiu & B. J. Kuipers. 1992. Comparative analysis and qualitative integral representations. In Boi Faltings and Peter Struss (Eds.), *Recent Advances in Qualitative Physics*, MIT Press, 1992.
- P. Fouché & B. Kuipers. 1992. An assessment of current qualitative simulation techniques. In Boi Faltings and Peter Struss (Eds.), *Recent Advances in Qualitative Physics*, MIT Press, 1992.
- B. J. Kuipers, C. Chiu, D. T. Dalle Molle & D. R. Throop. 1991. Higher-order derivative constraints in qualitative simulation. *Artificial Intelligence* **51**: 343-379.
- J. M. Crawford & B. J. Kuipers. 1991. Algernon – a tractable system for knowledge representation. *SIGART Bulletin* **2**(3): 35-44, June 1991.
- J. M. Crawford & B. J. Kuipers. 1991. Negation and proof by contradiction in access-limited logic. In *Proceedings of the National Conference on Artificial Intelligence (AAAI-91)*, AAAI/MIT Press, 1991.
- Akira Hayashi & B. J. Kuipers. 1991. Path planning for highly-redundant manipulators using a continuous-curvature model. In *Proceedings of the National Conference on Artificial Intelligence (AAAI-91)*, AAAI/MIT Press, 1991.
- B. Kuipers & Karl Åström. 1991. The composition of heterogeneous control laws. In *Proceedings of the American Control Conference*, 1991.
Reprinted in Abraham Kandel & Gideon Langholz (Eds.), *Fuzzy Control Systems*, CRC Press, Boca Raton, FL, 1994, pp. 243-261.
Reprinted in R. R. Yager & L. A. Zadeh (Eds.), *Fuzzy Sets, Neural Networks and Soft Computing*, Van Nostrand Reinhold, New York, 1994, pp. 45-62.
- D. Dvorak & B. Kuipers. 1991. Process monitoring and diagnosis: a model-based approach. *IEEE EXPERT* **6**(3): 67-74, June 1991.
- M. E. Fonteyn, S. J. Grobe and B. J. Kuipers. 1991. A descriptive analysis of expert critical care nurses' clinical reasoning. In E. Hovenga, K. Hannah, K. McCormick and J. Ronald (Eds.), *Nursing Informatics '91*. Holland: Springer-Verlag.
- A. D. Bailey, Jr., Y. Kiang, B. Kuipers, and A. B. Whinston. 1991. A theoretical framework for modeling executive support systems — a qualitative and causal reasoning approach. In M.G. Singh and L. Travé-Massuyès (Eds.), *Decision Support Systems and Qualitative Reasoning*, Elsevier Science Publishers B.V. (North-Holland), 1991.
- A. D. Bailey, Jr., M. Y. Kiang, B. Kuipers & A. B. Whinston. 1991. Analytical procedures: Qualitative and causal reasoning in auditing. In E. Blocher (Ed.), *Applications in Management Science, Volume 6, Accounting Applications in Management Science*, pp. 7-57. Greenwich CT: JAI Press, 1991.

- A. Hayashi, J. Park, B. J. Kuipers. Toward planning and control of highly redundant manipulators. In *Proceedings of the Fifth IEEE International Symposium on Intelligent Control*, Philadelphia, September 5-7, 1990.
- David M. Pierce and B. J. Kuipers. 1991. Learning hill-climbing functions as a strategy for generating behaviors in a mobile robot. In J.-A. Meyer and S. W. Wilson (Eds.), *From Animals to Animats: Proceedings of the International Conference on Simulation of Adaptive Behavior*, pp. 327-336. Cambridge, MA: MIT Press/Bradford Books, 1991.
- J. M. Crawford, A. Farquhar, B. J. Kuipers. 1990. QPC: a compiler from physical models into qualitative differential equations. *Proceedings of the National Conference on Artificial Intelligence (AAAI-90)*, AAAI/MIT Press, 1990.
Revised version in Boi Faltings and Peter Struss (Eds.), *Recent Advances in Qualitative Physics*, MIT Press, 1992.
- J. M. Crawford & B. J. Kuipers. 1991. ALL: formalizing access-limited reasoning. In John Sowa (Ed.), *Principles of Semantic Networks*, pp. 299-330. San Mateo, CA: Morgan Kaufmann.
- B. J. Kuipers & Y.-T. Byun. 1991. A robot exploration and mapping strategy based on a semantic hierarchy of spatial representations. *Journal of Robotics and Autonomous Systems* **8**: 47-63.
Reprinted in Walter Van de Velde (ed.), *Towards Learning Robots*, Bradford/MIT Press, 1993, pages 47-63.
- B. J. Kuipers. 1990. Simulation, Qualitative. In M. G. Singh (Ed.), *Systems & Control Encyclopedia, Supplementary Volume 1*. NY: Pergamon Press.
- D. L. Dvorak, D. T. Dalle Molle, B. J. Kuipers, and T. F. Edgar. 1990. Qualitative simulation for expert systems. 1990 Congress, International Federation of Automatic Control (IFAC), Tallin, Estonia, USSR.
- B. J. Kuipers. 1989. Qualitative reasoning: modeling and simulation with incomplete knowledge. *Automatica* **25**: 571-585, July 1989.
- D. Dvorak & B. J. Kuipers. 1989. Model-based monitoring of dynamic systems. In *Proceedings of the Eleventh International Joint Conference on Artificial Intelligence (IJCAI-89)*. Los Altos, CA: Morgan Kaufman.
Reprinted in Walter Hamscher, Luca Console & Johan deKleer (Eds.), *Readings in Model-Based Diagnosis*, Morgan Kaufmann, 1992.
- B. J. Kuipers & Y.-T. Byun. 1989. Spatial learning robots with a qualitative + quantitative hierarchical model. In *Proceedings of World Conference on Information Processing and Communication (Wocon-Infor-89)*, K. W. Lee and C. Wu (Eds.). Seoul, Korea.
- J. M. Crawford and B. J. Kuipers. 1989. Toward a theory of access-limited logic for knowledge representation. In *Proceedings of the First International Conference on Principles of Knowledge Representation and Reasoning (KR'89)*. Los Altos, CA: Morgan Kaufmann.

- B. J. Kuipers. 1989. Qualitative reasoning with causal models in diagnosis of complex systems. In L. Widman, K. Loparo, & N. Nielson (Eds.), *Artificial Intelligence, Simulation and Modeling*. New York: John Wiley & Sons, 1989, pp. 257-274.
- B. J. Kuipers. 1989. Qualitative reasoning with causal models in medical diagnosis. In T. Furukawa (Ed.), *Artificial Intelligence in Medicine: Current State and Future of Medical Artificial Intelligence*. Tokyo: Toyobo Biotechnology Foundation, 1989, pp. 72-94.
- B. J. Kuipers & Y.-T. Byun. 1988. A robust, qualitative approach to a spatial learning mobile robot. In *Sensor Fusion: Spatial Reasoning and Scene Interpretation. Proceedings, SPIE, Volume 1003, 1988*. Bellingham, WA: SPIE – The International Society of Optical Engineering, pp. 366-375.
Reprinted in S. S. Iyengar and A. Elfes (Eds.), *Autonomous Mobile Robots: Perception, Mapping, and Navigation*, Los Alamitos, CA: IEEE Computer Society Press, 1991, pp. 353-362.
- B. J. Kuipers. 1988. Qualitative simulation using time-scale abstraction. *Int. J. Artificial Intelligence in Engineering* 3(4): 185-191, 1988.
- B. J. Kuipers. 1988. The qualitative calculus is sound but incomplete: a reply to Peter Struss. *Int. J. Artificial Intelligence in Engineering* 3(3): 170-173, 1988.
- D. T. Dalle Molle, B. J. Kuipers, and T. F. Edgar. 1988. Qualitative modeling and simulation of dynamic systems. *Computers and Chemical Engineering* 12: 853-866, 1988.
- D. T. Dalle Molle, B. J. Kuipers, and T. F. Edgar. 1988. Qualitative modeling of physical systems. Preprints of the *Third International Symposium on Process Systems Engineering 1988*, pp. 169-174, Sydney, Australia, 28 August - 2 September 1988. The Institution of Engineers, Australia. National Conference Publications No. 88/17.
- W. W. Lee & B. J. Kuipers. 1988. Non-intersection of trajectories in qualitative phase space: a global constraint for qualitative simulation. In *Proceedings of the National Conference on Artificial Intelligence (AAAI-88)*. Los Altos, CA: Morgan Kaufmann, 1988.
Reprinted in D. S. Weld & J. de Kleer (Eds.), *Readings in Qualitative Reasoning about Physical Systems*, Los Altos, CA: Morgan Kaufmann, 1990.
- B. J. Kuipers & D. Berleant. 1988. Using incomplete quantitative knowledge in qualitative reasoning. In *Proceedings of the National Conference on Artificial Intelligence (AAAI-88)*. Los Altos, CA: Morgan Kaufman, 1988.
- B. J. Kuipers & Y.-T. Byun. 1988. A robust qualitative method for spatial learning in unknown environments. In *Proceedings of the National Conference on Artificial Intelligence (AAAI-88)*. Los Altos, CA: Morgan Kaufman, 1988. (Selected as one of the ten best papers in AAAI-88.)
- B. J. Kuipers and T. Levitt. 1988. Navigation and Mapping in Large Scale Space. *AI Magazine*, vol. 9, no. 2, Summer 1988, pp. 25-43.
Reprinted in *Advances in Spatial Reasoning, Volume 2*, Su-shing Chen (Ed.), Norwood NJ: Ablex Publishing, 1990.

