

Ayanna M. Howard, Ph.D.
Associate Professor
School of Electrical and Computer Engineering

I. EARNED DEGREES

B.S. Computer Engineering, Brown University, May 1993.

M.S. Electrical Engineering, University of Southern California, December 1994.

Ph.D. Electrical Engineering, University of Southern California, May 1999.

M.B.A. (Masters of Business Administration, concentration in Strategy), Claremont Graduate University, May 2005.

II. EMPLOYMENT

NASA's Jet Propulsion Laboratory, Pasadena, California **May 1993-June 2005**

Senior Robotics Researcher – Mobility Systems Concept Development Section 9/02-6/05

Deputy Manager – Strategic University Research Partnership Office, Office of Chief Scientist 9/03-6/05

- *Cognizant Engineer*: research and design autonomy software based on human cognition for landing a robotic spacecraft safely on a remote surface, formation flying of multiple spacecrafts, and safe navigation of a planetary rover.
- *Task Manager*: responsible for state-of-the-art research development of an Artificial Intelligence toolkit for interactive learning.
- *Deputy Manager*: responsible for managing science and technology research liaisons that establish and strengthen strategic relationships with leading universities. Provided direct input to Chief Technologist on technical projects and resources.

Robotics Researcher – Telerobotics Research and Applications Group 2/99-9/02

- *Task Manager*: secured funding for and managed integrated hardware/software research development of a reconfigurable robotic system.
- *Principal Investigator*: developed intelligent software tool for terrain-based analysis of the Martian surface for spacecraft landing.
- *Cognizant Engineer*: designed and developed a real-time control package for autonomous rover navigation on hazardous terrain.

Information Systems Engineer - Information Technologies Research Section 1/97-2/99

- Using clustering and neural network techniques, developed algorithms for identifying ground-based military targets embedded in spectral frequency data.
- Using neural networks, developed vision based recognition algorithms for real-time identification and tracking of airborne targets (ATR).

Computer Scientist - Advanced Technology Section 6/93-12/96

- Using UNIX Based OSF/Motif and the C programming language, created a GUI Toolkit for intelligent manipulation of military tactical groupings.
- Provided real time data analysis of intelligent neural systems for launch vehicle health monitoring through a computer graphics support unit.

Georgia Institute of Technology, Atlanta, GA **July 2005-present**

Associate Professor – School of Electrical and Computer Engineering

Adjunct Associate Professor – School of Interactive Computing, College of Computing

Chair, Robotics PhD program (appointed August 2010)

- *Director*: The Human-Automation Systems (HumAnS) Lab performs research centered around the concept of humanized control in intelligent systems, the process of embedding human cognitive capability into the control path of autonomous systems. <http://humanslab.ece.gatech.edu/>

III. SCHOLARLY ACCOMPLISHMENTS

III.A. Published Books and Parts of Books

1. E. Tunstel, H. Seraji, A. Howard, Chapter 11: "Soft Computing Approach to Safe Navigation of Autonomous Planetary Rovers," *Intelligent Control Systems Using Soft Computing Methodologies*, Eds. Zilouchian and Jamshidi, CRC Press, 2001.
2. E. Tunstel, A. Howard, T. Huntsberger, A. Trebi-Ollenu, J. Dolan, "Applied Soft Computing Strategies for Autonomous Field Robotics," *Autonomous Robotic Systems: Soft Computing and Hard Computing Methodologies and Applications*, Eds. Zhou, Moravall, and Ruan, vol. 116, pgs. 75-102, Physica-Verlag, 2003.
3. A. Howard, E. Tunstel, "Using Geospatial Information for Autonomous Systems Control," *Frontiers of Geographic Information Technology*, Eds. Rana and Sharma, Springer Science, Dec. 2005.
4. A. Howard, E. Tunstel, "A Self-Contained Traversability Sensor for Safe Mobile Robot Guidance in Unknown Terrain," *Applied Soft Computing Technologies: The Challenge of Complexity*, Abraham, A.; Baets, B.D.; Köppen, M.; Nickolay, B. (Eds.), Springer, May 2006.
5. A. Howard, E. Tunstel (Editors), *Intelligence for Space Robotics*, TSI Press, San Antonio, Texas, July 2006.
6. A. Howard, S. Remy, C.H. Park, H.W. Park, and D. Brooks. "Intelligent robotics for assistive healthcare and therapy," *The Path to Autonomous Robots*; G. Sukhatme (Ed), Springer Science, November 2008.
7. S. Williams, D. Brooks, A. Howard, "Robot Vision for Science-Driven Navigation in Challenging Arctic Environments," *Robot Vision: New Research*; T. Matsuda (Ed), Nova Science, 2009.

