

CURRICULUM VITAE

Dr. Kenneth O. Stanley
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U.S. Citizen

Degrees

Doctor of Philosophy in Computer Science, The University of Texas at Austin, August 2004.

Master of Science in Computer Science, The University of Texas at Austin, May 1999.

Bachelor of Science *magna cum laude* in Engineering, major in Computer Science Engineering, minor in Cognitive Science, University of Pennsylvania, May 1997.

Professional Experience

Assistant Professor,

Department of Electrical Engineering and Computer Science, The University of Central Florida,
Since January 2006.

Postdoctoral Researcher,

Department of Computer Sciences, The University of Texas at Austin,
September 2004 to December 2005;
Research on real-time neuroevolution in NERO and developing a neuroevolution engine for the TIELT gaming research framework. Supervising Professor: Risto Miikkulainen.

Research Assistant,

Department of Computer Sciences, The University of Texas at Austin, 2000 to 2004;
IC2 Institute Digital Media Collaboratory at The University of Texas at Austin, Fall 2003.
Toyota Corporation, Spring and Summer 2004
Research on Neuroevolution: *NeuroEvolution of Augmenting Topologies (NEAT)*. Supervising Professor: Risto Miikkulainen.

Teaching Assistant, Department of Computer Sciences, The University of Texas at Austin, September 1997 to May 2000. Course: *Foundations of Computer Science* (for entering CS majors). Held office hours, attended classes, corrected papers and exams, and independently lectured to 50 students, 25 at a time. Received **TA Service Commendation**.

Research Intern, Hewlett-Packard Laboratories, Hewlett-Packard Company, Palo Alto, CA, Summer 1999. Applied neuroevolution techniques to failure prediction. Patent granted.

Software Development Intern, OLAP Division, Oracle Corporation, Waltham, MA, Summer 1997.
Upgraded object component technology behind Oracle's table component software.

Information Technology Intern, Goldman, Sachs & Co., New York City, NY, Summer 1996.
Developed system for organizing real-time securities data feeds.

Recognition and Awards

Finalist, 2010 Indie Game Challenge (Las Vegas, NV), for the Galactic Arms Race Video Game created at UCF to demonstrate novel AI technology.

12 finalists chosen out of more than 250 independent games submitted.

Best Paper Award in Computational Intelligence and Games, IEEE 2009 Symposium on Computational Intelligence and Games (CIG'09, Milan, Italy), for Hastings, E., Guha, R., and Stanley, K., Evolving Content in the Galactic Arms Race Video Game.

Best Paper Award in Artificial Life, Evolutionary Robotics, Adaptive Behavior, Evolvable Hardware, Genetic and Evolutionary Computation Conference (GECCO-2009, Montreal, Canada), for Risi, S., Vanderbleek, S., Hughes, C., Stanley, K., How Novelty Search Escapes the Deceptive Trap of Learning to Learn.

Best AI in an Independent Game (Editor's Pick), 2009 AIGameDev.com Awards for Game AI for the Galactic Arms Race Video Game.

Best Paper Award in Generative and Developmental Systems, Genetic and Evolutionary Computation Conference (GECCO-2008, Atlanta, GA), for D'Ambrosio, D. and Stanley, K., Generative Encoding for Multiagent Learning.

Best Paper Award in Evolutionary Music and Art, Sixth European Workshop on Evolutionary and Biologically Inspired Music, Sound, Art and Design (EvoMUSART 2008, Naples, Italy), for Hoover, A. and Stanley, K., Scaffolding for Interactively Evolving Novel Drum Tracks for Existing Songs.

Outstanding Graduate Teaching Award, presented to Kenneth O. Stanley on April 14, 2008 by the School of Electrical Engineering and Computer Science at the University of Central Florida.

Best Student Video Award, Twenty-Second Conference on Artificial Intelligence (AAAI-07), for Balogh, J., Dubbin, G., Do, M., and Stanley K. (supervisor), Dance Evolution..

Nominated for Best Paper Award in Generative and Developmental Systems, Genetic and Evolutionary Computation Conference (GECCO-2007, London, UK), for D'Ambrosio, D. and Stanley, K., A Novel Generative Encoding for Exploiting Neural Network Sensor and Output Geometry.

Winner, Independent Games Festival Student Showcase, Middleware Category, 2006 Game Developers Conference (GDC'06, San Jose, CA), for the NERO video game. Recognizes "outstanding student-created independent PC games."

Best Paper Award in Computational Intelligence and Games, IEEE 2005 Symposium on Computational Intelligence and Games (CIG'05, Colechester, UK), for Stanley, K., Bryant, B., and Miikkulainen, R., Evolving Neural Network Agents in the NERO Video Game.

Best Paper Award in Genetic Algorithms, Genetic and Evolutionary Computation Conference (GECCO-2002, New York, NY), for Stanley, K. and Miikkulainen, R., Efficient Reinforcement Learning Through Evolving Neural Network Topologies.

Teaching Assistant Service Commendation, Department of Computer Sciences, The University of Texas at Austin, December 1999

Tau Beta Pi National Engineering Honor Society, 1996-97

Vice President, Eta Kappa Nu Electrical Engineering and Computer Science Honor Society, University of Pennsylvania Chapter, 1996-97

Golden Key National Honor Society, 1996-97

Magna Cum Laude Graduate, University of Pennsylvania, 1997

Research Key Words

Areas of interest: **artificial intelligence, machine learning, neural networks, evolutionary computation, evolutionary complexity, neuroevolution, indirect encoding, generative and developmental systems, video game AI, video game development**

Publications

Articles in Books

Ryan Cornelius, Kenneth O. Stanley, and Risto Miikkulainen (2006). Constructing Adaptive AI Using Knowledge-Based NeuroEvolution. In Rabin, Woodcock, Forrester, Houlette, Orkin, and Manslow (editors), *AI Game Programming Wisdom 3*. Boston, MA: Charles River Media: 693–708.

Risto Miikkulainen, Bobby D. Bryant, Ryan Cornelius, Igor Karpov, Kenneth O. Stanley, and Chern Han Yong (2006). Computational Intelligence in Games. In Yen and Fogel (editors), *Computational Intelligence: Principles and Practice*. Piscataway, NJ: IEEE Computational Intelligence Society: 155–191.

Refereed Journal Articles

Accepted (To Appear)

Jason J. Gauci* and Kenneth O. Stanley (2010). Autonomous Evolution of Topographic Regularities in Artificial Neural Networks. *Neural Computation*, Cambridge, MA: MIT Press (manuscript 38 pages).

In Print

Erin Hastings*, Ratan K. Guha, and Kenneth O. Stanley (2009). Automatic Content Generation in the Galactic Arms Race Video Game. *IEEE Transactions on Computational Intelligence and AI in Games*, 4(1): 245–263, Piscataway, NJ: IEEE Press (18 pages).

Kenneth O. Stanley, David B. D’Ambrosio*, and Jason J. Gauci* (2009). A Hypercube-Based Indirect Encoding for Evolving Large-Scale Neural Networks. *Artificial Life*, 15(2):185–212, Cambridge, MA: MIT Press (27 pages).