- B. J. Kuipers. 1988. Artificial intelligence: a new approach to modeling and control. In C. Cobelli and L. Mariani (Eds.), *Modelling and Control in Biomedical Systems*, Preprints of the IFAC Symposium, Venice, Italy, 6-8 April 1988. Pergamon Press, 1988.
- B. J. Kuipers. 1988. Abstraction by time-scale in qualitative simulation for biomedical modeling. In C. Cobelli and L. Mariani (Eds.), *Modelling and Control in Biomedical Systems*, Preprints of the IFAC Symposium, Venice, Italy, 6-8 April 1988. Pergamon Press, 1988.
- B. J. Kuipers, A. J. Moskowitz, and J. P. Kassirer. Critical Decisions Under Uncertainty: Representation and Structure. *Cognitive Science* **12**: 177-210, 1988.
Reprinted in G. Shafer and J. Pearl (Eds.), *Readings in Uncertain Reasoning*, San Mateo, CA: Morgan Kaufmann Publishers, 1990.
- A. J. Moskowitz, B. J. Kuipers, and J. P. Kassirer. Dealing with uncertainty, risks, and tradeoffs: A cognitive science approach. *Annals of Internal Medicine* **108**: 435-449, 1988.
- B. J. Kuipers & Y.-T. Byun. 1987. A qualitative approach to robot exploration and map-learning. In *Spatial Reasoning and Multi-Sensor Fusion: Proceedings of the 1987 Workshop*, Avi Kak and Su-Shing Chen (Eds.), Los Altos, CA: Morgan Kaufman, 1987.
- B. J. Kuipers. 1987. New reasoning methods for artificial intelligence in medicine. *International Journal of Man-Machine Studies* **26**: 707-718.
- B. J. Kuipers and C. Chiu. 1987. Taming intractible branching in qualitative simulation. In *Proceedings of the Tenth International Joint Conference on Artificial Intelligence (IJCAI-87)*. Los Altos, CA: Morgan Kaufman.
Reprinted in D. S. Weld & J. de Kleer (Eds.), *Readings in Qualitative Reasoning about Physical Systems*, Los Altos, CA: Morgan Kaufmann, 1990.
- B. J. Kuipers. 1987. Abstraction by time-scale in qualitative simulation. In *Proceedings of the National Conference on Artificial Intelligence (AAAI-87)*. Los Altos, CA: Morgan Kaufman.
Reprinted in D. S. Weld & J. de Kleer (Eds.), *Readings in Qualitative Reasoning about Physical Systems*, Los Altos, CA: Morgan Kaufmann, 1990.
- B. J. Kuipers. 1987. Qualitative simulation as causal explanation. *IEEE Transactions on Systems, Man, and Cybernetics* **17**(3): 432-444.
- B. J. Kuipers and J. P. Kassirer. 1987. Knowledge acquisition by analysis of verbatim protocols. In A. Kidd (Ed.), *Knowledge Acquisition for Expert Systems*. New York: Plenum, 1987.
- B. J. Kuipers. 1987. Causal Reasoning. In S. C. Shapiro (Ed.), *Encyclopedia of Artificial Intelligence*. New York: Wiley-Interscience, 1987, pp. 827-832.
- B. J. Kuipers. 1986. Qualitative Simulation. *Artificial Intelligence* **29**: 289 - 338, 1986.
Reprinted in D. S. Weld & J. de Kleer (Eds.), *Readings in Qualitative Reasoning about Physical Systems*, Los Altos, CA: Morgan Kaufmann, 1990.
- B. J. Kuipers. 1985. The limits of qualitative simulation. *Proceedings of the Ninth International Joint Conference on Artificial Intelligence (IJCAI-85)*. Los Angeles, CA, August 1985.

- B. J. Kuipers. 1984. Commonsense reasoning about causality: deriving behavior from structure. *Artificial Intelligence* **24**: 169-203.
Reprinted in D. G. Bobrow (Ed.), *Qualitative Reasoning about Physical Systems*. New York: North-Holland, 1984. Paperback publication by MIT Press, Cambridge, MA, 1985.
- B. J. Kuipers and J. P. Kassirer. 1984. Causal reasoning in medicine: analysis of a protocol. *Cognitive Science* **8**: 363-385, 1984.
Reprinted in slightly revised form in A. Kidd (Ed.), *Knowledge Acquisition for Expert Systems*. New York: Plenum, 1987.
- B. J. Kuipers and J. P. Kassirer. 1983. How to discover a knowledge representation for causal reasoning by studying an expert physician. In *Proceedings of the Eighth International Joint Conference on Artificial Intelligence (IJCAI-83)*. Karlsruhe, Germany, August 1983.
- B. J. Kuipers. 1983. Modeling human knowledge of routes: partial knowledge and individual variation. In *Proceedings of the National Conference on Artificial Intelligence (AAAI-83)*. Washington, D.C., August 1983.
- B. J. Kuipers. 1983. The cognitive map: Could it have been any other way? In H. L. Pick, Jr. and L. P. Acredolo (Eds.), *Spatial Orientation: Theory, Research, and Application*. New York: Plenum Press, 1983, pages 345–359.
- J. P. Kassirer, B. J. Kuipers, and G. A. Gorry. 1982. Toward a theory of clinical expertise. *The American Journal of Medicine* **73**: 251-259, 1982.
- B. J. Kuipers. 1982. The ‘Map in the Head’ metaphor. *Environment and Behavior* **14**: 202-220, 1982.
- B. J. Kuipers. 1982. Getting the envisionment right. In *Proceedings of the National Conference on Artificial Intelligence (AAAI-82)*. Pittsburgh, Pennsylvania, August 1982.
- B. J. Kuipers. 1979. Commonsense knowledge of space: learning from experience. In *Proceedings of the Sixth International Joint Conference on Artificial Intelligence (IJCAI-79)*. Tokyo, Japan, August 1979.
Reprinted in *Advances in Spatial Reasoning, Volume 2*, Su-shing Chen (Ed.), Norwood NJ: Ablex Publishing, 1990.
- B. J. Kuipers. 1979. On representing common sense knowledge. In N. V. Findler (Ed.), *Associative Networks: The Representation and Use of Knowledge by Computers*. New York: Academic Press, 1979.
- B. J. Kuipers. 1978. Cognitive modeling of the map user. In G. Dutton (Ed.), *Harvard Papers on Geographic Information Systems, vol. 7*. Cambridge, Mass: Laboratory for Computer Graphics and Spatial Analysis, Harvard University, 1978.
- B. J. Kuipers. 1978. Modeling spatial knowledge. *Cognitive Science* **2**: 129-153, 1978.
Reprinted in *Advances in Spatial Reasoning, Volume 2*, Su-shing Chen (Ed.), Norwood NJ: Ablex Publishing, 1990.

- B. J. Kuipers. 1977. Modeling spatial knowledge. In *Proceedings of the Fifth International Joint Conference on Artificial Intelligence (IJCAI-77)*. Cambridge, Massachusetts, August 1977.
- B. J. Kuipers. 1977. Representing Knowledge of Large-Scale Space. Doctoral dissertation, Mathematics Department, Massachusetts Institute of Technology, Cambridge, Massachusetts, June 1977. Published as Technical Report 418, M.I.T. Artificial Intelligence Laboratory, 1977.
- B. J. Kuipers. 1975. A frame for frames: representing knowledge for recognition. In D. G. Bobrow and A. M. Collins (Eds.), *Representation and Understanding*. New York: Academic Press, 1975.
Reprinted in *Artificial Intelligence Memoranda of MIT*. New York: Comtex Scientific Corporation, 1983.
- B. J. Kuipers. 1974. An hypothesis-driven recognition system for the blocks world. In *Proceedings of the Second International Joint Conference on Pattern Recognition*. Copenhagen, Denmark, August 1974.

Abstracts, Working Papers, Commentaries, and Reviews

- J. Muga and B. Kuipers. The Qualitative Learner of Action and Perception, QLAP. *AAAI Video Competition (AIVC 2010)*, 2010. Video available at: <http://www.youtube.com/watch?v=xJ0g-NoerZ0>
- L. Fishgold, B. Kuipers and D. H. Ballard. A computational model of learning intuitive object dynamics (poster). *IEEE Int. Conf. on Development and Learning (ICDL)*, 2010.
- B. Hyun, B. Kuipers, A. Girard. Learning-to-grasp: from an infant to a troublemaker. (poster). *IEEE Int. Conf. on Development and Learning (ICDL)*, 2010.
- B. Kuipers. Why don't I take military funding? (Reprinted web essay.) *International Network of Engineers and Scientists for Global Responsibility*, Newsletter No. 56, 2007.
- S. Ramamoorthy and B. Kuipers. 2006. Dynamic bipedal walking on irregular terrain: an online adaptive algorithm. *Dynamic Walking: mechanics and control of human and robot locomotion*. Ann Arbor, Michigan, 6-8 May 2006.
- S. Ramamoorthy, H. Subramanian, P. Stone and B. J. Kuipers. Safe strategies for autonomous financial trading agents: A qualitative multiple-models approach. Poster spotlight, *Machine Learning in Finance Workshop, Neural Information Processing Systems*, British Columbia, Canada, 2005.
- B. Kuipers. 2004. Making sense of commonsense knowledge. Interview in *ACM Ubiquity* 4(45), January 13–19, 2004.
- B. J. Stankiewicz, D. G. Tecuci and B. Kuipers. 2003. Using the skeleton in the cognitive map to predict wayfinding behavior. Poster presented at the 44th annual Psychonomics Society Conference, Vancouver, Canada.
- P. Beeson, M. MacMahon, J. Modayil, J. Provost, F. Savelli and B. Kuipers. 2003. Exploiting local perceptual models for topological map-building. *IJCAI-2003 Workshop on Reasoning with Uncertainty in Robotics (RUR-03)*, Acapulco, Mexico, pages 15–22.

- B. Kuipers and A. Stroupe. The AAI-2002 Robot Challenge. *AI Magazine* **24**(1): 65–71, Spring 2003.
- B. Kuipers and P. Beeson. 2001. Toward bootstrap learning for place recognition. In *Anchoring Symbols to Sensor Data in Single and Multiple Robot Systems: Papers from the 2001 AAI Fall Symposium*. Technical Report FS-01-01, AAI Press, Menlo Park, CA, pages 25–30.
- B. Kuipers. 2000. Cognitive maps in humans, animals and robots. In *NASA/JPL Workshop on Biomimetic Robotics*, Pasadena, CA, 14-16 August 2000.
- B. Kuipers and Howie Choset. 2000. On topological maps and Voronoi diagrams. In *Integrating Sensors with Mobility and Manipulation*, workshop at the *IEEE International Conference on Robotics and Automation*, San Francisco, 28 April 2000.
- Bernhard Rinner and B. Kuipers. 1999. Monitoring piecewise continuous behaviors by refining trackers and their models. In *Hybrid Systems and AI: Modeling, Analysis and Control of Discrete + Continuous Systems*, AAI Technical Report SS-99-05, pages 164-169, March 1999.
- B. Kuipers. 1999. The Spatial Semantic Hierarchy. University of Texas at Austin Artificial Intelligence Lab TR AI99-281.
- Herbert Kay, Bernhard Rinner, B. Kuipers. 1999. SQUID: A Semi-Quantitative System Identification Method for Refining Imprecise ODE Models. University of Texas at Austin Artificial Intelligence Lab TR AI99-279.
- Gribble, W. S., R. L. Browning, M. Hewett, E. Remolina and B. J. Kuipers. 1998. Integrating vision and spatial reasoning for assistive navigation. In *Proceedings of the AAI-98 Workshop on Integrating Artificial Intelligence and Assistive Technology*.
- Emilio Remolina and B. Kuipers. 1998. Boundary region relations. In *Cognitive Robotics, Papers from the 1998 AAI Fall Symposium*, Technical report FS-98-02, AAI Press, Menlo Park, CA, pages 117-124.
- B. J. Kuipers. 1997. “Ben Kuipers: Using qualitative reasoning.” Interview in *IEEE Expert*, May/June 1997, pages 94–97.
- D. Bobrow, B. Falkenhainer, A. Farquhar, R. Fikes, K. Forbus, T. Gruber, Y. Iwasaki, and B. Kuipers. 1996. A compositional modeling language. In *Working Papers of the Tenth International Workshop on Qualitative Reasoning about Physical Systems (QR-96)*, Fallen Leaf Lake, California. AAI Technical Report WS-96-01, AAI Press, May 1996.
- Richard S. Mallory, Bruce W. Porter, and B. J. Kuipers. 1996. Comprehending complex behavior graphs through abstraction. In *Working Papers of the Tenth International Workshop on Qualitative Reasoning about Physical Systems (QR-96)*, Fallen Leaf Lake, California.
- B. J. Kuipers. 1995. Monitoring with trackers based on semi-quantitative models. In M. Vescovi (Ed.), *IJCAI-95 Workshop on Engineering Problems for Qualitative Reasoning*, Montreal, Quebec, 20 August 1995.