III.B. Refereed Publications

III.B.1. Refereed Journal Publications

1. A. Howard, C. Padgett, "A generalized approach to real-time pattern recognition in sensed data," *Pattern Recognition*, vol. 32:12, pgs. 2069-2071, Dec. 1999.
2. A. Howard, G. Bekey, "Intelligent Learning for Deformable Object Manipulation," *Autonomous Robots*, 9 (1): pgs. 51-58, August 2000.
3. A. Howard, H. Seraji, "Vision-Based Terrain Characterization and Traversability Assessment," *Journal of Robotic Systems*, 18(10), pgs. 577-587, 2001.
4. A. Howard, H. Seraji, "An Intelligent Terrain-Based Navigation System for Planetary Rovers," *IEEE Robotics and Automation Magazine*, vol. 8, no. 4, pgs. 9-17, December 2001.
5. H. Seraji and A. Howard, "Behavior-Based Navigation on Challenging Terrain: A Fuzzy Logic Approach," *IEEE Transactions on Robotics and Automation*, 18(3), pgs. 308-321, June 2002.
6. E. Tunstel, A. Howard, H. Seraji, "Rule-based reasoning and neural network perception for safe off-road robot mobility," *Expert Systems*, 19(4), pgs. 191-200, Sept. 2002.
7. E. Tunstel, A. Howard, "Approximate Reasoning for Safety and Survivability of Planetary Rovers," *Fuzzy Sets and Systems*, vol. 134, no. 1, pgs. 27-46, Feb. 2003.
8. A. Howard, C. Padgett, "An Adaptive Learning Methodology for Intelligent Object Detection in Novel Imagery Data," *NeuroComputing*, vol. 51, pgs. 1-11, March 2003.
9. A. Howard, H. Seraji, "Multi-Sensor Terrain Classification for Safe Spacecraft Landing," *IEEE Transactions on Aerospace and Electronic Systems*, vol. 40, Issue 4, pgs. 1122-1131, October 2004.
10. A. Howard, H. Seraji, B. Werger, "Global and Regional Path Planners for Integrated Planning and Navigation," *Journal of Robotic Systems*, vol. 22, no. 12, pgs. 767-778, December 2005.
11. Z. Dodds, L. Greenwald, A. Howard, S. Tejada, J. Weinberg, "Components, Curriculum, and Community: Robots and Robotics in Undergraduate AI Education," *AI Magazine*, Vol. 27, pgs. 11-22, Spring 2006.
12. A. Howard, "A Systematic Approach to Predict Performance of Human-Automation Systems," *IEEE Transactions on Systems, Man, and Cybernetics--Part C*, Vol. 37, No. 4, July 2007.