Amy K. Hoover* and Kenneth O. Stanley (2009). Exploiting Functional Relationships in Musical Composition. *Connection Science Special Issue on Music, Brain, and Cognition*, 21(2&3):227 - 251, Abington, UK: Taylor and Francis (24 pages).

Erin Hastings*, Ratan K. Guha, and Kenneth O. Stanley (2009). Interactive Evolution of Particle Systems for Computer Graphics and Animation *IEEE Transactions on Evolutionary Computation*, 13(2): 418–432, Piscataway, NJ: IEEE Press (14 pages).

Jimmy Secretan*, Nicholas Beato*, David B. D’Ambrosio*, Adelein Rodriguez*, Adam Campbell*, and Kenneth O. Stanley (2008). Picbreeder: Collaborative Interactive Evolution of Images *Leonardo* (Transactions Section), 41(1): 98–99, Cambridge, MA: MIT Press (2 pages).

Note: This article is a short two-page transaction notice announcing the Picbreeder experiment. A full-length journal article is under review at Evolutionary Computation journal.

Kenneth O. Stanley (2007). Compositional Pattern Producing Networks: A Novel Abstraction of Development. *Genetic Programming and Evolvable Machines Special Issue on Developmental Systems*, 8(2): 131–162, New York: Springer (31 pages).

Cited by: 39 (Google Scholar)

Kenneth O. Stanley, Bobby D. Bryant, and Risto Miikkulainen (2005). Real-time Neuroevolution in the NERO Video Game. *IEEE Transactions on Evolutionary Computation Special Issue on Evolutionary Computation and Games*, 9(6): 653–668, Piscataway, NJ: IEEE Press (15 pages).

Cited by: 121 (Google Scholar)

Kenneth O. Stanley and Risto Miikkulainen (2004). Competitive Coevolution through Evolutionary Complexification. *Journal of Artificial Intelligence Research*, 21: 63–100, Marina del Rey, CA: AI Access Foundation (37 pages).

Cited by: 149 (Google Scholar)

Kenneth O. Stanley and Risto Miikkulainen (2003). A Taxonomy for Artificial Embryogeny. *Artificial Life*, 9(2): 93–130, Cambridge, MA: MIT Press (37 pages).

Cited by: 165 (Google Scholar)

Most cited article in *Artificial Life* since its year of publication (Google Scholar)

Kenneth O. Stanley and Risto Miikkulainen (2002). Evolving Neural Networks through Augmenting Topologies. *Evolutionary Computation*, 10(2): 99–127, Cambridge, MA: MIT Press (28 pages).

Cited by: 446 (Google Scholar)

Most cited article in *Evolutionary Computation* since its year of publication (Google Scholar)

Adrian Agogino, Kenneth O. Stanley, and Risto Miikkulainen (2000). Online Interactive Neuroevolution. *Neural Processing Letters*, 11(1):29–37, New York: Springer (8 pages).

Refereed Conference, Symposium, and Workshop Papers

Accepted (To Appear)

David B. D.Ambrosio*, Joel Lehman*, Sebastian Risi*, and Kenneth O. Stanley (2010). Evolving Policy Geometry for Scalable Multiagent Learning In: *Proceedings of the Ninth International Conference on Autonomous Agents and Multiagent Systems (AAMAS-2010)* (Toronto, Canada). International Foundation for Autonomous Agents and Multiagent Systems.

Greg Dubbin* and Kenneth O. Stanley (2010). Learning to Dance through Interactive Evolution. To appear in: *Proceedings of the Eighth European Event on Evolutionary and Biologically Inspired Music, Sound, Art and Design (EvoMUSART 2010, Istanbul, Turkey)*. New York, NY: Springer.

Julian Togelius, Georgios N. Yannakakis, Kenneth O. Stanley, and Cameron Browne (2010). Search-based Procedural Content Generation. In: *Proceedings of the 2nd European event on Bio-inspired Algorithms in Games (EvoGAMES 2010, Istanbul, Turkey)*. New York, NY: Springer.

In Print

Erin Hastings*, Ratan Guha, and Kenneth O. Stanley (2009). Evolving Content in the Galactic Arms Race Video Game. In: *Proceedings of the IEEE Symposium on Computational Intelligence and Games (CIG'09)*. (Milan, Italy). Piscataway, NJ: IEEE, 241–248.

Winner of the Best Paper Award.

(out of 76 submissions)

Sebastian Risi*, Sandy D. Vanderbleek*, Charles E. Hughes, and Kenneth O. Stanley (2009). How Novelty Search Escapes the Deceptive Trap of Learning to Learn. In: *Genetic and Evolutionary Computation Conference (GECCO-2009, Montreal)*. New York, NY: The Association for Computing Machinery, 153–160.

Winner of the Best Paper Award in Artificial Life, Evolutionary Robotics, Adaptive Behavior, Evolvable Hardware.

(out of 42 submissions in track)

Georgios C. Anagnostopoulos, Michael Georgiopoulos, Veton Z. Kepuska, Kenneth O. Stanley, Alison Morrison-Shetlar, Pat Lancey, Paula Krist, and Tace Crouse (2009). The AMALTHEA REU Program: Activities, Experiences & Outcomes of a Collaborative Summer Research Experience in Machine Learning. In: *Proceedings of the American Society of Engineering Education 2009 Annual Conference and Exposition (ASEE 2009, Austin, TX)*.

Jason Gauci* and Kenneth O. Stanley (2008). A Case Study on the Critical Role of Geometric Regularity in Machine Learning. In: *The Twenty-Third AAAI Conference on Artificial Intelligence (AAAI-2008, Chicago)*. Menlo Park, CA: AAAI Press, 628–633.

Jimmy Secretan*, Nicholas Beato*, David B. D'Ambrosio*, Adelein Rodriguez*, Adam Campbell*, and Kenneth O. Stanley (2008). Picbreeder: Evolving Pictures Collaboratively Online. In: *Proceedings of the Computer Human Interaction Conference (CHI 2008, Milan)*. New York, NY: The Association for Computing Machinery, 1759–1768.

Amy K. Hoover*, Michael P. Rosario*, and Kenneth O. Stanley (2008). Scaffolding for Interactively Evolving Novel Drum Tracks for Existing Songs. To appear in: *Proceedings of the Sixth European Workshop on Evolutionary and Biologically Inspired Music, Sound, Art and Design (EvoMUSART 2008, Naples, Italy)*. New York, NY: Springer, 412–422.

Winner of the Best Paper Award.

(out of 31 submissions)

David D'Ambrosio* and Kenneth O. Stanley (2008). Generative Encoding for Multiagent Learning. In: *Genetic and Evolutionary Computation Conference (GECCO-2008, Atlanta)*. New York, NY: The Association for Computing Machinery, 819–826.

Winner of the Best Paper Award in Generative and Developmental Systems.

(out of 13 submissions in track)

Joel Lehman* and Kenneth O. Stanley (2008). Exploiting Open-Endedness to Solve Problems Through the Search for Novelty. In: *Eleventh International Conference on the Simulation and Synthesis of Living Systems (Artificial Life XI, Winchester, UK)*, 329–336.