- B. J. Kuipers. 1994. An ontological hierarchy for spatial knowledge. In B. Kuipers (Ed.), *Control of the Physical World by Intelligent Agents*, Working Notes from the AAAI-94 Fall Symposium, New Orleans, LA, 4-6 November 1994.
- B. J. Kuipers and B. Shults. 1994. Reasoning in logic about continuous systems. In *Working Papers of the Eighth International Workshop on Qualitative Reasoning about Physical Systems (QR-94)*, Nara, Japan.
- D. Clancy and B. Kuipers. 1994. Model decomposition and simulation. In *Working Papers of the Eighth International Workshop on Qualitative Reasoning about Physical Systems (QR-94)*, Nara, Japan.
- S. Ramachandran, R. J. Mooney & B. J. Kuipers. 1994. Learning qualitative models for systems with multiple operating regions. In *Working Papers of the Eighth International Workshop on Qualitative Reasoning about Physical Systems (QR-94)*, Nara, Japan.
- E. Gazi, H. Kay, B. J. Kuipers, W. D. Seider, L. H. Ungar. Controller verification using qualitative reasoning. (Extended abstract) American Institute of Chemical Engineers, 1993 meeting.
- D. Clancy and B. Kuipers. 1993. Behavior abstraction for tractable simulation. In *Working Papers of the Seventh International Workshop on Qualitative Reasoning about Physical Systems*, Orcas Island, Washington.
- W. W. Lee and B. Kuipers. 1993. A qualitative method to construct phase portraits. In *Working Papers of the Seventh International Workshop on Qualitative Reasoning about Physical Systems*, Orcas Island, Washington.
- B. Kuipers, R. Froom, W.-Y. Lee & D. Pierce. 1992. The semantic hierarchy approach to robot learning. In Working Papers of the AAAI Fall Symposium, *Applications of Artificial Intelligence to Real-World Autonomous Mobile Robots*. Cambridge, MA, October, 1992.
- H. Kay and B. Kuipers. 1992. Numerical behavior envelopes for qualitative models. In *Working Papers of the Sixth International Workshop on Qualitative Reasoning about Physical Systems*, Edinburgh, Scotland.
- P. Fouché & B. Kuipers. 1991. Abstracting irrelevant distinctions in qualitative simulation. *Working Papers of the Fifth International Workshop on Qualitative Reasoning About Physical Systems*, Austin, Texas.
- I. Kraan, B. Richards & B. Kuipers. 1991. Automatic abduction of qualitative models. *Working Papers of the Fifth International Workshop on Qualitative Reasoning About Physical Systems*, Austin, Texas.
- J. M. Crawford & B. Kuipers. 1991. Algernon User's Manual for Algernon version 1.2. University of Texas Artificial Intelligence Laboratory TR AI91-166, October 1991.
- D. Berleant & B. Kuipers. Bridging the gap from qualitative to numerical simulation (preliminary version). University of Texas Artificial Intelligence Laboratory TR AI91-158, March 1991.

- A. Hayashi & B. Kuipers. Obstacle avoidance of the Swan's Neck manipulator. University of Texas Artificial Intelligence Laboratory TR AI90-142, October 1990.
- P. Fouché & B. Kuipers. An assessment of current qualitative simulation techniques. University of Texas Artificial Intelligence Laboratory TR AI90-140, September 1990.
- P. Fouché & B. Kuipers. Reasoning about energy in qualitative simulation. University of Texas Artificial Intelligence Laboratory TR AI90-139, September 1990.
- B. Kuipers & K. Åström. The Composition of Heterogeneous Control Laws. University of Texas Artificial Intelligence Laboratory TR AI90-138, September 1990.
- J. Crawford, A. Farquhar & B. Kuipers. QPC: a compiler from physical models into qualitative differential equations. *Papers of the Fourth International Workshop on Qualitative Physics*, Lugano, Switzerland, 9-12 July 1990.
- D. Berleant & B. Kuipers. Combined qualitative and numerical simulation with Q3. *Papers of the Fourth International Workshop on Qualitative Physics*, Lugano, Switzerland, 9-12 July 1990.
- P. Fouché & B. Kuipers. An assessment of current qualitative simulation techniques. *Papers of the Fourth International Workshop on Qualitative Physics*, Lugano, Switzerland, 9-12 July 1990.
- J. M. Crawford and B. Kuipers. 1990. "Towards a formalization of access-limited logic." University of Texas Artificial Intelligence Laboratory TR AI90-133.
- B. Kuipers & D. Berleant. A smooth integration of incomplete quantitative knowledge into qualitative simulation. University of Texas Artificial Intelligence Laboratory TR AI90-122, January 1990.
- B. Kuipers. 1989. "The good workman does not blame his tools." Letter to the editor, *AI Magazine*, **10**(4), Winter 1989, p. 10. Follow-up letter, *AI Magazine*, **11**(2), Summer 1990, p. 24.
- B. Kuipers and Y.-T. Byun. 1989. Robot Exploration Based on the Spatial Semantic Hierarchy. In *Working Notes of the AAAI Spring Symposium on Robot Navigation*. Stanford, CA, March 28-30, 1989.
- J. M. Crawford and B. J. Kuipers. 1989. A formalization of access-limited logic for knowledge representation. Workshop on Formal Aspects of Semantic Networks, Catalina Island, CA, February, 1989.
- "Modeling chemical processes with unknown parameters." (D. T. Dalle Molle, T. F. Edgar, and B. J. Kuipers.) *Proceedings of ISA-88 International Conference and Exhibit*, Houston, Texas, 16-21 October 1988. (Instrument Society of America)
- "Mimic: Model-Based Monitoring of Dynamic Systems (extended abstract)." (with D. Dvorak.) In *Abstracts of the AAAI-88 Workshop on AI in Process Engineering*, St. Paul, Minnesota, 25 August 1988.
- "Qualitative Reasoning with Incomplete Knowledge in Medicine." *Abstracts of the World Congress on Medical Physics and Biomedical Engineering*, San Antonio, Texas, 8 August 1988.

- “The TOUR Model: A Theoretical Definition.” University of Texas at Austin, Artificial Intelligence Laboratory AI TR 88-78, 1988.
- “Developments Towards Constraining Qualitative Simulation.” (with W. W. Lee and C. Chiu.) University of Texas at Austin, Artificial Intelligence Laboratory AI TR 87-44, January 1987.
- “Aspects of Qualitative Reasoning About Mechanisms.” In *Abstracts of the First World Congress on Computational Mechanics*, Austin, Texas: University of Texas at Austin, September 1986.
- “The Map-Learning Critter.” University of Texas at Austin, Artificial Intelligence Laboratory AI TR 85-17, December 1985.
- “Qualitative Simulation in Medical Physiology: A Progress Report.” MIT Laboratory for Computer Science TM-280, 1985.
- “Qualitative Simulation of Mechanisms.” MIT Laboratory for Computer Science TM-274, 1985.
- “The Cognitive Map Overlaps the Environmental Frame, the Situation, and the Real-World Formulary.” Commentary on an article by Feldman. *The Behavioral and Brain Sciences* 8(2): 298-299, June 1985.
- “Clinical Reasoning Versus Decision Analysis.” (with A. J. Moskowitz and J. P. Kassirer.) In *Proceedings of the Medical Decision Making Conference*, November 1984.
- “Is This a Theory of Competence or Performance?” Commentary on an article by Nashner and McCollum. *The Behavioral and Brain Sciences* 8(1): 159, March 1985.
- “Sensorimotor Knowledge of Space.” Tufts University Working Papers in Cognitive Science, No. 21, June 1983.
- “Stepping Carefully into the Computer Age: Recommendations for Tufts University.” Report of the Ad Hoc Computer Policy Committee to the Dean of the Faculty of Arts and Sciences, Tufts University, May 1983. (Principal author, with D. Dennett, R. Goldner, C. Gray, J. O’Leary, A. Reschovsky, and R. Stollow)
- “The Cognitive Map Must Be A Separate Module.” Commentary on an article by I. Lieblich and M. A. Arbib. *The Behavioral and Brain Sciences* 5: 645-646, December 1982.
- “What Do Eidetic Images Tell Us About Vision?” Commentary on an article by R. N. Haber. *The Behavioral and Brain Sciences* 5: 296, June 1982.
- “Expert Causal Models in the Medical Knowledge Base.” Tufts University Working Papers in Cognitive Science, No. 19, November 1982.
- “De Kleer and Brown’s ‘Mental Models’: A Critique.” Tufts University Working Papers in Cognitive Science, No. 17, November 1981.
- “Cognitive Representations of Medical Expertise.” Tufts University Working Papers in Cognitive Science, No. 14, November 1979.

- “A Model of the Acquisition of Spatial Knowledge.” Tufts University Working Papers in Cognitive Science, No. 11, February 1980.
- A. Stevens, D. Getty, B. Kuipers and C. Steinberg. “Studies of Human Spatial Information Processing.” Final project report to the Defense Advanced Research Projects Agency. Cambridge, MA: Bolt Beranek and Newman, Inc. Report No. 3785. November, 1978.
- “Spatial Knowledge.” MIT Artificial Intelligence Laboratory Memo 359, June 1976. Reprinted in *Artificial Intelligence Memoranda of MIT*. New York: Comtex Scientific Corporation, 1983.
- “Reactions to Weizenbaum’s Book.” *SIGART Newsletter* **58**: 4-5, June 1976.
- “CBL Report on the Software and Hardware Problems of University Computer Centers Serving Fast-Real-Time Users: 1969 - 1973.” R. Walton with the assistance of W. Baum, S. Bradner, P. Clark, B. Kuipers, M. Novey, Y. Peduel, A. Razdow, R. Strom, and E. Wanner. Cambridge, MA: Computer Based Laboratory, Psychology Department, Harvard University, 1975.
- Review of E. Sandewall, “An approach to the frame problem, and its implementation.” *Information and Control* **26**: 393-394, December 1974. (with B. C. Smith.)

DOCTORAL STUDENTS GRADUATED

1. Yung-Tai Byun, “Spatial learning mobile robots with a spatial semantic hierarchical model.” Ph.D., May 1990. Professor, Department of Computer Science, Hongik University, Seoul, Korea.
2. James Crawford, “Access-limited logic: a language for knowledge representation.” Ph.D., May 1991. Composite Software.
3. John Hartman, “Automatic control understanding for natural programs.” Ph.D., May 1991.
4. Akira Hayashi, “Geometrical motion planning for highly redundant manipulators using a continuous manipulator model.” Ph.D., May 1991. Professor of Information Sciences, Hiroshima City University, Japan.
5. David Throop, “Model-based diagnosis of complex, continuous mechanisms.” Ph.D., August 1991. Research Scientist, Boeing Computer Services, Huntsville, Alabama.
6. Daniel Berleant, “The use of partial quantitative knowledge with qualitative reasoning.” Ph.D., December 1991. Professor, Department of Information Science, University of Arkansas at Little Rock.
7. Dan Dvorak, “Monitoring and diagnosis of continuous dynamic systems using semiquantitative simulation.” Ph.D., May 1992. Jet Propulsion Laboratories, Pasadena, CA.
8. David Franke, “A theory of teleology.” Ph.D., May 1992. Research Scientist, Trilogy Development Group, Austin, Texas.
9. Wood Wai Lee, “A qualitative simulation based method to construct phase portraits.” Ph.D., May 1993. Development Engineer, Dowell Schlumberger, Tulsa, Oklahoma.
10. Adam Farquhar, “Automated modeling of physical systems in the presence of incomplete knowledge.” Ph.D., December 1993. British Library, London UK.