13. A. Howard, L. Parker, B. Smith, "A Learning Approach to Enable Locomotion of Multiple Robotic Agents Operating in Natural Terrain Environments," *International Journal of Intelligent Automation and Soft Computing*, Vol. 14(1), pgs. 47-59, 2008.
14. A. Howard, S. Remy, "Integrating Virtual and Human Instructors in Robotic Learning Environments," *International Journal of Virtual Reality*, Vol. 7(1), pgs. 9-14, 2008.
15. S. Remy, A. Howard, "Learning Approaches Applied to Human-Robot Interaction for Space Missions," *International Journal of Intelligent Automation and Soft Computing*, Vol. 14, No. 3, pgs. 249-262, 2008.
16. B. Smith, M. Egerstedt, A. Howard, "Automatic Generation of Persistent Formations for Multi-Agent Networks Under Range Constraints," *ACM/Springer Mobile Networks and Applications Journal*, Vol 14, No. 3, 2009.
17. B. Smith, A. Howard, J. McNew, Jiuguang-Wang, M. Egerstedt, "Multi-robot deployment and coordination with Embedded Graph Grammars," *Autonomous Robots*, Vol 26(1), pgs. 79-98, January 2009.
18. A. Viguria, A. Howard, "An Integrated Approach for Achieving Multi-Robot Task Formations," *IEEE/ASME Transactions on Mechatronics*, Vol. 14 (2), Page(s): 176-186 April 2009.
19. S. Williams, A. Howard, "Developing Monocular Visual Odometry and Pose Estimation for Arctic Environments," *Journal of Field Robotics*, Vol. 27(2), Pages(s): 145-157, March 2010.
20. A. Viguria, A. Howard, "Probabilistic Analysis of Market-Based Algorithms for Initial Robotic Formations," *International Journal of Robotics Research*, Vol. 29, No. 9, pgs. 1154-1172, August 2010.
21. S. Williams, L. Parker, A. Howard, "Calibration and Validation of Earth-observing Sensors using Deployable Surface-based Sensor Networks," *IEEE Journal of Selected Topics in Earth Observations and Remote Sensing*, Vol. 3, No. 4, pgs 427-432, Dec. 2010.
22. A. Howard, B. Jones, N. Serrano, "An Integrated Sensing Approach for Entry, Descent, and Landing of a Robotic Spacecraft," *IEEE Transactions on Aerospace and Electronic Systems*, to appear January 2011.
23. D. Brooks, A. Howard, "Quantifying Upper-Arm Rehabilitation Metrics for Children through Interaction with a Humanoid Robot," *Applied Bionics and Biomechanics*, submitted October 2010.
24. A. Howard, C.H. Park, S. Remy, "Designing Haptic and Auditory Interaction Tools for Teaching Robot Programming to Students with Visual Impairments," *IEEE Transactions on Learning Technologies*, submitted October 2010.
25. M.B. Blake, S. Remy, A. Howard, "Towards Robotic Access to WWW Resources Using Service-Oriented Computing and Web Interfaces," *IEEE Robotics and Automation Magazine*, submitted December 2010.

III.B.2. Refereed Conference Publications

1. A.M. Howard, G.A. Bekey, "Recursive Learning for Deformable Object Manipulation," *8th Int. Conf. Advanced Robotics (ICAR)*, pgs. 939-943, Monterey, CA, July 1997.
2. A. Howard, C. Padgett, C. Liebe, "A Multi-Stage Neural Network for Automatic Target Detection," *IEEE Int. Joint Conference on Neural Networks (IJCNN)*, pgs. 231-236, Anchorage, Alaska, May 1998.
3. A. Howard, C. Padgett, K. Brown, "Intelligent Target Detection in Hyperspectral Imagery," *13th Applied Geologic Remote Sensing Conference*, Vancouver, Canada, March 1999.
4. A. Howard, G. Bekey, "Intelligent Learning for Deformable Object Manipulation," *IEEE Intern. Symposium on Computational Intelligence in Robotics and Automation*, pgs. 15-20, Monterey Bay, CA, Nov. 1999.
5. A. Howard, C. Padgett, K. Brown, "Real Time Intelligent Target Detection and Analysis with Machine Vision," *3rd International Symposium on Intelligent Automation and Control*, Maui, HI, June 2000.
6. A. Howard, G. Bekey, "A Learning Methodology for Robotic Manipulation of Deformable Objects," *8th International Symposium on Robotics and Applications*, Maui, HI, June 2000.
7. A. Howard, H. Seraji, "A Real-Time Autonomous Rover Navigation System," *World Automation Congress*, Maui, HI, June 2000.
8. A. Howard, H. Seraji, "Real-Time Assessment of Terrain Traversability for Autonomous Rover Navigation," *IEEE/RSJ Intern. Conf. on Intelligent Robots and Systems (IROS)*, pgs. 58-63, Takamatsu, Japan, Nov. 2000.