David D'Ambrosio* and Kenneth O. Stanley (2007). A Novel Generative Encoding for Exploiting Neural Network Sensor and Output Geometry. In: *Genetic and Evolutionary Computation Conference (GECCO-2007, London)*. New York, NY: The Association for Computing Machinery, 974–981.

**Nominated for Best Paper Award in Generative and Developmental Systems.
(3 of 24 nominated in track)**

- Jason Gauci* and Kenneth O. Stanley (2007). Generating Large-Scale Neural Networks through Discovering Geometric Regularities. In: *Genetic and Evolutionary Computation Conference (GECCO-2007, London)*. New York, NY: The Association for Computing Machinery, 997–1004.
- Erin Hastings*, Ratan Guha, and Kenneth O. Stanley (2007). NEAT Particles: Design, Representation, and Animation of Particle System Effects. In: *Proceedings of the IEEE Symposium on Computational Intelligence and Games (CIG'07)*. (Honolulu, HI). Piscataway, NJ: IEEE, 154–160.
- Kenneth O. Stanley, Bobby D. Bryant, Igor Karpov, Risto Miikkulainen (2006). Real-Time Evolution of Neural Networks in the NERO Video Game. In: *Proceedings of the Twenty-First National Conference on Artificial Intelligence (AAAI-2006, Boston, MA)*. Menlo Park, CA: AAAI Press, 1671–1674.
- Chern Han Yong, Kenneth O. Stanley, Risto Miikkulainen, and Igor V. Karpov (2006). Incorporating Advice into Neuroevolution of Adaptive Agents. In: *Proceedings of the Artificial Intelligence and Interactive Digital Entertainment Conference (AIIDE 2006, Marina Del Rey, CA)*. Menlo Park, CA: AAAI Press, 96–104.
- German A. Monroy, Kenneth O. Stanley, Risto Miikkulainen (2006). Coevolution of Neural Networks using a Layered Pareto Archive. In: *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2006, Seattle, WA)*. New York, NY: The Association for Computing Machinery.
- Nate Kohl, Kenneth Stanley, Risto Miikkulainen, Michael Samples, and Rini Sherony (2006). Evolving a Real-World Vehicle Warning System. In: *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2006, Seattle, WA)*. New York, NY: The Association for Computing Machinery.
- Thomas D'Silva, Roy Janik, Michael Chrien, Kenneth O. Stanley, and Risto Miikkulainen (2005). Retaining Learned Behavior During Real-time Neuroevolution. In: *Proceedings of the Artificial Intelligence and Interactive Digital Entertainment Conference (AIIDE 2005, Marina Del Rey, CA)*. Menlo Park, CA: AAAI Press.
- Kenneth O. Stanley, Nate Kohl, Rini Sherony, and Risto Miikkulainen (2005). Neuroevolution of an Automobile Crash Warning System. In: *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2005, Washington D.C)*. New York, NY: The Association for Computing Machinery.
- Shimon Whiteson, Peter Stone, Kenneth O. Stanley, Risto Miikkulainen, and Nate Kohl (2005). Automatic Feature Selection in Neuroevolution. In: *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2005, Washington D.C)*. New York, NY: The Association for Computing Machinery.
- Kenneth O. Stanley, Bobby D. Bryant, and Risto Miikkulainen (2005). Evolving Neural Network Agents in the NERO Video Game. In: *IEEE Symposium on Computational Intelligence and Games (CIG'05)* (Colchester, UK), 182–189.
Best Paper Award at CIG'05 (out of 54 papers submitted)
- Kenneth O. Stanley and Risto Miikkulainen (2004). Evolving A Roving Eye for Go. In: *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2004, Seattle, WA)*. New York, NY: Springer-Verlag.

Joseph Reisinger, Kenneth O. Stanley, and Risto Miikkulainen (2004). Evolving Reusable Neural Modules. In: *Proceedings of the Genetic and Evolutionary Computation Conference* (GECCO-2004, Seattle, WA). New York, NY: Springer-Verlag.

Kenneth O. Stanley, Bobby D. Bryant, and Risto Miikkulainen (2003). Evolving Adaptive Neural Networks with and without Adaptive Synapses. In: *Proceedings of the 2003 Congress on Evolutionary Computation* (CEC 03, Canberra, Australia). Piscataway, NJ: IEEE.

Kenneth O. Stanley and Risto Miikkulainen (2003). Achieving High-Level Functionality through Complexification. In: *2003 AAAI Spring Symposium on Computational Synthesis* (Stanford, CA), 226–232. Menlo Park, CA: AAAI Press.

Kenneth O. Stanley and Risto Miikkulainen (2002). Efficient Reinforcement Learning through Evolving Neural Network Topologies. In: *Proceedings of the Genetic and Evolutionary Computation Conference* (GECCO-2002, New York, NY), 569–577. San Fransisco, CA: Kaufman.

Winner of the Best Paper Award in Genetic Algorithms (out of over 100 papers submitted)

Cited by: 87 (Google Scholar)

Kenneth O. Stanley and Risto Miikkulainen (2002). Continual Coevolution through Complexification. In: *Proceedings of the Genetic and Evolutionary Computation Conference* (GECCO-2002, New York, NY), 113–120. San Fransisco, CA: Kaufman.

Kenneth O. Stanley and Risto Miikkulainen (2002). Efficient Evolution of Neural Network Topologies. In: *Proceedings of the 2002 Congress on Evolutionary Computation* (CEC 02, Honolulu, HI), 1757–1762. Piscataway, NJ: IEEE.

Non-Competitive Workshops and Symposia

In Print

Kenneth O. Stanley (2006). Exploiting Regularity Without Development. In: *Proceedings of the AAAI Fall Symposium on Developmental Systems*. (Washington, D.C.), 49–56. Menlo Park, CA: AAAI Press.

Kenneth O. Stanley (2006). Comparing Artificial Phenotypes with Natural Biological Patterns. In: *Proceedings of the Genetic and Evolutionary Computation Conference Workshop Program* (GECCO-2006, Seattle, WA). New York, NY: The Association for Computing Machinery.

Igor V. Karpov, Thomas D.Silva, Craig Varrichio, Kenneth O. Stanley, Risto Miikkulainen (2006). Integration and Evaluation of Exploration-Based Learning in Games. In: *IEEE Symposium on Computational Intelligence and Games (CIG'06)* (Reno, NV), 39–44.

Joseph Reisinger, Kenneth O. Stanley, and Risto Miikkulainen (2005). Towards an Empirical Measure of Evolvability. In: *Proceedings of the Genetic and Evolutionary Computation Conference Workshop Program* (GECCO-2005, Washington D.C). New York, NY: The Association for Computing Machinery.

Kenneth O. Stanley, Joseph Reisinger, and Risto Miikkulainen (2004). Exploiting Morphological Conventions for Genetic Reuse. In: *Proceedings of the Genetic and Evolutionary Computation Conference Workshop Program* (GECCO-2004, Seattle, WA). New York, NY: Springer-Verlag.