11. Richard Froom, "High-speed navigation with approximate maps." Ph.D., May 1995. National Instruments, Austin, Texas
12. David Pierce, "Map learning with uninterpreted sensors and effectors." Ph.D., May 1995. National Instruments, Austin, Texas.
13. Raman Rajagopalan, "Qualitative reasoning about dynamic change in the spatial properties of a physical system." Ph.D., December 1995. i2 Corporation, Dallas, Texas.
14. Bert Kay, "Refining imprecise models and their behaviors." Ph.D., December 1996. Deceased, June 1997.
15. Wan-Yik Lee, "Spatial semantic hierarchy for a physical mobile robot." Ph.D., December 1996. Development Scientist, Ascent Technology, Cambridge, Massachusetts.
16. Daniel J. Clancy. "Solving complexity and ambiguity problems within qualitative simulation." Ph.D., December 1997. Google.
17. Micheal Hewett, "Computational perceptual attention." Ph.D., May 2001. CEO, Hewett Research.
18. Emilio Remolina, "A logical account of causal and topological maps." Ph.D., December 2001. Stottler-Henke Associates, Inc. (SHAI), San Mateo, CA.
19. Stacia Wyman, "Algorithms for the analysis of whole genomes." (Co-supervised with Robert Jansen, Integrative Biology.) Ph.D., August 2004. Fred Hutchinson Cancer Research Center.
20. Harold Chaput, "The constructivist learning architecture: a model of cognitive development for robust autonomous robots." (Co-supervised with Risto Miikkulainen.) Ph.D., August 2004. Electronic Arts, Vancouver, British Columbia.
21. Mohan Sridharan, "Robust structure-based autonomous color learning on a mobile robot." (Co-supervised with Peter Stone.) Ph.D. in ECE, August 2007. Assistant Professor of Computer Science, Texas Tech University.
22. Matt MacMahon, "Following natural language route instructions." Ph.D. in ECE, August 2007. Google.
23. Subramanian Ramamoorthy, "Task encoding, motion planning and intelligent control using qualitative models." Ph.D. in ECE, August 2007. Lecturer, School of Informatics, University of Edinburgh.
24. Jefferson Provost, "Reinforcement learning in high-diameter, continuous environments." (Co-supervised with Risto Miikkulainen.) Ph.D., August 2007. Amazon.
25. Joseph Modayil, "Robot developmental learning of an object ontology grounded in sensorimotor experience." Ph.D., August 2007. Post-doc at University of Alberta.
26. Patrick Foil Beeson, "Creating and utilizing hybrid representations of spatial knowledge using mobile robots." Ph.D., August 2008. Senior Scientist at the TRACLabs, Houston TX.
27. Aniket Murarka, "Building safety maps using vision for safe local mobile robot navigation." Ph.D., August 2009.

28. Jonathan Mugan, "Autonomous qualitative learning of distinctions and actions in a developing agent." Ph.D., August 2010.

RESEARCH GRANTS

- TEMA-Toyota Technical Center. "Active sensing of the physical environment for autonomous systems." 1-1-2010 to 12-31-2010.
- National Science Foundation, Cyber-Physical Systems Program. "CPS: Medium: Learning to Sense Robustly and Act Effectively." (CPS-0931474) 9-1-09 to 8-31-12.
- Texas Higher Education Coordinating Board, Advanced Technology Program. "Developmental robotics: Learning hand-eye skills." (003658-0170-2007.) 5-15-2008 to 8-31-2010.
- National Science Foundation, Information and Intelligent Systems. "RI: Robot developmental learning of objects, actions, and tools." (IIS-0713150) 9-15-07 to 8-31-10.
- National Science Foundation, Information and Intelligent Systems. "SGER: A simulation platform for research on developmental robotics." (IIS-0750011) 9-1-07 to 2-28-09.
- National Science Foundation, Artificial Intelligence and Cognitive Sciences. "Artificial Intelligence: An Academic Genealogy." (IIS-0538927) 7-1-2005 to 6-30-2007.
- National Science Foundation, Artificial Intelligence and Cognitive Sciences. "Learning the Sensorimotor Foundation for Spatial Reasoning." (IIS-0413257) 1-1-2005 to 12-31-2008.
- National Institutes of Health, National Eye Institute. "Development of a Bayesian Low-Vision Navigation Aid" (1 R03 EY016089) (Co-PI. Brian J. Stankiewicz, PI), 12-1-2004 to 11-30-2007.
- IBM Faculty Research Award. "Enabling Autonomic Computing by Building Cognitive Maps of Complex Computing Systems." IBM Austin Center for Advanced Studies. 11-27-2002 to 12-31-04.
- IBM Faculty Research Award. "Enabling Autonomic Computing by Building Cognitive Maps of Complex Computing Systems." Tivoli Center of Excellence and IBM Austin Center for Advanced Studies. 12-7-2001 to 4-17-2003.
- Texas Higher Education Coordinating Board, Advanced Technology Program. "Strategic Autonomy for Planetary Rovers." (003658-0656-2001.) 1-1-2002 to 8-31-2004.
- Tivoli Corporation. "Building a Cognitive Map of a Large-Scale Computing System." 4-18-2000 to 4-17-2003.
- Microsoft Corporation. "Elements of Computing" (equipment support). 6-15-2000 to 6-14-2003.
- Texas Higher Education Coordinating Board, Advanced Research Program. "Spatial Knowledge for Agents in the Physical World." (003658-347.) 1-1-1998 to 8-31-2000.
- National Science Foundation, CISE Research Instrumentation Program. "CISE Research Instrumentation: Robotics Equipment for Research on Assistive Intelligence." (CDA-9617327.) 2-1-1997 to 1-31-2001.

- National Aeronautics and Space Administration, Lyndon B. Johnson Space Center. “Spatial Reasoning for Scalable Distributed Mobile Robot Vision.” (NAG 9-898.) 8-6-96 to 7-31-97.
- National Science Foundation, Knowledge Models and Cognitive Systems Program. “An Ontological Hierarchy for Spatial Knowledge.” (IRI-9504138.) 12-1-1995 to 11-30-1999.
- Texas Higher Education Coordinating Board, Advanced Research Program. “A Modern, Access-Limited Knowledge Representation System.” (003658-242.) 1-1-1996 to 12-31-1997.
- National Aeronautics and Space Administration, Ames Research Center. “Monitoring with Trackers Based on Semi-Quantitative Models.” (NAG 2-994.) 8-15-1995 to 8-14-1996.
- National Aeronautics and Space Administration, Lyndon B. Johnson Space Center. “A Scalable Distributed Approach to Mobile Robot Vision.” (NAG 9-828.) 9-1-95 to 8-31-96.
- Lower Colorado River Authority, Austin, Texas. “Development of Automated Stage/Discharge Relationship Generation Capabilities.” 1994.
- Electric Power Research Institute, Palo Alto, California. “Qualitative Design and Verification of Heterogeneous Controllers.” (RP8030-21.) 1994-96.
- National Science Foundation, Robotics and Machine Intelligence Program. “Qualitative Design and Verification of Heterogeneous Controllers.” (IRI-9216584.) 1993-96.
- National Aeronautics and Space Administration, Lyndon B. Johnson Space Center. “Dynamic Modeling for Failure Analysis.” (NAG 9-665.) 1993.
- National Aeronautics and Space Administration, Ames Research Center. “Self-Calibrating Models for Dynamic Monitoring and Diagnosis.” (NCC 2-760.) 1992-94.
- National Science Foundation, Knowledge Models and Cognitive Systems Program. “Software Upgrade and Distribution Support for QSIM.” (IRI-9017047.) 1991-93.
- California Institute of Technology, Jet Propulsion Laboratory (NASA). “A Study on Qualitative Reasoning.” (JPL Contract No. 958788.) 1990-93.
- National Science Foundation, Robotics and Machine Intelligence Program. “Qualitative Methods for Robot Exploration.” (IRI-8904454.) 1989-94. Extended to five years “for special creativity based on outstanding scientific/technical progress achieved to date under this grant.”
- National Aeronautics and Space Administration, Lyndon B. Johnson Space Center. “Diagnosis and Model Building for Dynamic Systems.” (NAG 9-512.) 1991-92.
- Texas Higher Education Coordinating Board, Advanced Research Program. “Access-Limited Logic as a Language for Knowledge Representation.” (003658-175.) 1989-91.
- National Science Foundation, Knowledge Models and Cognitive Systems Program. “Qualitative Modeling and Simulation of Physical Systems.” (IRI-8905494.) 1989-92.
- National Aeronautics and Space Administration, Ames Research Center. “System Monitoring and Diagnosis With Qualitative Models.” (NAG2-507.) 1988-91.

- National Aeronautics and Space Administration, Lyndon B. Johnson Space Center. “A Qualitative Approach to Robot Exploration and Mapping.” (NAG9-200.) 1987-89.
- National Science Foundation, Intelligent Systems Program. “Deep and Shallow Models in the Knowledge Base.” (IRI-8602665.) 1986-89.
- National Science Foundation, Intelligent Systems Program. “Knowledge Representations for Expert Causal Models (Computer Research).” (MCS-8303640; DCR-8417934; DCR-8512779.) 1983-86.
- National Institutes of Health, National Library of Medicine. “Expert Causal Models in the Medical Knowledge Base.” (R01 LM04125; R01 LM 04374; R01 LM04515.) 1983-86.
- National Institutes of Health, National Library of Medicine. “Cognitive Representations of Medical Expertise.” (R23 LM03603) 1980-83.
- National Institutes of Health, National Library of Medicine. “Clinical Decision Analysis.” (via subcontract through New England Medical Center Hospital). 1979-80.
- Advanced Research Projects Agency, Department of Defense. “Studies of Human Spatial Information Processing.” (via subcontract through Bolt, Beranek and Newman, Inc.). 1977-78.

ACADEMIC HONORS

2008 ICRA Best Paper Award finalist (top 4) for S. Ramamoorthy and B. J. Kuipers, “Trajectory generation for dynamic bipedal walking through qualitative model based manifold learning.”

2007 AAAI Classic Paper Award, Honorable Mention for “A robust, qualitative method for robot spatial learning” by Benjamin Kuipers and Yung-Tai Byun, as one of the most influential papers from the seventh National Conference on Artificial Intelligence, held in 1988.

Best Student Paper Award. A. Murarka, J. Modayil and B. Kuipers, “Local safety maps for a wheelchair robot using vision and lasers.” *Third Canadian Conference on Computer and Robot Vision*, 2006.

