Andrew L. Nelson, Ph.D.

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Education

Ph.D. (2003) Electrical Engineering, North Carolina State University, Raleigh, North Carolina. Title of Dissertation: **"Competitive Relative Performance and Fitness Selection for Evolutionary Robotics,"** under the direction of Dr. Edward Grant.

M.S. (2000) Electrical Engineering, North Carolina State University, Raleigh, North Carolina. Title of Thesis: **"Characterization of Winding Faults in Axial Flux Reluctance Motors in the Context of Electric Vehicle Propulsion Systems."**

B.S. (1990) The Evergreen State College, Olympia, Washington, concentration in Computer Science and secondary concentration in Art.

Technical Employment History

Jan. 2005-Present: Staff researcher, Androtics LLC. (P.O. box 44065, Tucson, AZ 85733-4065, U.S.A.)

Duties include planning and preliminary inception of research and business plan, design and fabrication of prototype robots, review of related research and preparation of scholarly research publications.

Accomplishments published 5 peer-reviewed research papers, articles and book chapters, designed and fabricated a teleoperated service robot with integral gripper, preparation of a literature summary document covering over 800 references, and worked with other founding members to incorporate as an LLC.

Oct. 2003-Dec. 2004: Visiting Research Faculty, Department of Computer Science and Engineering, University of South Florida. (Computer Science & Engineering, University of South Florida, ENB 118, 4202 E. Fowler Ave., Tampa, FL 33620-5399, U.S.A.)

Duties included autonomous robot control design and implementation, preparation of scholarly research publications, collaboration with other research groups, and preparation of new research proposals.

Accomplishments included publication of 3 peer-reviewed articles, implementation of an outdoor autonomous robot control navigation and obstacle avoidance system, and preparation and submission of 2 research proposals.

Aug. 2000-Sept. 2003: Research Assistant, PhD. degree candidate, Center for Robotics and Intelligent Machines (CRIM), Laboratory of Dr. Edward Grant, The Center for Robotics and Intelligent Machines, North Carolina State University. (Dept. ECE, North Carolina State University, Campus Box 7911, Raleigh, NC 27695-7911, U.S.A.)

Duties included research using artificial neural networks to control autonomous robots and preparation of scholarly research publications. Further duties included design of software and hardware components used in a swarm of small autonomous research robots (the EvBots), and the design and coding of a related vision-based simulation software application.

Accomplishments included publication of 8 peer-reviewed articles, presentations at technical conferences, design and development of an autonomous control architecture and simulation environment written in MATLAB for a colony of small research robots, development of a robot vision system and tactile sensor system, and design and fabrication of an indoor robot testing arena with overhead video tracking system.

June 2000-Aug. 2000: Analog Design Intern, Unitrode division of Texas Instruments. (111 Corning Rd, Cary, NC 27511, U.S.A.)

Duties included simulation of VLSI circuits containing both analog and digital components, simulation of transformer design for use in battery charging products, and documentation of product development.

Accomplishments included the design of a mixed analog-digital battery charger controller for charging Li-ion batteries.

Aug. 1998-June 2000: Teaching Assistant, MS degree candidate, Department of Electrical and Computer Engineering at North Carolina State University. (Dept. ECE, North Carolina State University, Campus Box 7911, Raleigh, NC 27695-7911, U.S.A.)

Duties included teaching undergraduate laboratory courses including Introductory and Intermediate electric circuits, as well as grader and teaching assistant for graduate level classes in control theory. Research related to electric propulsion systems for electric vehicles was also conducted and included advising an undergraduate research group.

Accomplishments included the design, fabrication, and testing of a research scale 7-phase permanent magnet brushless DC electric motor. The research was published in a peer-reviewed archival journal.

May 1997--Aug. 1998: Molecular Biology Laboratory Technician: Cystic Fibrosis Center, The laboratory of Dr. Scott Randell, University of North Carolina School of Medicine. (University of North Carolina, 7011 Thurston-Bowles Bldg, CB 7248, Chapel Hill, NC 27599-7248, U.S.A., phone: (919) 966-8093.)

Duties included molecular biology laboratory work including PCR (polymerase chain reaction) DNA amplification, DNA isolation, Southern blots, tissue culture, microscopy imaging, radiological assays, and preparation of results for publication.

Accomplishments included publication of one peer-reviewed article as well as completion of several research studies related to the expression of CF-related genes in bronchial tissue.

Aug. 1997-Dec. 1997: Electrical Engineering Intern: AVX division of Kyocera. (801 17th Ave. South, P.O. Box 867, Myrtle Beach, SC 29578-0867, U.S.A., phone: 843-448-9411.)

Duties included automation line maintenance, ABB industrial robotic manipulator programming, Ladder Logic programming, upgrading manufacturing equipment, and installation of video-based quality monitoring components on production lines.

Accomplishments included upgrade of an industrial manufacturing-line robot control program, the upgrade of several ceramic capacitor manufacturing machines, and the installation of a vision-based quality assurance system.