Kenneth O. Stanley and Risto Miikkulainen (2002). The Dominance Tournament Method of Monitoring Progress in Coevolution. In: *2002 Genetic and Evolutionary Computation Conference Workshop Program* (GECCO-2002, New York, NY), 242–248. San Francisco, CA: Kaufman.

Non-Refereed Publications

Kenneth O. Stanley (2003). Learning Concept Drift with a Committee. Technical Report AI-00-285, Department of Computer Sciences, University of Texas at Austin. 14 pages.

Cited by: 42 (Google Scholar)

Demonstrations

Erin Hastings*, Ratan Guha, and Kenneth O. Stanley (2009). Demonstrating Automatic Content Generation in the Galactic Arms Race Video Game. In: *Proceedings of the Artificial Intelligence and Interactive Digital Entertainment Conference Demonstration Program* (AIIDE 2009, Palo Alto, CA). Menlo Park, CA: AAAI Press.

Kenneth O. Stanley, Igor Karpov, Risto Miikkulainen, and Aliza Gold (2006). Real-time Interactive Learning in the NERO Video Game. In: *Proceedings of the Twenty-First National Conference on Artificial Intelligence Demonstration Program* (AAAI-2006, Boston, MA). Menlo Park, CA: AAAI Press.

Kenneth O. Stanley, Igor Karpov, Risto Miikkulainen, and Aliza Gold (2006). The NERO Video Game. In: *Proceedings of the Artificial Intelligence and Interactive Digital Entertainment Conference Demonstration Program* (AIIDE 2006, Marina Del Rey, CA). Menlo Park, CA: AAAI Press.

Kenneth O. Stanley, Ryan Cornelius, Risto Miikkulainen, Thomas D’Silva, and Aliza Gold (2005). Real-time Learning in the NERO Video Game. In: *Proceedings of the Artificial Intelligence and Interactive Digital Entertainment Conference Demonstration Program* (AIIDE 2005, Marina Del Rey, CA). Menlo Park, CA: AAAI Press.

Videos

Erin Hastings*, Ratan Guha, and Kenneth O. Stanley (2009). Galactic Arms Race (GAR): Automatic Content Generation In a Multiplayer Online Video Game. *Proceedings of the Twenty-First International Joint Conference on Artificial Intelligence AI Video Competition* (IJCAI-2009, Pasadena, CA).

Jeff Balogh*, Greg Dubbin*, Michael Do*, and Kenneth O. Stanley (2007). Dance Evolution.. In: *Proceedings of the Twenty-Second National Conference on Artificial Intelligence AI Video Competition* (AAAI-2007, Vancouver, BC, Canada). Menlo Park, CA: AAAI Press.

Best Student Video Award

Invited Talks and Presentations

“Evolutionary Complexity Research Group Research Overview.” **NAVAIR**, Orlando, FL, November 2, 2009.

“Abandoning Objectives and the Search for Novelty.” **Invited Plenary for the Exploring New Horizons in Evolutionary Design of Robots Half-day Workshop at the 2009 IEEE/RSJ International Conference on Intelligent RObots and Systems (IROS 2009)**, St. Louis, MO, October 11, 2009.

- “Compositional Pattern Producing Networks: Abstracting Local Interaction and Growth Out of Development.” **Invited talk at the 13th Evolutionary Biology Meeting at Marseilles**, Marseille, France, September 22, 2009.
- “Galactic Arms Race and Automatic Content Generation.” **Valve Software**, Bellevue, WA, March 6, 2009.
- “Abandoning Objectives and the Search for Novelty.” **Invited talk for the UCF Artificial Intelligence Forum**, Orlando, FL, February 12, 2009.
- “A Novel Biological Abstraction for the Encoding and Evolution of Form and Neural Structure.” **Invited talk for *Machines and Organisms Seminar Series* at Cornell University**, Ithica, NY, December 4, 2008.
- “Abstracting Biological Development to Evolve Large-Scale Artificial Neural Networks.” **Invited Plenary for the 18th International Conference on Artificial Neural Networks (ICANN 2008)**, Prague, Czech Republic, September 6th, 2008.
- “Evolutionary Computation, Neuroevolution, and NEAT.” **Burnett Honors College Summer Institute**, Orlando, FL, July 25, 2008.
- “NeuroEvolution of Augmenting Topologies (NEAT) Open Source Software.” **Second Open-Source Software for Applied Genetic and Evolutionary Computation (SoftGEC) Workshop, Genetic and Evolutionary Computation Conference (GECCO-2008)**, Atlanta, GA, July 12, 2008.
- Various Topics and Panels, **2007 DARPA Information Science and Technology (ISAT) study group**, Arlington, VA, Boston, MA, and Berkeley, CA (several meetings), Winter and Spring, 2007.
- “NeuroEvolution of Augmenting Topologies (NEAT) Open Source Software.” **Open-Source Software for Applied Genetic and Evolutionary Computation (SoftGEC) Workshop, Genetic and Evolutionary Computation Conference (GECCO-2007)**, London, U.K., July 7, 2007.
- “Multi-agent Evolution in The NERO Video Game.” **Evolutionary Computation and Multi-Agent Systems and Simulation (ECoMASS) Workshop, Genetic and Evolutionary Computation Conference (GECCO-2007)**, London, U.K., July 7, 2007.
- “Neural Networks and Evolutionary Computation in Video Games.” **Electronic Arts**, Vancouver, BC, Canada, June 18, 2007.
- “Practical Issues in Evolving Neural Network Controllers for Video Game Agents.” Invited tutorial for **IEEE Computational Intelligence and Games Symposium**, Honolulu, HI, April 1, 2007.
- “Neural Networks and Evolutionary Computation in Video Games.” **Electronic Arts**, Orlando, FL, February 1, 2007.
- “NERO.” **Google Zeitgeist Science Fair, Google Headquarters**, Mountain View, CA, October 3-5, 2006. From Google’s description of Zeitgeist: “...over 400 of the world’s top business and creative minds will take an in-depth look at the signs of the times that impact arenas such as marketing, advertising, and technology.”
- “Real-time Neuroevolution of Augmenting Topologies for Interactive Simulations.” **Environmental Tecnics Corporation ADMS Innovation Center**, Orlando, FL, July 31, 2006
- “NERO.” **Burnett Honors College Summer Institute**, Orlando, FL, July 28, 2006

- “Complexification in Coevolution,” **AAAI Fall Symposium on Coevolutionary and Coadaptive Systems**, Arlington, Virginia, November 4, 2005.
- “Neuroevolution of an Automobile Crash Warning System,” **Toyota Higashifuji Technical Center**, Mishuku, Japan, September 27, 2005.
- “A Taxonomy of Developmental Systems,” **Scalable, Evolvable, Emergent Design and Developmental Systems (SEEDS) Workshop, Genetic and Evolutionary Computation Conference (GECCO-2005)**, Washington D.C, June 26, 2005.
- “NERO.” **Experimental Gameplay Workshop, Game Developers Conference (GDC 2005)**, San Francisco, CA, March 10, 2005
- “Complexification and Artificial Embryogeny.” **Crowley Davis Research Inc.**, Eagle, Idaho, December 7, 2004.
- “Applications of NeuroEvolution of Augmenting Topologies.” **Computer Science Department, University of Trondheim, Norway**, September 27, 2004.
- “Efficient Evolution of Neural Networks through Complexification.” **Cognitive Science Seminar Series, University of California, San Diego**, November 20, 2003.
- “Efficient Evolution of Neural Networks through Complexification.” **Computer Science Department, University of California, Los Angeles**, November 17, 2003.
- “Competitive Coevolution of Complexifying Neural Networks for Video Games.” **2nd Annual Game Development Workshop on Artificial Intelligence, Interactivity, and Immersive Environments**, Austin, TX. August 21, 2003.
- “Neuroevolution: Can Artificial Brains Be Evolved?” **Forum for Artificial Intelligence, University of Texas at Austin**. March 10, 2000.