Artificial Intelligence honored two papers (1984 and 1986) as among the 25 most cited papers in the first 50 volumes of the journal [*Artificial Intelligence* **59**, 1993].

Number of published papers reprinted in Readings volumes or other edited collections: 17.

Best Paper Award in Machine Reasoning. R. Rajagopalan and B. Kuipers, “The Figure Understander: a system for integrating text and diagram input to a knowledge base.” *Industrial and Engineering Applications of Artificial Intelligence and Expert Systems Conference (IEA/AIE)*, 1994.

NSF Creativity Award, 1992: “Qualitative Methods for Robot Exploration” (IRI-8904454). “This two-year extension for special creativity is based on outstanding scientific/technical progress achieved to date under this grant.”

1988 AAAI Best Paper Award nominee (top 10). B. J. Kuipers & Y.-T. Byun, “A robust qualitative method for spatial learning in unknown environments.” *National Conference on Artificial Intelligence (AAAI)*, 1988.

College of Natural Sciences Teaching Excellence Award, 2004.

Guest Professor, University of Science and Technology of China, Hefei, China, May 2002.

Fellow, Institute of Electrical and Electronics Engineers, 1999.
Endowed Professorship in Computer Sciences (No. 3), from 1997.
David Bruton, Jr. Centennial Professorship in Computer Sciences (No. 1), 1992-97.
Fellow, American Association for Artificial Intelligence, 1992.
Computer Sciences Faculty Fellowship (No. 1), 1987-92.
Sigma Xi, student member 1970, full member 1976.
Phi Beta Kappa, Swarthmore College, 1970.
Danforth Graduate Fellowship, 1970.
National Science Foundation Graduate Fellowship, 1970.
National Merit Scholar, 1966.

CONSULTING

Schlumberger Technology Committee, 2000-03.
Georgia Institute of Technology, College of Computing, Board of Regents Review Committee,
3-5 March 2002.
NASA Space Research and Technology Subcommittee (SRTS) of the Space Systems and Tech-
nology Advisory Committee (SSTAC), Human and Machine Operations Panel, appointed
September 1992.
Peat Marwick Foundation, Montvale, New Jersey, 1989-90.
Microelectronics and Computer Technology Corporation, Austin, Texas, 1985-87.
U. S. Coast Guard Research and Development Center, Groton, Connecticut, 1986-87.
CISE, Milan, Italy, 1986-88.
NASA Systems Autonomy Demonstration Project, Houston, Texas, March 1987.

PROFESSIONAL ACTIVITIES

Professional Committee Service

Elected Member-at-large, Section T, American Association for the Advancement of Science
(AAAS), 2008-2012.
Fellow Selection Committee, Association for the Advancement of Artificial Intelligence (AAAI),
2009-2012.

Chair or Co-Chair

General Co-Chair, IEEE International Conference on Development and Learning (ICDL), 2010.
Program Co-Chair, Senior Member Track, National Conference on Artificial Intelligence (AAAI-
08).
Program Co-Chair, Conference on Spatial Information Theory (COSIT), 2007.
Program Co-Chair, International Workshop on Qualitative Reasoning (QR-06), Dartmouth,
2006.
Program Co-Chair, National Conference on Artificial Intelligence (AAAI-97), Providence, RI,
July 1997.
Program Co-Chair, Control of the Physical World by Intelligent Agents, AAAI Fall Symposium
Series, New Orleans, 4-6 November 1994.
Program Chair, International Workshop on Qualitative Reasoning (QR-91), Austin, 1991.

Program Committees

Workshop on Computational Spatial Language Interpretation (CoSLI), 2010.
 Robotics: Science and Systems, 2010.
 Associate Editor, IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS), 2009
 Control Mechanisms for Spatial Knowledge Processing in Cognitive/Intelligent Systems, AAAI
 Spring Symposium, 2007
 Space Syntax & Spatial Cognition Workshop, Bremen, 2006
 Integrated Intelligence Special Track at AAAI-07
 Robotics: Science and Systems (RSS), 2006
 Epigenetic Robotics Conference, 2006, 2007
 International Conference on Development and Learning (ICDL-06, ICDL-07, ICDL-08, ICDL-
 09; General Co-Chair, ICDL-2010)
 International Joint Conference on Artificial Intelligence (IJCAI-05)
 International Conference on Machine Learning (ICML-05)
 GIScience 2004, 2006.
 AAAI 2004 Spring Symposium on Knowledge Representation and Ontology for Autonomous
 Systems
 Symposium on Hybrid Systems: Computation and Control (HSCC-03, HSCC-04)
 International Conference on Spatial Information Theory: COSIT'95, COSIT'99, COSIT'01,
 COSIT'03
 International Workshops on Qualitative Reasoning: QR-97, QR-98, QR-99, QR-00, QR-01,
 QR-02, QR-03, QR-04, QR-05, QR-07, QR-08, QR-09, QR-2010
 RoboCup International Symposium 2001.
 Special Track on Spatiotemporal Reasoning at FLAIRS 2001.
 National Conferences on Artificial Intelligence, AAAI-83, AAAI-84, AAAI-87, AAAI-88,
 AAAI-90 (area chair), AAAI-92 (area chair), AAAI-93 (area chair), AAAI-94 (area chair),
 AAAI-97 (program cochair), AAAI-2000, AAAI-04, AAAI-06, AAAI-07 (main program,
 nectar and integrated intelligence tracks).
 Knowledge Representation and Reasoning: KR'91, KR'96.
 AAAI96 Workshop on Theories of actions, planning and robot control, August 1996.
 Common Sense Reasoning Symposium (Common Sense 96), Stanford, January 1996.
 Seventh Portuguese Conference on Artificial Intelligence (EPIA'95), 1995.
 Intelligent Systems in Process Engineering (ISPE'95), July 1995.
 Second International Conference on Intelligent Systems Engineering, 1994.
 Third IMACS/IFORS/IEEE Conference on Decision Support and Qualitative Reasoning, Barcelona,
 June 1993.
 IEEE International Symposium on Intelligent Control, 1991.
 IJCAI-91 (area cochair, Qualitative Physics).
 IMACS Workshop on Decision Support Systems and Qualitative Reasoning, 1991.
 Model-Based Reasoning Workshops, AAAI-90, AAAI-91.
 Avignon'89, Avignon'90, Avignon'91. Second Generation Expert Systems, Avignon, France.
 AAAI Spring Symposium on Robot Navigation, March 1989.
 Qualitative Physics Workshop, 1988.
 IEEE Conference on AI Applications, 1987.

Review Panels

NSF CISE review panel, March 2006.
 NSF CISE review panel, October 2004.
 NSF review panel, January 1999
 Judge, Computer Science, Fifth Texas State Science & Engineering Fair, 12 April 1991.
 System Requirements Review and Study Committee, NASA Systems Autonomy Demonstration Project, March 1987.
 Project Site Visit Team, National Library of Medicine, Ohio State University, Columbus, Ohio, 8 October 1987.
 Final Panel, NSF CISE Institutional Infrastructure - Small Scale (II-SS) program, October, 1989.

Boards

Editorial Board, *International Journal of Humanoid Robotics*, 2010-2012.
 Advisory Board, School of Interactive Computing, Georgia Institute of Technology, 2009 - .
 Advisory Editor, *Spatial Cognition and Computation*, 1998- .
 Associate Editor, *IEEE Transactions on Autonomous Mental Development*, 2008- .
 Editorial Board, *International Journal of Machine Consciousness*, 2008- .
 Member-at-Large of the Section Committee of the AAAS Section on Information, Computing, and Communication (2008-2012).
 Scientific Advisory Board, *Cognitive Systems for Cognitive Assistants* project (EU funded), 2005-
 Scientific Advisory Board, *BACS – Bayesian Approach to Cognitive Systems* project (EU funded), 2006-
 Scientific Advisory Board, *Edubot* project, CMU, 2006-
 Schlumberger Technology Committee, 2000-03.
 Editorial Board, *Computational Intelligence*, 1992-2004.
 Executive Council, American Association for Artificial Intelligence, 1992-95.
 Editorial Board, *Journal of Artificial Intelligence Research*, 1994-97.
 Editorial Board, *The Knowledge Engineering Review*, 1994-96.
 Member, IFIP Technical Committee 12, Working Group 12.3, 1993.
 Associate Editor, *IEEE Expert*, 1991-95.
 Editorial Board, *AI & Medicine: An International Journal for the Theory and Practice of Expert Systems in Medicine*, 1989-91.

Proposal and Manuscript Reviews, etc.

Air Force Office of Scientific Research
 Canada Council for the Arts
 Eidgenössische Technische Hochschule Zürich (ETH) (Switzerland)
 Fonds de Formation des Chercheurs et d'Action Concertée (Canadian)
 Fonds zur Förderung der wissenschaftlichen Forschung (Austrian)
 Medical Research Council (UK)

National Institutes of Health
NSF Biophysics Program
NSF Computer Research Equipment
NSF Cyber-Physical Systems
NSF Division of Information Technology
NSF Geography and Regional Science Program
NSF Human Resource Development for Minorities in Science and Engineering
NSF Information and Intelligent Systems Program
NSF Intelligent Systems Program
NSF Interactive Systems Program
NSF Knowledge and Database Systems Program
NSF Mechanical and Structural Systems/Structures and Building Systems Program
NSF Robotics and Machine Intelligence Program
NSF Visiting Professorships for Women
NSF Division of International Programs
Schweizerischer Nationalfonds zur Förderung der wissenschaftlichen Forschung (Swiss)
Swedish Research Council for Engineering Sciences
U. S. Civilian Research and Development Foundation (CRDF)
Academic Press
Kluwer Academic Publishers
Morgan Kaufmann Publishers
MIT Press
Prentice-Hall Publishing Company
Annals of Mathematics and Artificial Intelligence
Applied Artificial Intelligence
Artificial Intelligence
Artificial Intelligence for Engineering Design, Analysis and Manufacturing (AIEDAM)
Artificial Intelligence in Medicine
Automatica
Autonomous Robots
Behavioral and Brain Sciences
Cognitive Psychology
Cognitive Science
Communications of the ACM, CACM
Computational Intelligence
Control and Intelligent Systems
Decision Support Systems
Engineering Applications of Artificial Intelligence
Environment and Behavior
Environmental Psychology
European Journal of Control
European Journal of Plant Pathology
Geographical Analysis
Geoinformatica
IEE Proceedings, Control Theory and Applications

IEEE Expert
IEEE International Conference on Robotics and Automation
IEEE Transactions on Automation Science and Engineering
IEEE Transactions on Autonomous Mental Development
IEEE Transactions on Industrial Informatics
IEEE Transactions on Knowledge and Data Engineering
IEEE Transactions on Neural Networks
IEEE Transactions on Pattern Analysis and Machine Intelligence
IEEE Transactions on Robotics
IEEE Transactions on Robotics and Automation
IEEE Transactions on Systems, Man and Cybernetics
Information Sciences
Information Systems Research
International Joint Conferences on Artificial Intelligence (IJCAI)
International Journal of Computer Vision
International Journal of Intelligent Systems
International Journal of Robotics Research
ISA Transactions
Journal of Environmental Psychology
Journal of Experimental Psychology: Applied
Journal of Field Robotics
Journal of System Science and System Engineering
Knowledge Engineering Review
Machine Learning
Mathematics and Computers in Simulation
Natural Computing
New England Journal of Medicine
PLoS ONE
Psychological Research
Robotics and Autonomous Systems
Science
Spatial Cognition and Computation
 ECCAI AI Dissertation Award, 2001
 Kyoto Prizes, Inamori Foundation

External Examiner

Barry D. Reich, University of Pennsylvania
 Enrico Coeira, University of New South Wales, Australia
 A. Sowmya, Indian Institute of Technology, Bombay, India
 Pierre Fouché, Université de Technologie de Compiègne, Compiègne, France.
 Raffaella Guglielmann, Università di Milano, Italy, October 2000.
 Luis E. Garza Castañón, Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM)
 Campus Monterrey
 Daniel Nikovsky, Carnegie-Mellon University, November 2001.