Jan. 1996-May 1997: Full time student fulfilling requirements for entry into the Graduate program at the Department of Electrical and Computer Engineering at North Carolina State University, Raleigh, North Carolina.

Jan. 1992-Dec. 1995: Cell Biology Laboratory Technician: The laboratories of Dr. Keith Burridge, Cytoskeletal Signaling Research, Department of Cell Biology and Anatomy, University of North Carolina at Chapel Hill. (Department of Cell Biology and Anatomy, University of North Carolina, CB 7090, Chapel Hill, NC 27599, U.S.A., phone: (919) 966-5783.)

Duties included cell biology laboratory work including protein isolation, tissue culture, fluorescence microscopy, the production of monoclonal antibodies, electrophoresis, Western blots, the development of a radiological protein enzyme activity assay, scientific photography, preparation of research results for presentation and publication, and general lab maintenance.

Accomplishments included publication of one peer-reviewed article, the design and testing of a system for visualizing stress generated by cells growing on silicon-rubber substrates, numerous protein purifications, completion of several sets of experiments related to cell signaling involving phosphorilation of signaling molecules, and various other cell biology research projects.

Skills

Engineering and Computer Skills:
Matlab, Simulink, HTML, Windows, Visio, Linux/UNIX, BasicX, LabView, National Instruments, neural networks and soft computing, machine learning, machine design, machine prototyping, image processing.

Research and Publication Skills:
Research design, scientific writing, technical writing, publication preparation, web publication, peer reviewing, literature survey, grant preparation, technical presentation, tutorial presentation, lecture preparation.

Representative Publications

A.L. Nelson, E. Grant, "Aggregate selection in evolutionary robotics," in *Mobile Robots: The Evolutionary Approach*, eds. N. Nedjah, L. Coelho, L. Mourelle, Studies in Computational Intelligence , Vol. 50, pp. 63-88, Springer, 2007.

A.L. Nelson, B.L. Bailey, "What can life on earth tell us about artificial life and the creation of autonomous agents?" *Theoria et Historia Scientiarum, Special issue of on Artificial Life*, in press, vol. 8, no. 1, The Nicolaus Copernicus University Press, 2007.

A.L. Nelson, E. Grant, "Using direct competition to select for competent controllers in evolutionary robotics," *Robotics and Autonomous Systems*, vol. 54, no. 10, pp. 840-857, Oct. 2006.

A.L. Nelson, E. Grant, "Developmental analysis in evolutionary robotics," in *Proceedings of the 2006 IEEE SMC Mountain Workshop on Adaptive and Learning Systems (SMCals'06)*, July 2006, pp. 201-206.

N.B. Almutairi, M.T. Alrifai, A.L. Nelson "Position Control of an Axial Flux Variable Reluctance PM Motor Using Fuzzy Logic," *ACSE International Journal on Automatic Control and Systems Engineering*, vol. 5, no. 4, Dec., 2005.

A.L. Nelson, E. Grant, T.C. Henderson, "Evolution of neural controllers for competitive game playing with teams of mobile robots," *Journal of Robotics and Autonomous Systems*, vol. 46, no. 3, pp. 135-150, 2004.

A.L. Nelson, E. Grant, J.M. Galeotti, S. Rhody, "Maze exploration behaviors using an integrated evolutionary robotics environment," *Journal of Robotics and Autonomous Systems*, vol. 46, no. 3, pp. 159-173, 2004.

G.J. Barlow, T.C. Henderson, A.L. Nelson, E. Grant, "Dynamic leadership protocol for S-nets," in *Proceedings of the 2004 IEEE International Conference on Robotics and Automation (ICRA'04)*, New Orleans LA, Apr. 26-May 1, 2004, vol. 2, pp. 1091-1096.

D. Gastelum, T. Jones, A. Agarwal, J. Kothari, S. Bhat, H.K. Lee, E. Grant, A. Nelson, S. Rubin, G.K. Lee, "The development of a testbed for evolutionary learning algorithms for mobile robotic colonies," in *Proceedings of the 2004 International Symposium on Collaborative Technologies and Systems - Western Multiconference*, San Diego CA, 2004, pp. 212-217.

Grant, E. Mattos, L. Barlow, G. Nelson, A.L. Luthy, K. Levedahl, B. Lee, G. "Evolutionary neural controllers for mobile robot colonies," in *Proceedings of the World Automation Congress*, June 28 - July 1, 2004, vol. 17, pp. 37-42.

A.L. Nelson, L. Doitsidis, M.T. Long, K.P. Valavanis, R.R. Murphy, "Incorporation of MATLAB into a distributed behavioral robotics architecture," *Proceedings of the 2004 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS'04)*, Sendai, Japan, 2004, pp. 2028-2035.