Patents

Patents Granted:

- Sherony, R., Miikkulainen, R., Stanley, K. O., and Kohl, N. (Patent Granted November, 2009). Crash Prediction Network with Visual Input for Vehicle. United States Patent 7,613,569.
- Sherony, R., Miikkulainen, R., Stanley, K. O., and Kohl, N. (Patent Granted July, 2009). Crash Prediction Network With Graded Warning for Vehicle. United States Patent 7,565,231.
- Stanley, K. O., Miikkulainen, R. (Patent Granted July, 2009). Method and Apparatus for Providing Real-time Machine Learning to Computer-controlled Agents Used in Video Games United States Patent 7,559,843.
- Evan Kirshenbaum, Kenneth O. Stanley, and Bin Zhang (Patent Granted January, 2006). Deriving a genome representation for evolving graph structure weights United States Patent 6,988,089. Hewlett-Packard Corporation.

Patents Pending:

- Erin Hastings and Kenneth O. Stanley (Provisional Patent Pending since 2009). *Evolutionary Content Generation*. University of Central Florida

- Amy Hoover (Undergraduate student), Michael Rosario (former Masters student), and Kenneth O. Stanley (Patent Pending since July, 2008). *System and Method for Evolving Music Tracks*. University of Central Florida

Teaching

New Courses Developed:

- CAP 4053 AI for Game Programming (originally taught as Special Topics: AI for Game Programming in Spring 2008)
- CAP 6616 Neuroevolution and Generative and Developmental Systems (originally taught as Special Topics in NeuroEvolution and Developmental Encoding in Spring 2006)

Graduate:

- Neuroevolution and Generative and Developmental Systems (CAP 6616; Fall 2009)
- Neuroevolution and Generative and Developmental Systems (CAP 6616; Fall 2008)
- Neuroevolution and Generative and Developmental Systems (CAP 6616; Fall 2007)
- Machine Learning (CAP 5610; Spring 2007)
- Special Topics in NeuroEvolution and Developmental Encoding (CAP 6938; Spring 2006, Fall 2006)

Undergraduate:

- AI for Game Programming (CAP 4053; Spring 2010)
- AI for Game Programming (CAP 4053; Spring 2009)
- AI for Game Programming (CAP 4938 Special Topics; Spring 2008)
- Machine Learning II (EEL 4817; co-taught with Prof. Ronald DeMara and Prof. Michael Georgiopoulos; Spring 2007)
- Machine Learning I (EEL 4818; co-taught with Prof. Ronald DeMara and Prof. Michael Georgiopoulos; Fall 2006) Contributed 5 lectures.

Informal Seminars:

- *Evolutionary Complexity Research Group*, meeting most weeks since January 2006.

Students Supervised

At University of Central Florida

Graduate Students Graduated:

- Erin Hastings (Ph.D.; co-advisor with Prof. Ratan Guha; starting August 2006, graduated August 2009). Dissertation title: *Interactive Evolution of Computer Graphics Content*. Current position: Software Engineer, Alion Science and Technology, Orlando, FL.
- Adelein Rodriguez (Masters; co-advisor with Prof. Annie Wu starting May 2006, graduated December 2007). Thesis title: *A NEAT Approach to Genetic Programming*.

Undergraduate Honors Students Graduated:

- Greg Dubbin (Honors in the Major; started January 2008, passed April 2009). Title: *Dance Evolution: Interactively Evolving Neural Networks to Control Dancing Three-Dimensional Models*
- Amy Hoover (Honors in the Major; started January 2007, passed November 2008). Title: *NEAT Drummer: Computer-Generated Drum Tracks*.

Current Advising (Ph.D.):

- Brian Woolley (since August 2009).
- Amy Hoover (since August 2009).
- Sebastian Risi (since August 2008).
- Joel Lehman (since August 2007, passed qualifier).
- Phillip Verbancsics (since September 2006, passed qualifier).
- Jason Gauci (since May 2006, passed qualifier, passed proposal).
- David D'Ambrosio (since January 2006, passed qualifier, passed proposal).

Current Advising (Honors in the Major):

- Randy Olson (since September 2009)

Dissertation Committee Member for: Gautham Anil (Drs. Wu and Wiegand), Hansen Schwartz (Dr. Gomez), Elena Erbiceanu (Dr. Hughes), Saad Ali (graduated 2007; Dr. Shah), Craig Chanslor (I am external reader for his Masters under Wouter van Oortmerssen at Guildhall SMU), Benjamin Inden (graduated 2007; I am external committee member for his Ph.D. under Peter F. Stadler at University of Leipzig, Germany), Victor Hung (Dr. Gonzalez), Linus Luotsinen (graduated 2007; Dr. Boloni), Gary Stein (graduated 2009; Dr. Gonzalez)

Undergraduate Honors Thesis Committee Member for: Gary Williams (passed provisionally November 2008)

At the University of Texas at Austin

Co-supervised 4 senior undergraduate students (with Prof. Miikkulainen) and a team of undergraduate programmers:

- NERO Programming Team, 10/2003-12/2005. Over a dozen undergraduates worked on the NERO project as volunteer programmers under my supervision.
- Ryan Cornelius, since 9/2004.
Independent study project, *Initializing NEAT from a Finite State Machine*.
- Joseph Reisinger, 1/2003-5/2004.
Honors thesis project, *Modular NEAT*. Winner of a CRA Outstanding Undergraduate Awards Honorable Mention, a VIGRE grant from the Department of Mathematics, and a UROP award from the Department of Computer Sciences.
- Kennon Ballou, 5/2001-8/2001.
Independent study project, *Species-Specific Variable Mutation Rates in NEAT*.
- Timothy Andersen, 9/2001-5/2002.
Independent study project and Honors thesis project, *Neuro-Evolution through Augmenting Topologies Applied To Evolving Neural Networks To Play Othello*.