Bernhard Rinner, Habilitation, Technical University, Graz, Austria, January 2002.
 Robert Sim, McGill University, November 2003.
 Francesco Savelli, Università degli Studi di Roma “La Sapienza”, November 2004.
 John Santore, University of Buffalo, December 2004.
 Urs-Jakob Ruetschi, University of Zurich, April 2007.
 Ananth Ranganathan, Georgia Institute of Technology, February 2008,
 Jan Oliver Wallgrün, Universität Bremen, Germany, August 2008.
 Elin Anna Top, KTH, Sweden, October 2008.
 Christopher Crick, Yale University, October 2009.

Memberships

Fellow, American Association for Artificial Intelligence
 Fellow, Institute for Electrical and Electronic Engineers
 Fellow, Society for Values in Higher Education
 Association for Computing Machinery
 American Association for the Advancement of Science

University and Departmental Service: University of Michigan

Executive Committee, Computer Science and Engineering Division, 2009-11 (elected position).

University and Departmental Service: University of Texas at Austin

University Task Force on Curricular Reform, 2004-06.
 University Research Policy Committee, 2002-2006, Chair, 2003-04, 2004-05.
 Executive Council, Center for Perceptual Systems, 2002-2008.
 Chairman, Computer Science Department, 1997-2001.
 College of Natural Sciences Tenure and Promotion Committee, Member, 1994-95, 2002-03;
 Chair, 1995-96, 2003-04.

INVITED PRESENTATIONS

Plenary and Keynote Addresses

- “How can a robot learn the foundations of knowledge?” Distinguished Lecture. School of Informatics, University of Edinburgh, Edinburgh, Scotland, 20 October 2010.
- “How shall we learn how to learn how to grasp?” Keynote address. Workshop on Grasping – Representations for object grasping and manipulation, IEEE International Conference on Robotics & Automation (ICRA-10), Anchorage, Alaska, 3 May 2010.
- “How can a robot learn the foundations of knowledge?” Keynote address, Fourth International Conference on Cognitive Systems (CogSys-10), ETH Zurich, Switzerland, 28 January 2010.
- “Evaluating the Robot Cognitive Mapper.” Keynote address, Performance Measurement for Intelligent Systems (PerMIS-09), NIST, Gaithersburg, MD, 22 September 2009.

- “Why don’t I take military funding?” The INESPE Lecture Series on the Social Responsibility of Engineers and Scientists. Niels Bohr Institute, University of Copenhagen, 14 October 2008.
- “Navigation within the Hybrid Spatial Semantic Hierarchy.” Invited talk, ICRA 2008 Workshop on Future Directions in Visual Navigation, Pasadena, CA, 19 May 2008.
- “The Robot Wheelchair.” Technologies and Strategies for the Physical Transfer of Individuals with Motor Impairments. Interagency Committee on Disability Research. Arlington VA, 10 September 2007.
- “Where do concepts come from?” Invited talk, International Workshop on Natural and Artificial Cognition, Oxford, England, 25 June 2007
- “Learning the foundations for life-long learning.” Invited talk, Special Session on Enabling Lifelong Human-Robot Interaction, International Conference on Development and Learning, London, 12 July 2007.
- “Can a Robot Have Knowledge of its Own?” From Sensors to Human Spatial Concepts: Geometric Approaches and Appearance-Based Approaches, Workshop at IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS-06), Beijing, China, 10 October 2006.
- “The Intelligent Wheelchair.” Summer Research Institute on Technology in Health Promotion Research for Underserved Populations, Center for Health Promotion and Disease Prevention Research in Underserved Populations (CHPR), The University of Texas at Austin School of Nursing, Austin, Texas, 19 June 2006.
- “Bayesian Reasoning in the Hybrid Spatial Semantic Hierarchy.” Bayesian Cognition International Workshop, Paris, France, 16 January 2006.
- “What Building Robots Can Teach Us About the Mind.” Lecture series, *The Human Edge: Technology, Mankind, and the Future*, Institute for the Humanities at Salado, Salado, Texas, 2 April 2005.
- “Spatial Navigation Research Results.” Artificial Intelligence in Games, GameDev Workshop 2003, Austin, Texas, 22 August 2003.
- “Learning about Space, Qualitatively and Quantitatively.” Fifteenth International Workshop on Qualitative Reasoning, San Antonio, Texas, 17 May 2001.
- “The Skeleton in the Cognitive Map.” Third International Symposium on Space Syntax. Atlanta, Georgia, 10 May 2001.
- “The Hybrid Future of Qualitative Reasoning.” VII Conferencia de la Asociacion Española para la Inteligencia Artificial (CAEPIA’97). Terremolinos, Spain, 13 November 1997.
- “The Spatial Semantic Hierarchy for Large-Scale and Visual Space.” Herbstkolloquium 97 des DFG-Schwerpunktprogramms ‘Raumkognition’ in Trier. Trier, Germany, 29 September 1997.
- “Qualitative Reasoning Approaches the Millenium.” IX International Symposium on Artificial Intelligence. Cancun, Mexico, 15 November 1996.

- “On Commonsense Knowledge of Space.” Workshop on Formal Models of Common-Sense Geographical Worlds, National Center for Geographic Information and Analysis (NCGIA), Research Initiative 21. San Marcos, Texas, 31 October 1996.
- “Qualitative Reasoning for Monitoring and Control.” Second International Conference on Intelligent Systems Engineering. Technical University of Hamburg-Harburg, Germany, 8 September 1994.
- “Spatial Learning and Navigation.” International Conference GIS: From Space to Territory. Theories and Methods of Spatio-Temporal Reasoning. Pisa, Italy, 21 September 1992.
- “Qualitative Reasoning with Incomplete Knowledge.” Workshop on Automation and Robotics. NASA Johnson Space Center, 12 March 1992.
- “Robot Exploration and the Symbol Grounding Problem.” First U.S.-Japan Workshop on Integrated Systems in Multi-Media Environments. New Mexico State University, Las Cruces, NM, 12 December 1991.
- “Qualitative Simulation and Constraint Satisfaction.” Constraint-Based Reasoning Workshop, AAAI 1991 Spring Symposium, Stanford University, 26 March 1991.
- “Qualitative Reasoning and Decision Support.” IMACS International Workshop on Decision Support Systems and Qualitative Reasoning, Toulouse, France, 14 March 1991.
- “The Use of Qualitative Simulation in Support of Model-Based Reasoning.” SPIE Applications of Artificial Intelligence VIII. Orlando, Florida, 17 April 1990.
- “Artificial intelligence: a new approach to modeling and control.” Plenary lecture, First IFAC Symposium on Modelling and Control in Biomedical Systems, Venice, Italy, 8 April 1988.
- “Abstraction by time-scale in qualitative simulation for biomedical modeling.” Invited lecture, First IFAC Symposium on Modelling and Control in Biomedical Systems, Venice, Italy, 8 April 1988.
- “Qualitative Reasoning with Causal Models in Medical Diagnosis.” The Fifth Toyobo Biotechnology Foundation Symposium: Artificial Intelligence in Medicine, Tokyo, Japan, 22 August 1986.
- “Concepts of Qualitative Reasoning.” Alvey Project Deep Knowledge Based Systems Workshop, University of Cambridge, Cambridge, England, 16 April 1986.
- “Expert Causal Models in the Medical Knowledge Base.” Le Congrès Hippocrate 2001, Monte Carlo, Monaco, 5 November 1985.
- “Refuting the ‘Map in the Head’ Theory.” SSRC Spatial Orientation Conference, Center for Research in Human Learning, University of Minnesota. Wayzata, Minnesota, 16 July 1980.

Tutorials

- “Autonomous robot learning of foundational representations.” CoSy Summer Workshop on Multi-Sensory Modalities in Cognitive Science, Gerzensee, Switzerland, 28 August 2007.

- “Spatial Reasoning.” International Conference GIS: From Space to Territory. Theories and Methods of Spatio-Temporal Reasoning. Pisa, Italy, 20 September 1992.
- “Qualitative Reasoning about Physical Systems.” (with Elisha Sacks) Eighth National Conference on Artificial Intelligence (AAAI-90), Boston, Massachusetts, 1 August 1990.
- “Qualitative Reasoning: Modeling and Simulation with Incomplete Knowledge.” Kansai Institute of Information Systems (Osaka, Japan) Study Group. Seventeen Japanese scientists visiting Austin, Texas, 31 October 1988.
- “Qualitative Simulation and Causal Models.” (with Brian Williams) Seventh National Conference on Artificial Intelligence (AAAI-88), St. Paul, Minnesota, 22 August 1988.
- “Qualitative Simulation and Causal Models.” (with Ramesh Patil) Sixth National Conference on Artificial Intelligence (AAAI-87), Seattle, Washington, 16 July 1987.
- “Qualitative Simulation and Causal Models.” Fifth National Conference on Artificial Intelligence (AAAI-86), Philadelphia, Pennsylvania, 14 August 1986.

Lecture Series

- International Spatial Cognition Summer Institute, Bad Zwischenahn, Germany, 25-29 August 2003.
 - “The Spatial Semantic Hierarchy,” 25 August 2003,
 - “A logical theory of the topological map,” 26 August 2003,
 - “Metrical mapping: Integrating large- and small-scale space,” 27 August 2003,
 - “Way-finding and the boundary relation hypothesis,” 28 August 2003,
 - “Place recognition via bootstrap learning,” 29 August 2003.
- University of Science and Technology of China, Hefei, Anhui, China, 28-31 May 2002.
 - “Qualitative modeling and simulation,” 29 May 2002,
 - “Semi-quantitative reasoning in a qualitative framework,” 29 May 2002,
 - “Scaling up to large-scale problems,” 30 May 2002,
 - “Learning the cognitive map and its foundations,” 30 May 2002.
- MONET Summer School on Model-Based Systems and Qualitative Reasoning, Bertinoro, Italy, 15-19 May 2000.
 - “Modeling and simulation with incomplete knowledge,” 18 May 2000,
 - “Semi-quantitative simulation,” 18 May 2000,
 - “Tractability: abstraction and temporal logic,” 18 May 2000,
 - “Model-based reasoning for control tasks,” 18 May 2000.
- Department of Geography, University of California, Santa Barbara, 11-13 January 1983.
 - “Knowledge of Space I: Sensorimotor Representations,” 11 January 1983,
 - “Knowledge of Space II: Topological Representations,” 12 January 1983,
 - “Knowledge of Space III: Metrical Representations,” 13 January 1983.