A.L. Nelson, E. Grant, G.J. Barlow, T.C. Henderson, "A colony of robots using vision sensing and evolved neural controllers," *Proceedings of the 2003 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS'03)*, Las Vegas, NV, vol. 3, Oct. 27-31, 2003, pp. 2273-2278.

A.L. Nelson, E. Grant, G.J. Barlow, M. White, "Evolution of autonomous robot behaviors using relative competitive fitness," *Proceedings of the 2003 International Conference, Integration of Knowledge Intensive Multi-Agent Systems (KIMAS'03) Modeling, Exploration, and Engineering Systems*, Boston, MA, Oct. 1-3, 2003, pp. 145-150.

A.L. Nelson, E. Grant, G. Lee, "Developing evolutionary neural controllers for teams of mobile robots playing a complex game," *Proceedings of the 2003 IEEE International Conference on Information Reuse and Integration (IRI 2003)*, Las Vegas, NV, Oct. 27-29, 2003, pp. 212-218.

A.L. Nelson, E. Grant, G. Lee, "Using genetic algorithms to capture behavioral traits exhibited by knowledge based robot agents," *Proceedings of the ISCA 15th International Conference: Computer Applications in Industry and Engineering (CAINE-2002)*, San Diego, CA, Nov. 7-9, 2002, pp. 92-97.

J. Galeotti, S. Rhody, A.L. Nelson, E. Grant, G. Lee, "EvBots – the design and construction of a mobile robot colony for conducting evolutionary robotic experiments," in *Proceedings of the ISCA 15th International Conference: Computer Applications in Industry and Engineering (CAINE-2002)*, San Diego CA, Nov. 7-9, 2002, pp. 86-91.

A.L. Nelson, E. Grant, T.C. Henderson, "Competitive relative performance evaluation of neural controllers for competitive game playing with teams of real mobile robots," *Measuring the Performance and Intelligence of Systems: Proceedings of the 2002 PerMIS Workshop*, NIST Special Publication 990, Gaithersburg, MD, Aug. 13-15, 2002, pp. 43-50.

A.L. Nelson, M. Chow, "Characterization of coil faults in an axial flux variable reluctance PM motor," *IEEE Transactions on Energy Conversion*, vol. 17, no. 3, pp. 340-348, Sept. 2002.

A. Nelson, M. Chow, "Electric vehicles and axial flux permanent magnet motor propulsion systems," *IEEE Industrial Electronics Society Newsletter*, vol. 46, no.4, pp.3-6, Dec. 1999.

S.H. Bernacki, A.L. Nelson, L. Abdullah, J.K. Sheehan, A. Harris, C. William Davis, S.H. Randell, "Mucin gene expression during differentiation of human airway epithelia in vitro. Muc4 and muc5b are strongly induced," *American Journal of Respiratory Cell and Molecular Biology*, vol. 20, no. 4, pp. 595-604, Apr. 1999.

K. Burridge, A. Nelson, "An in-gel assay for protein tyrosine phosphatase activity: detection of widespread distribution in cells and tissues," *Analytical Biochemistry*, vol. 232, no. 1, pp. 56-64, Nov. 1995.

Professional Affiliations and Service

Reviewing Service for the following journals and international conferences: Robotics and Autonomous Systems, IEEE Transactions of Evolutionary Computing, Autonomous Robots, IEEE Transactions on Robotics, Autonomous Robots, Communications of the Association for Computing Machinery, International Journal of Robotics and Automation, program committee member for the 2007 7th International Conference on Intelligent Systems Design and Applications, reviewer for the 2006 Sixth International Conference in Intelligent Systems and Applications, program committee member for the 2004 IEEE International Conference on Robotics and Automation (ICRA).

Member, **IEEE**, the Institute of Electrical and Electronics Engineers. Society memberships include the IEEE Robotics and Automation Society, the IEEE Systems, Man, and Cybernetics Society, and the IEEE Computational Intelligence Society.

Member, **AAAS**, American Association for the Advancement of Science. Member, the Computational Intelligence Group at Lakeland, University of South Florida, Lakeland, Florida.

Press

"Evolutionary Robotics Research Project," Industry/Research News. IEEE Robotics & Automation Magazine, March 2005, pg. 79.

"Evolution trains robot teams," Technology Research News, May 19-26, 2004, http://www.trnmag.com/Stories/2004/051904/Evolution_trains_robot_teams_051904.html

"When Robots Play Games," Archived discussion on Slashdot, 128 comments, May 23-24 2004, http://games.slashdot.org/games/04/05/23/1746233.shtml?tid=137&tid=216

R. Piquepaille “The EvBots: When Evolution Trains Robot Teams,” Roland Piquepaille's Technology Trends, May 20, 2004, http://www.primidi.com/2004/05/21.html#a848.

Extracurricular Interests

Mentored high school robotics club. Artwork has been shown in several galleries. Other interests include art machine design, automobile restoration, woodworking, metalworking, furniture design and restoration, graphic design and web design.

References available upon request.