Other Educational Contributions

- **Educational Partnership with Electronic Arts (EA):** Visitors from EA spoke to my *AI for Game Programming* (CAP 4053) course in 2008 and 2009
- **Participating Faculty:** NSF Advances of Machine Learning in Theory & Applications (NSF AMALTHEA) Summer Program for Undergraduates at UCF (organized by Drs. Georgios C. Anagnostopoulos and Michael Georgiopoulos). (Summer 2008)
- **Guest Lecturer:** Burnett Honors College Summer Institute (2006, 2008)

Grants and Funding

Funded

Defence Advanced Research Projects Agency Computer Science Study Group Phase 2, “Scalable Heterogeneous Multiagent Teams through Learning Policy Geometry,” May 2009 – May 2011, \$424,605.00. (I am only PI)

Defence Advanced Research Projects Agency Computer Science Study Group Phase 1, “Machine Learning and Control through Neuroevolution,” January 2008 – December 2008, \$99,980.00. (I am only PI)

Toyota USA Foundation, Unrestricted Gift to Lab (2008), \$45,000.(I am only PI)

Toyota USA Foundation, “Predicting Vehicle Behavior in Traffic 2,” January 1st 2008 – June 1st 2008, \$12,686. (I am PI)

Dr. Charles Bailey, Unrestricted Gifts to Lab (2008), \$26,850. (I am only PI; separate gifts received in April, May, and August)

Toyota USA Foundation, “Predicting Vehicle Behavior in Traffic,” June 1st 2007 – September 30th 2007, \$28,225. (I am only PI)

Funded (Prior to UCF)

Fellowship and Funded Project Proposal: *Neuroevolution-based Video Game.* IC2 Institute Digital Media Collaboratory, Since October 2003.

Proposal delivered at the 2nd Annual Game Development Workshop on Artificial Intelligence. Based on the proposal, the IC2 Institute at the University of Texas committed to fund and support the development of the pioneering neuroevolution-based video game NERO. IC2 formed a project team of institute employees and student volunteers, including posts for project management, design, programming, art, and artificial intelligence. The game uses rtNEAT as its core AI technology. NERO continues to be developed as a special class on game design at the University of Texas at Austin.

Significant Contribution to Grant Proposal: *Collision Avoidance through Neuroevolution Reinforcement Learning.* Toyota Corporation, September 1, 2003 – August 31, 2005, \$333,750. Principal Investigator: Risto Miikkulainen.

Significant Contribution to Grant Proposal: *Cooperative Coevolution of Neural Networks in Sequential Decision Tasks.* National Science Foundation #IIS-0083776, September 5th 2000 – August 31st 2003, \$419,114. Principal Investigator: Risto Miikkulainen.

Professional Activities

Service to the Department, College, and University:

Department Committees: EECS IAB Awards Committee (2009), Curriculum Oversight and Review Committee (2008-), Intelligence Systems and Machine Learning Committee (2007-), Graduate and Research Committee (2006-2009), Fellowship Committee for UCF I2 Lab Fellowship (2006).

Senior Design Reviewer for CPE (2009)

UCF AI Forum student group started and advised by myself and Prof. Annie Wu (2008-)

Service to the Profession:

Program Committee Member for 2010 *IEEE Conference on Computational Intelligence and Games (CIG'10)*, *The Eleventh International Conference on the Simulation of Adaptive Behavior (SAB-2010)*, *Genetic and Evolutionary Computation Conference (GECCO-2010)*, *8th European Event on Evolutionary and Biologically Inspired Music, Sound, Art and Design (EvoMUSART 2009)*, *2009 IEEE Symposium on Computational Intelligence and Games (CIG'09)*, *Twenty-first International Joint Conference on Artificial Intelligence (IJCAI-09) Video Competition*, *Twenty-first International Joint Conference on Artificial Intelligence (IJCAI-09)*, *7th European Workshop on Evolutionary and Biologically Inspired Music, Sound, Art and Design (EvoMUSART 2009)*, *2009 IEEE Congress on Evolutionary Computation (IEEE CEC 2009) Special Session on Evolutionary Development*, *AAAI-08 AI Video Competition*, *2008 IEEE Symposium on Computational Intelligence and Games (CIG'08)*, *European Conference on Complex Systems (ECCS'07)*, *The Twenty-Second National Conference on Artificial Intelligence (AAAI-2007)*, *Fourth International Symposium on Neural Networks (ISSN 2007)*, *Genetic and Evolutionary Computation Conference (GECCO-2006)*, *Genetic and Evolutionary Computation Conference Complexity through Development and Self-Organizing Representations (CODESOAR) Workshop* (2006), *AAAI Fall Symposium on Developmental Systems* (2006), *Genetic and Evolutionary Computation Conference (GECCO-2005)*, and *Genetic and Evolutionary Computation Conference (GECCO-2004)*

Reviewer for *Artificial Life* (2004), *BioSystems Journal* (2001), *The Computer Journal* (2010), *Evolutionary Intelligence* (2008), *Genetic Programming and Evolvable Machines* (2006 Special Issue on Developmental Systems, 2008), *IEEE Systems, Man and Cybernetics - Part B* (2003, 2007), *IEEE Transactions on Evolutionary Computation* (2003, 2005, 2006, 2008, 2009), *IEEE Transactions on Image Processing* (2006, 2007), *IEEE Transactions on Neural Networks* (2007), *Information Fusion Journal* (2004, 2005), *International Journal of Neural Systems* (2005), *JMLR* (2004, 2005, 2007), *Machine Learning* (2009), *Neural Computation* (2002, 2003), Book Chapter in *Springer Book on Foundations of Computational Intelligence* (2008), Book Chapter in *Springer's Series in Studies in Computational Intelligence* (2007), *Theory in Biosciences* (2007).

Professional Societies: ACM SIGEVO (formerly ISGEC; since 2001), American Association for Artificial Intelligence (since 2000)

Task Force Chair of *IEEE Task Force on Computational Intelligence in Video Games* since 2007

Track Co-Chair and Co-Founder of the new *Generative and Developmental Systems Track* at the Genetic and Evolutionary Computation Conference (GECCO-2007, 2008, and 2009).

Organizer of the *Generative and Developmental Systems Tutorial* at the *Genetic and Evolutionary Computation Conference (GECCO 2008, 2009, 2010)*

Organizer of the *Generative and Developmental Systems Workshop* at the *Genetic and Evolutionary Computation Conference (GECCO 2009)*

Organizer of the *Practical Issues in Evolving Neural Network Controllers for Video Game Agents Tutorial* at the *IEEE Symposium on Computational Intelligence and Games (2007,2009)*

Organizer of the *Advanced Coevolution Tutorial* (with Anthony Bucci, Edwin De Jong, Sevan Ficici, and Paul Wiegand) at the *Genetic and Evolutionary Computation Conference (GECCO, 2006 and 2007)*

Invited VIP Member of AIGameDev.com website for AI game programming community (2008)

Discussion Panels

Understanding Coevolution Workshop, *Genetic and Evolutionary Computation Conference (GECCO-2002, New York, NY), July 2002.*

Panel on Novel Uses of AI in Video Games, *2nd Annual Game Development Workshop on Artificial Intelligence, Interactivity, and Immersive Environments, August, 2003.* (Proposed a neuroevolution-based video game)

Coevolution Discussion Forum, *Genetic and Evolutionary Computation Conference (GECCO-2005, Washington D.C.), June 2005.*

Task Force Member of *IEEE Task Force on Coevolution* since 2003

Editorial Service

Associate Editor of *IEEE Transactions on Computational Intelligence and AI in Games* since 2008

Other External Professional Service Activities

European Research Area Network (ERA-NET) Complexity-NET Panelist in 2010

NSF (Information and Intelligent Systems) Panelist in 2009

DARPA ISAT Study Group in 2007

Other Professional Activities

Co-Chair of the *Forum for Artificial Intelligence* at the University of Texas at Austin. 1/2001-5/2002. Planned and organized all aspects of talk series with invited speakers every two weeks.