Panels

- “AR&A in Temporal and Spatial Reasoning.” Symposium on Abstraction, Reformulation and Approximation (SARA-2000). Horseshoe Bay, Texas, 29 July 2000.
- “Open Problems and Directions for Future Research in Adaptive Spatial Representations of Dynamic Environments.” IJCAI-99 Workshop on Adaptive Spatial Representations of Dynamic Environments. Stockholm, Sweden, 1 August 1999.
- “Robot Action Planning — where are we? where are we going?” IJCAI-99 Workshop on Robot Action Planning. Stockholm, Sweden, 31 July 1999.
- “Common Sense.” Society of Minds Symposium (Festschrift, Day Two), MIT Media Lab, Cambridge, Massachusetts, 19 October 1993.
- “What has Qualitative Reasoning Achieved, and Why?” Sixth International Workshop on Qualitative Reasoning about Physical Systems. Edinburgh, Scotland, 26 August 1992.
- “QR and the Frame (non?) Problem.” IFIP Workshop on the Role of Knowledge Representation in Qualitative Reasoning. Islamorada, FL, 29 February 1992.
- “Open Issues – Needs, Expectations and Realities in Spatial Reasoning and Multisensor Fusion.” 1987 Workshop on Spatial Reasoning and Multi-Sensor Fusion, St. Charles, Illinois, 7 October 1987.
- “Summary Panel.” Conference on Social and Ethical Consequences of Designs for Medical Information Systems, Massachusetts Institute of Technology, 20 June 1986.
- “Expert Causal Reasoning and Explanation.” Presented as part of a symposium entitled “Expert Systems and Cognitive Psychology: Implications for Medicine.” American Educational Research Association Annual Meeting, Chicago, Illinois, 31 March 1985.
- “Deep Models, Qualitative Reasoning, Compiling From Deep Models, Anatomical and Physiological Reasoning.” Artificial Intelligence in Medicine Workshop, Ohio State University, Columbus, Ohio, 2 June 1984.
- “Cognitive Psychology and AIM.” Artificial Intelligence in Medicine Workshop, Ohio State University, Columbus, Ohio, 1 June 1984.
- “Computers and Education: A Technological Fix?” Tufts University All-University Forum, Medford, Massachusetts, 14 February 1984.
- “Expert Systems.” Fifth Annual Conference of the Cognitive Science Society, Rochester, New York, 20 May 1983.
- “What Is a Number, That a Man May Know It?” (Moderator) Artificial Intelligence Society of New England, Storrs, Connecticut, 30 October 1982.

Research Seminars

- “Learning the foundations of objects and actions in 3D.” Institute of Perception, Action and Behavior, School of Informatics, University of Edinburgh Edinburgh, Scotland, 21 October 2010.
- “How can a robot learn the foundations of knowledge?” Robotics Group, Engineering Science Department, Oxford University, UK, 25 January 2010.
- “How can a robot learn the foundations of knowledge?” Cognitive Science Seminar, College of Computing, Georgia Institute of Technology, 15 January 2010.
- “Bootstrap learning of sensors, effectors, local space, objects and actions.” Performance Measurement for Intelligent Systems (PerMIS-09), NIST, Gaithersburg, MD, 22 September 2009.
- “Autonomous robot learning of foundational representations.” Computer Science and Engineering Colloquium, Michigan State University, East Lansing, Michigan, 17 April 2009.
- “Autonomous robot learning of foundational representations.” Computer Science and Artificial Intelligence Laboratory, MIT, Cambridge MA, 16 March 2009.
- “Robot Navigation within the Hybrid Spatial Semantic Hierarchy.” Controls Seminar, University of Michigan, Ann Arbor MI, 30 January 2009.
- “Navigation within the Hybrid Spatial Semantic Hierarchy.” Robotics Institute, Carnegie-Mellon University, Pittsburgh, PA, 14 November 2008.
- “Autonomous robot learning of foundational representations.” Center for Autonomous Systems, KTH, Stockholm, Sweden, 13 October 2008.
- “Autonomous robot learning of foundational representations.” College of Computing, Georgia Institute of Technology, Atlanta, GA, 29 February 2008.
- “Autonomous robot learning of foundational representations.” GRASP Lab, University of Pennsylvania, Philadelphia, PA, 15 February 2008.
- “Autonomous robot learning of foundational representations.” Spatial Intelligence and Learning Center, Temple University, Philadelphia, PA, 14 February 2008.
- “The Hybrid Spatial Semantic Hierarchy: Factoring the Mapping Problem.” ICRA Workshop on Cognitive Robots and Systems, Orlando, Florida, 19 May 2006.
- “Bootstrap Learning from Pixel Level to Object Level.” Sony Computer Science Laboratory, Paris, France, 11 January 2006.
- “The Role of Spatial Cognition for Robotics.” Dagstuhl Seminar on Spatial Cognition, Schloss Dagstuhl, Germany, 8 December 2005.
- “The Hybrid Spatial Semantic Hierarchy: Factoring the Mapping Problem.” Center for Visual Science, University of Rochester, Rochester, NY, 4 November 2005.
- “Factoring the Mapping Problem.” Information Technology Laboratory, National Institute of Standards and Technology, Gaithersburg, MD, 7 March 2005.

- “Qualitative Simulation for Design and Diagnosis.” NI Week, Austin, Texas, 18 August 2004.
- “Factoring the Mapping Problem.” Computer Science Department, Stanford University, Stanford CA, 29 June 2004.
- “Factoring the Mapping Problem.” NASA Ames Research Center, Moffett Field, CA, 28 June 2004.
- “Qualitative Simulation for Design and Diagnosis.” National Instruments, Austin, Texas, 13 May 2004.
- “Learning to Explore Space.” UMIACS, University of Maryland, College Park MD, 10 December 2002.
- “Learning to Explore Space.” NCARAI, Naval Research Laboratory, Washington DC, 9 December 2002.
- “Bootstrap Learning for Place Recognition” (with Patrick Beeson). Joint presentation for Center for Perceptual Systems and Cognition and Perception Forum, University of Texas at Austin, 7 October 2002.
- “Qualitative Simulation: Progress and Applications.” Chinese Association for System Simulation, Beijing University of Aeronautics and Astronautics, Beijing, China, 7 June 2002.
- “Learning the Cognitive Map and its Foundations.” Microsoft Research Asia, Beijing, China, 6 June 2002.
- “Learning the Cognitive Map and its Foundations.” NSF VIGRE Program, Mathematics Department, University of Texas at Austin, Austin, Texas, 2 April 2002.
- “Learning the Cognitive Map and its Foundations.” Institut für Technische Informatik, Technical University of Graz, Graz, Austria, 29 January 2002.
- “Learning the Cognitive Map and its Foundations.” Cognitive Science Program, Georgia Institute of Technology, Atlanta, Georgia, 25 January 2002.
- “Learning the Cognitive Map and its Foundations.” Center for Perceptual Systems, University of Texas at Austin, Austin, Texas, 30 November 2001.
- “Learning the Cognitive Map and its Foundations.” AI Seminar, Robotics Institute, Carnegie Mellon University, Pittsburgh, PA, 26 November 2001.
- “The Spatial Semantic Hierarchy.” Institut für Technische Informatik, Technical University of Graz, Graz, Austria, 22 May 2000.
- “The Spatial Semantic Hierarchy.” Istituto Analisi Numerica - C.N.R., Pavia, Italy, 23 May 2000.
- “Spatial Knowledge and the Intelligent Wheelchair.” Cognitive Neuroscience Colloquium Series, University of Minnesota, Minneapolis, Minnesota, 7 January 1999.
- “Exploration and Reasoning in Large-Scale and Visual Spaces.” AI-Vision-Robotics Colloquium, Computer Science Department, Stanford University, Stanford, California, 16 April 1998.

- “Intelligent Systems for Model-Building and Simulation, and Applications to Monitoring and Control.” Texas Institute for Computational and Applied Mathematics, Colloquium, Austin, Texas, 26 February 1998.
- “Academic/Industrial Interaction.” R & D Group, Radian International, Austin, Texas, 12 December 1997.
- “Exploration and Reasoning in Large-Scale and Visual Space.” Cognitive Science Program, Georgia Institute of Technology, Atlanta, Georgia, 5 December 1997.
- “The Spatial Semantic Hierarchy for Human and Robot Cognitive Maps.” Workshop on Mental Representations in Navigation. Nissan Cambridge Basic Research Laboratory, Cambridge, Massachusetts, 25 June 1996.
- “The Spatial Semantic Hierarchy for Human and Robot Cognitive Maps.” NCARAI, Naval Research Laboratory, Washington DC, 22 April 1996.
- “An Ontological Hierarchy for Spatial Knowledge.” Department of Computer Science, University of Chicago, Chicago, Illinois, 14 February 1996.
- “An Ontological Hierarchy for Spatial Knowledge.” Institute for Learning Sciences, Northwestern University, Evanston, Illinois, 13 February 1996.
- “Spatial Knowledge, Cognitive Maps, and the Spatial Semantic Hierarchy.” *Spatial Orientation and Navigation*, ONR Meeting, NAS Study Center, Woods Hole, MA, 14 September 1995.
- “Qualitative Reasoning for Monitoring and Control.” Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM), Monterrey, Mexico, 27 June 1995.
- “Qualitative Reasoning for Monitoring and Control.” Department of Computer Science, University of Colorado, Boulder, 16 February 1995.
- “Robot Learning with the Spatial Semantic Hierarchy.” Nara Institute for Science and Technology, Nara, Japan, 13 June 1994.
- “Robot Learning with the Spatial Semantic Hierarchy.” Keihanna Interaction Corp., Nara, Japan, 10 June 1994.
- “Robot Learning with the Spatial Semantic Hierarchy.” Department of Computer Science, Texas A & M University, College Station, Texas, 11 April 1994.
- “Robot Learning with the Spatial Semantic Hierarchy.” Introspection Series, Department of Computer Sciences, University of Texas at Austin, 18 February 1994.
- “Robot Learning with the Spatial Semantic Hierarchy.” Robotics Institute, Carnegie Mellon University, Pittsburgh, Pennsylvania, 31 January 1994.
- “Self-Calibrating Models for Dynamic Monitoring and Diagnosis.” Space Operations, Applications, and Research Symposium (SOAR’93), NASA Johnson Space Center, Houston, Texas, 4 August 1993.