Impact and Publicity

NEAT is the primary machine learning technique used to obtain **the most accurate measurement to date of the top quark at the Fermilab Tevatron particle accelerator**; reported in a top physics journal: T. Aaltonen, et al. (over 100 authors). Measurement of the top quark mass with dilepton events selected using neuroevolution at CDF. *Physical Review Letters* 102:152001 (2009).

NEAT is the featured method (given 54 pages) in the final chapter of the book: *AI Techniques for Game Programming*, by Mat Buckland, Premier Press, 2002.

Eight publicly available software versions of NEAT have been produced by independent programmers:

- *Java NEAT* (released 6/02) by Ugo Vierucci, available at:
[http://www.cs.utexas.edu/users/nn/soft-view.php?RECORD_KEY\(Software\)=SoftID&SoftID\(Software\)=5](http://www.cs.utexas.edu/users/nn/soft-view.php?RECORD_KEY(Software)=SoftID&SoftID(Software)=5)
- *Windows NEAT* (released 9/02) by Mat Buckland, available at:
[http://www.cs.utexas.edu/users/nn/soft-view.php?RECORD_KEY\(Software\)=SoftID&SoftID\(Software\)=6](http://www.cs.utexas.edu/users/nn/soft-view.php?RECORD_KEY(Software)=SoftID&SoftID(Software)=6)
- *Matlab NEAT* (released 8/03) by Christian Mayr, available at:
[http://www.cs.utexas.edu/users/nn/soft-view.php?RECORD_KEY\(Software\)=SoftID&SoftID\(Software\)=23](http://www.cs.utexas.edu/users/nn/soft-view.php?RECORD_KEY(Software)=SoftID&SoftID(Software)=23)
- *Delphi NEAT* (released 1/04) by Mattias Fagerlund, available at:
<http://www.hypeskeptic.com/Mattias/DelphiNEAT/>
- *SharpNEAT* (released 4/04) by Colin Green, available at:
<http://sharpneat.sourceforge.net/>
- *ANJI: Another NEAT Java Implementation* (released 9/04) by Derek James and Philip Tucker, available at: <http://anji.sourceforge.net/>
- *NEAT4J* (released 9/06) by Matt Simmerson, available at: <http://neat4j.sourceforge.net/>
- *NEAT Python* (released 5/08) by Cesar G. Miguel and Carolina Feher da Silva, available at:
<http://code.google.com/p/neat-python/>

Derek James founded (in August 2003) and continues to run an active **NEAT Users Group** (messages have been posted every month since inception) with over **450 registered members** from around the world at: <http://groups.yahoo.com/group/neat>

Over **100,000** NERO software downloads since 6/2005 (see <http://www.nerogame.org>)

Over **10,000** GAR software downloads since 7/2009

Interviews:

2/20/09: Central Florida Future. Interviewed for article on Galactic Arms Race.

12/11/08: aigamedev.com (AI for Game Development Website). Interviewed about our video game project, *Galactic Arms Race*, which evolves its own spaceship weapons systems. Transcript at: <http://aigamedev.com/interviews/galactic-arms-race>

9/30/06: biota.org (Artificial Life Community Website) Biota.org keeps an archive of recorded podcast interviews with prominent individuals in the artificial life community.

5/23/05: KXAN News Austin (channel 36) about NERO on 5/23/05. Partial transcript posted on the web: <http://www.kxan.com/Global/story.asp?S=3381601&nav=0s3caC93>

NERO received worldwide media coverage after its release:

- Slashdot 6/27/05: “AI researchers produce new kind of PC game.”
<http://games.slashdot.org/article.pl?sid=05/06/27/2129214&tid=206&tid=10>
- GarageGames News 6/27/05: “University of Texas uses Torque for AI game experiment.”
<http://www.garagegames.com/news/8129>
- Gamasutra 7/12/05: “Round-Up: NERO Fiddles, Germans Write, Pixel Corps.”
http://www.gamasutra.com/php-bin/news_index.php?next=5926&st=6927
- University of Texas Dept. of Computer Sciences Promotional Media, 6/2005: “Meet Dr. Kenneth Stanley and his virtual robots who learn.”
http://oea.cs.utexas.edu/imagine/ken_stanley/index.html
- University of Texas Featured Project 7/21/05: “Neural networks research produces NERO, a game in which characters get smarter.”
<http://www.utexas.edu/research/projects/nero.html>

- MIT Technology Review Blog by Brad King 6/28/05: “UT Game Group Unveils AI Project.”
http://king.trblogs.com/archives/2005/06/ut_game_group_u.html
- American Assoc. for Artificial Intelligence (AAAI) video games page: Untitled paragraph on NERO.
<http://www.aaai.org/AITopics/html/video.html>
- Generation5 6/25/05: “NeuroEvolving Robotic Operatives (NERO).”
<http://www.generation5.org/news.asp?Action=Full&ID=766>
- MSNBC Blog 6/30/05: “What are friends for?” Article mentions NERO.
<http://www.msnbc.msn.com/id/8382695/>
- Nano News Press Releases 6/29/05: “The New Genre of Video Games.”
<http://www.thenanotechnologygroup.org/index.cfm?Content=88&PressID=194>
- Belgium; Tweakers.net 6/28/05: “Wetenschappers ontwikkelen nieuw computerspel.”
<http://www.tweakers.be/nieuws/37837?t=1119994875>
- France; ZDNet “Innovons” Blog 6/28/05: “NERO.”
<http://blogs.zdnet.fr/index.php/2005/06/28/nero/>
- Germany; Computer Magazine “ct” (in print) 7/2005: “Intelligenter spielen fur die Wissenschaft (Playing more intelligently for science),” p.59.
<http://www.heise.de/ct/>
- Germany; PC Action Magazine (in print) 9/2005: “NERO,” p.128.
<http://www.pcaction.de/>
- Germany; 4players.de 6/28/05: “Nero macht euch zum Militar-Ausbilder.”
http://www.4players.de/4players.php/dispcnews/PC-CDROM/Aktuelle_News/43212.html
- Germany; Golem.de IT News 6/28/05: “Spiel von KI-Forschern: Roboter ausbilden und kmpfen lassen.”
<http://www.golem.de/0506/38899.html>
- Germany; Windows mobile News 6/30/05: “NERO: Neuro Evolving Robotic Operatives.”
<http://www.pocketpc-salzburg.at/modules.php?name=AvantGo&file=print&sid=742>
- Hungary; Tech-tudomány 6/28/05: “Neveljen robothadsereget!”
<http://index.hu/tech/szoftver/nero0628/>
- Latvia; Fizmati 6/29/05: “Studenti rada jauna tipa speli.”
http://www.fizmati.lv/zinas/datorika/studenti_rada_jauna_tipa_speli/
- Netherlands; Gamer.nl 7/3/05: “Train kunstmatige intelligentie in gratis RTS NERO.”
<http://www.gamer.nl/nieuws/26841>
- Portugal; Nogome 7/2005: “Project NERO: jogos.”
<http://www.nogome.com/nogome/archives/001130.php>
- Russia; All-Games.ru 7/4/05:
<http://www.all-games.ru/news/2005/07/04/nn6892.html>
- Russia; IGROMANIA (in print) 8/2005:
<http://www.igromania.ru/>
- UK; Games Digest 7/2005: “AI researchers show off new game type.”
http://www.games-digest.com/2005/07/ai_researchers_.html
- UK; Guardian Unlimited Blog 6/28/05: “New game genre invented by boffins?”
http://blogs.guardian.co.uk/games/archives/2005/06/28/new_game_genre_invented_by_boffins.html#more