- “The Semantic Hierarchy in Robot Spatial Learning” College of Computer Science, Georgia Institute of Technology, Atlanta, Georgia, 7 March 1993.
- “The Semantic Hierarchy in Robot Spatial Learning” Knowledge Systems Laboratory, Stanford University, Stanford, California, 26 February 1993.
- “Progress in Qualitative and Semi-Quantitative Simulation.” Istituto di Analisi Numerica del Consiglio Nazionale delle Ricerche, Università degli Studi di Pavia, Pavia, Italy, 18 September 1992.
- “Model-Based Reasoning with Incomplete Knowledge.” Texas Instruments Central Research Laboratory, Dallas TX, 4 March 1992.
- “Symbolic Representations for Metric Spaces.” IFIP Workshop on the Role of Knowledge Representation in Qualitative Reasoning. Islamorada, FL, 28 February 1992.
- “Model-Based Reasoning with Incomplete Knowledge.” AT&T Bell Laboratories, Murray Hill, NJ, 21 November 1991.
- “Model-Based Reasoning with Incomplete Knowledge.” Computer Science Department, Princeton University, Princeton, NJ, 20 November 1991.
- “Cognitive Maps of Control Domains.” Robot Skills Research Seminar, Artificial Intelligence Laboratory, Massachusetts Institute of Technology, 3 July 1991.
- “The Composition of Heterogeneous Control Laws.” Control Theory Research Seminar, Laboratory for Computer Science, Massachusetts Institute of Technology, 25 July 1991.
- “Robot Mapping and Exploration.” The Quark Club, University of Texas at Austin, 26 September 1990.
- “Qualitative Simulation: Model-Based Reasoning with Incomplete Knowledge.” Computer Science Department, University of Chicago, Chicago, Illinois, 7 February 1990.
- “Qualitative Simulation: Model-Based Reasoning with Incomplete Knowledge.” Institute for Learning Science, Northwestern University, Evanston, Illinois, 8 February 1990.
- “Qualitative Reasoning.” Computer Science Research Review, Department of Computer Science, University of Texas at Austin, 16 October 1989.
- “Qualitative Reasoning: Modeling and Simulation with Incomplete Knowledge.” Laboratory for Computer Science, Massachusetts Institute of Technology, Cambridge, Massachusetts, 16 June 1989.
- “Robot Exploration Based on a Spatial Semantic Hierarchy.” Center for Cognitive Science, University of Texas at Austin, 20 April 1989.
- “Qualitative Reasoning: Modeling and Simulation with Incomplete Knowledge.” Computer Science Department, University of Toronto, Ontario, 23 February 1989.
- “Qualitative Reasoning: Modeling and Simulation with Incomplete Knowledge.” Microelectronics and Computer Technology Corporation, Austin, Texas, 11 January 1989.

- “A Robust, Qualitative Method for Robot Exploration.” MIT Artificial Intelligence Laboratory Revolving Seminar, Cambridge, MA, 8 November 1988.
- “Qualitative Reasoning: Modeling and Simulation with Incomplete Knowledge.” IBM T. J. Watson Research Center, Hawthorne, NY, 28 October 1988.
- “Qualitative Model-Based Reasoning.” Istituto di Analisi Numerica del Consiglio Nazionale delle Ricerche, Università degli Studi di Pavia, Pavia, Italy, 11 April 1988.
- “Advances in Qualitative Simulation.” CSL Lecture Series, Texas Instruments Research Laboratories, Dallas, Texas, 13 November 1987.
- “Qualitative Reasoning about Mechanisms.” CSL Lecture Series, Texas Instruments Research Laboratories, Dallas, Texas, 7 November 1986.
- “Aspects of Qualitative Reasoning About Mechanisms.” First World Congress on Computational Mechanics, Austin, Texas, 22 September 1986.
- “Qualitative Reasoning with Causal Models in Medical Diagnosis.” Electrotechnical Laboratory, Tsukuba, Japan, 21 August 1986.
- “Qualitative Reasoning with Causal Models in Medical Diagnosis.” Institute for New Generation Computer Technology (ICOT), Tokyo, Japan, 20 August 1986.
- “Comments on Decision Support Systems.” Recent Developments in Medical Information Systems: Available and Forthcoming Choices. Massachusetts Institute of Technology, Cambridge, Massachusetts, 19 June 1986.
- “Concepts of Qualitative Reasoning.” Hewlett-Packard Research Laboratories, Bristol, England, 18 April 1986.
- “Learning from Exploration in Large-Scale Space.” Graduate Group in Cognitive Science, University at Buffalo (SUNY), Buffalo, New York, 21 November 1985.
- “Qualitative Simulation of Mechanisms.” Joint Research Centre, Commission of the European Communities, Ispra, Italy, 8 November 1985.
- “Qualitative Simulation of Mechanisms and Causal Models in Medical Diagnosis.” Austin Chapter, ACM SIGART, Austin, Texas, 2 October 1985.
- “Artificial Intelligence Approaches to Clinical Reasoning.” Combined Renal Conference, University of Texas Health Science Center, San Antonio, Texas, 18 September 1985.
- “Qualitative Causal Reasoning in Diagnosis.” MIT Artificial Intelligence Laboratory Revolving Seminar, Cambridge, Massachusetts, 14 May 1985.
- “Qualitative Causal Reasoning in Diagnosis.” Microelectronics and Computer Technology Corporation, Austin, Texas, 24 April 1985.
- “Causal Reasoning and Qualitative Simulation.” Artificial Intelligence Symposium, Department of Computer Science, Columbia University, New York, New York, 12 April 1985.

- “Qualitative Simulation of Mechanisms.” Computer Science Colloquium, University of Texas, Austin, Texas, 18 September 1984.
- “Qualitative Causal Reasoning for Second-Generation Medical Diagnosis Programs.” Department of Computer Science, Boston University, Boston, Massachusetts, 20 April 1984.
- “Qualitative Causal Reasoning for Second-Generation Medical Diagnosis Programs.” Department of Electrical Engineering and Computer Science, University of California at San Diego, La Jolla, California, 18 April 1984.
- “Qualitative Causal Reasoning for Second-Generation Medical Diagnosis Programs.” Department of Computer Science, University of Texas, Austin, Texas, 16 April 1984.
- “Qualitative Causal Reasoning for Second-Generation Medical Diagnosis Programs.” Department of Computer and Information Science, University of Massachusetts, Amherst, Massachusetts, 12 April 1984.
- “Qualitative Causal Reasoning for Second-Generation Medical Diagnosis Programs.” School of Computer and Information Sciences, Georgia Institute of Technology, Atlanta, Georgia, 5 April 1984.
- “Qualitative Causal Reasoning for Second-Generation Medical Diagnosis Programs.” University of Minnesota Computer Science Department, Minneapolis, Minnesota, 30 March 1984.
- “Studying Experts To Learn About Qualitative Causal Reasoning.” Stanford University Computer Science Department, Stanford, California, 24 February 1984.
- “Knowledge Representations for Causal Reasoning.” MIT Center for Policy Alternatives and Technology and Policy Program, Cambridge, Massachusetts, 28 October 1983.
- “Commonsense Knowledge of Large-Scale Space.” Massachusetts Computer Associates, Wakefield, Massachusetts, 19 April 1983.
- “Modeling Spatial Knowledge.” Cognitive Science Research Colloquium, University of California, Santa Barbara, 14 January 1983.
- “Commonsense Reasoning About Causal Systems.” Department of Computer Science, University of Texas. Austin, Texas, 23 April 1982.
- “Commonsense Reasoning About Causal Systems.” Computer Science Laboratory Seminar, Texas Instruments. Dallas, Texas, 22 April 1982.
- “The Structure of Causal Reasoning.” Clinical Decision Making Seminar, Tufts-New England Medical Center Hospital. Boston, Massachusetts, 1 March 1982.
- “Causal Reasoning About Feedback Processes.” Center for Research on Human Learning, Department of Computer Science, and Department of Management Sciences, University of Minnesota. Minneapolis, Minnesota, 2 October 1981.
- “Explorations of Cognitive Space.” COINS Seminar, Department of Computer and Information Science, University of Massachusetts at Amherst. Amherst, Massachusetts, 6 April 1981.

- “New Explorations of Space.” University of New Hampshire Computer Science Colloquium. Durham, New Hampshire, 5 November 1979.
- “New Explorations of Space.” University of Maryland Computer Science Colloquium. College Park, Maryland, 15 October 1979.
- “Commonsense Knowledge of Space.” Yale University Computer Science Colloquium. New Haven, Connecticut, 4 April 1979.
- “Progress in Human Spatial Information Processing.” Advanced Research Projects Agency (DARPA) Contractors Meeting. New Orleans, Louisiana, 13 December 1977.
- “Cognitive Modeling of the Map User.” First International Advanced Study Symposium on Topological Data Structures for Geographical Information Systems. Dedham, Massachusetts, 18 October 1977.
- “Representing Spatial Knowledge.” Electrical Engineering and Computer Science Symposium, Massachusetts Institute of Technology. Cambridge, Massachusetts, 28 February 1977.
- “The TOUR Model of Spatial Cognition.” Center for Human Information Processing, University of California, San Diego. LaJolla, California, 5 November 1976.
- “The TOUR Model of Spatial Cognition.” ARPA Workshop on Psychology and Cartography. San Francisco, California, 30 October 1976.
- “Representing Spatial Knowledge.” Center for Human Information Processing, University of California, San Diego. La Jolla, California, 15 December 1975.
- “Mental Maps.” Artificial Intelligence Laboratory, Stanford University. Palo Alto, California, 29 January 1975.
- “Mental Maps.” Xerox Palo Alto Research Center. Palo Alto, California, 13 January 1975.

Other Presentations

- “Why don’t I take military funding?” Workshop on Teaching Ethics and Peace to Science and Engineering Students, University of Hamburg, 17 October 2008.
- “Spatial Reasoning and Robotics.” The ACM Seminar Series. Computer Science Department, University of Texas at Austin, 12 October 1998.
- “The Spatial Semantic Hierarchy for Human and Robotic Cognitive Maps.” Symposium on Cognitive Mapping, Development and Representation, Association of American Geographers, 93rd Annual Meeting, Fort Worth, Texas, 1 April 1997.
- “Robot Exploration and Mapping Strategy.” RoboFest 7. Austin, Texas, 14 September 1996.
- “Truth, Beauty, and Power.” Mrs. Zunker’s eighth grade honors algebra class, Grisham Middle School, Round Rock Independent School District, 9 November 1994.

- “How a Robot Can Understand Its World.” RoboFest 5. Austin, Texas, 26 March 1994.
- “Building Intelligent Agents.” Computer Science Industrial Forum, Department of Computer Sciences, University of Texas at Austin, 7 February 1994.
- “Why Build Robots, Anyway?” RoboFest 4. Austin, Texas, 22 May 1993.
- “Qualitative Reasoning About Physical Systems.” Demonstration and discussion, Computer Science Industrial Forum, Department of Computer Sciences, University of Texas at Austin, 18 February 1991.

MISCELLANY

- Developed the first symbolic differential equation solver. 1972. Cited in J. P. Golden, MACSYMA’s Symbolic Ordinary Differential Equation Solver, *Proceedings of the Macsyma Users Conference*, 1977.
Also cited (as MIT-ML disk files!) in David R. Stoutemyer, Computer Algebraic Manipulation for the Calculus of Variations, the Maximum Principle, and Automatic Control. University of Hawaii Aloha System TR A74-5, November 1974.
- Choreographed “He Built A Crooked House,” a Scottish country dance. In *A Yankee Sampler*, Cambridge, Mass: Royal Scottish Country Dance Society, Boston Branch, 1976.
- Cited along with D. E. Knuth for independent discovery of a key improvement to their string searching algorithm, in R. S. Boyer and J S. Moore, A fast string searching algorithm, *Communications of the ACM* **20**: 762 - 772, 1977.

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