- UK; Personal Computer World 7/1/05: “Gaming revolution as players train computers.”
<http://www.pcw.co.uk/vnunet/news/2139176/games-artificial-intelligence>

Galactic Arms Race received worldwide media coverage after its release:

- Slashdot 7/8/09: “ Experimental Video Game Evolves Its Own Content.”
<http://games.slashdot.org/story/09/07/08/1419242/Experimental-Video-Game-Evolves-Its-Own-Content>
- Gamasutra 7/27/09: “Analysis: The Game Design Lessons Of Permadeath.”
http://www.gamasutra.com/php-bin/news_index.php?story24468
- All Your Game Are Belong to Us 7/31/09: “GAR Galactic Arms Race.”
<http://allyourgamearebelongtous.blogspot.com/search/label/shooters>
- Armchair Arcade 7/12/09: “Applying evolutionary algorithms to gameplay to increase variety.”
<http://armchairarcade.com/neo/node/2741>
- Crispy Gamer 7/8/09: “Galactic Arms Race: changing content generation in online games.”
<http://www.crispygamer.com/news/index.php/2009-07-08/galactic-arms-race-changing-content-generation-in-online-games/>
- Offworld 7/9/09: “Thinking: Galactic Arms Race, ‘Space Diablo’ with AI-designed, evolving weapons.”
<http://www.offworld.com/2009/07/its-thinking-galactic-arms-rac.html>
- Blue’s News 7/9/09: “The Evolving Galactic Arms Race.”
<http://www.bluesnews.com/s/99826>
- Central Florida Future 2/19/09: “Student develops NEAT video game.”
<http://www.centralfloridafuture.com/student-develops-neat-video-game-1.1487037>
- PC Games Hardware (German) 7/9/09: “Revolution oder Evolution: Galactic Arms Race von US-Forschern.”
<http://www.pcgameshardware.de/aid,689544/Revolution-oder-Evolution-Galactic-Arms-Race-von-US-Forschern/Spiele/News/>
- PC Games (German) 7/9/09: “Galactic Arms Race: Revolutionieren US-Forscher die Welt der Computerspiele?”
<http://www.pcgames.de/aid,689464/Galactic-Arms-Race-Revolutionieren-US-Forscher-die-Welt-der-Computerspiele/PC/News/>
- Le Monde (French) 12/9/09: “Des jeux vido sur mesure.”
http://www.lemonde.fr/technologies/article/2009/12/09/des-jeux-video-sur-mesure_1277579_651865.html

Software Released

Galactic Arms Race (GAR) video game demonstrates novel AI technology invented at UCF called content-generating NEAT (cgNEAT). Released July 2009. The game generates its own new content (particle system weapons) based on player actions. Research on GAR won several awards: Best Paper Award at CIG-2009, AIGameDev.com Best AI in an Independent Game (Editor’s Pick), and Indie Game Challenge Finalist. Available at: <http://gar.eecs.ucf.edu/>

Novelty Search C++ software implements the novelty search algorithm introduced by Joel Lehman and Kenneth O. Stanley. Released Spring 2008. Supervised creation of software package by Joel Lehman (Ph.D. student). Available at: <http://eplex.cs.ucf.edu/software.html#noveltysearch>

HyperSharpNEAT (Hypercube-based NeuroEvolution of Augmenting Topologies software extended from Colin Green's original SharpNEAT source code). Released Winter 2007. Last update (v1.0) December 2007. Supervised creation of software package by David D'Ambrosio (Ph.D. student). Available at: http://eplex.cs.ucf.edu/index.php?option=com_content&task=view&id=17&Itemid=32

Dance Evolution software for interactively evolving three-dimensional dancers that can dance to MIDI songs. Released November 2007. Supervised creation by three undergraduates: Greg Dubbin, Jeff Balogh, and Michael Do. Available at: http://eplex.cs.ucf.edu/dance_evolution/

Picbreeder website for collaborative interactive evolution of images. Released August 2007. Continually updated. Supervised creation interactive online service by team of five graduate students: Jimmy Secretan, Nick Beato, Adam Campbell, David D'Ambrosio, and Adelein Rodriguez. Available at: <http://picbreeder.org>

HyperNEAT (Hypercube-based NeuroEvolution of Augmenting Topologies) software for evolving highly complex large-scale neural networks. Released Spring 2007. Last update (v1.0) April 2007. Supervised creation of software package by Jason Gauci (Ph.D. student). Available at: http://eplex.cs.ucf.edu/index.php?option=com_content&task=view&id=17&Itemid=32

NEAT Particles software for interactively evolving particle effects for movies, video games, and simulations. Released Spring 2007. Last update (v1.0) April 2007. Supervised creation of software package by Erin Hastings (Ph.D. student). Available at: http://eplex.cs.ucf.edu/index.php?option=com_content&task=view&id=17&Itemid=32

rtNEAT (Real-time NeuroEvolution of Augmenting Topologies) Software for evolving neural network topologies and weights in real-time interactive games and simulations. Released Spring 2006. Available at: <http://www.cs.utexas.edu/users/nn/keyword?rtNEAT>

NERO (NeuroEvolving Robotic Operatives) video game software using real-time NEAT (rtNEAT) as its core AI technology. The player can train virtual robots to perform tasks in real time. Released June 2005. Available at: <http://www.nerogame.org>

NEAT (NeuroEvolution of Augmenting Topologies) software for evolving neural network topologies and weights. Released Summer 2001. Last update (v1.1) July 2002. Available at: [http://www.cs.utexas.edu/users/nn/soft-view.php?RECORD_KEY\(Software\)=SoftID&SoftID\(Software\)=4](http://www.cs.utexas.edu/users/nn/soft-view.php?RECORD_KEY(Software)=SoftID&SoftID(Software)=4)