9. C. Padgett, A. Howard, S. Udomkesmalee, "Shape Based Object Recognition Using a Fast Analog Convolution Processor," *NASA/DoD Second Biomorphic Explorers Workshop*, Pasadena, CA, Dec. 2000.
10. E. Tunstel, A. Howard, H. Seraji, "Fuzzy Rule-Based Reasoning for Rover Safety and Survivability," *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pgs. 1413-1420, Seoul, Korea, May 2001.
11. H. Seraji, A. Howard, E. Tunstel, "Safe Navigation on Hazardous Terrain," *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pgs. 3084-3091, Seoul, Korea, May 2001.
12. A. Howard, H. Seraji, E. Tunstel, "A Rule-Based Fuzzy Traversability Index for Mobile Robot Navigation," *IEEE Int. Conf. on Robotics and Automation (ICRA)*, vol. 1, pgs. 3067-3071, Seoul, Korea, May 2001.
13. H. Seraji, A. Howard, E. Tunstel, "Terrain-Based Navigation of Planetary Rovers: A Fuzzy Logic Approach," *6th Int. Symposium on Artificial Intelligence, Robotics and Automation in Space (i-Sairas)*, Montreal, Canada, June 2001.
14. A. Howard, E. Tunstel, D. Edwards, A. Carlson, "Enhancing Fuzzy Robot Navigation Systems by Mimicking Human Visual Perception of Natural Terrain Traversability," *Joint 9th IFSA World Congress and 20th NAFIPS International Conference*, Vancouver, Canada, July 2001.
15. S. Mobasser, C.C. Liebe, A. Howard, "Application of Fuzzy Logic in Sunsensor Data Interpretation," *2nd International Conference on Intelligent Technologies (InTech '2001)*, Bangkok, Thailand, Nov. 2001.
16. S. Mobasser, C.C. Liebe, A. Howard, "Fuzzy Image Processing in Sun Sensor," *10th IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, pgs. 1337-1342, Melbourne, Australia, Dec. 2001.
17. C.C. Liebe, S. Mobasser, C.J. Wrigley, Y. Bae, A. Howard, J. Schroeder, "Micro Sun Sensor," *IEEE Aerospace Conference*, vol. 5, pgs. 2263-2273, Big Sky, Montana, March 2002.
18. A. Howard, "A Novel Information Fusion Methodology for Intelligent Terrain Analysis," *IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, pgs. 1472-1475, Honolulu, HI, May 2002.
19. E. Tunstel, A. Howard, "Sensing and Perception Challenges in Planetary Surface Robotics," *IEEE Sensors 2002*, vol. 2, pgs.1696-1701, Orlando, FL, June 2002.
20. A. Howard, H. Seraji, "A Rule-Based Fuzzy Safety Index for Landing Site Risk Assessment," *9th International Symposium on Robotics and Applications*, Orlando, FL, June 2002.
21. S. Mobasser, C.C. Liebe, A. Howard, "Fuzzy Image Processing in Sun Sensor," *International Fuzzy Systems Association World Congress*, Istanbul, Turkey, June 2003.
22. A. Howard, G. Rodriguez, "Validating Mission Relevance of Autonomy Technologies through Increased Science Return," *Workshop on Machine Learning in Space Systems, 20th International Conference on Machine Learning*, pgs. 31-35, Washington, D.C., August 2003.
23. A. Howard, B. Werger, H. Seraji, "Integrating Terrain Maps into a Reactive Navigation Strategy" *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pgs. 2012-2017, Taipei, Taiwan, September 2003.
24. A. Howard, E. Graham, "Bridging the Gap between Space Robotics Research and Robotics Education," *AAAI Symp. on Accessible, Hands-on AI/Robotics Education*, pgs. 126-128, San Jose, CA, March 2004.
25. A. Howard, et. al. "A Methodology to Determine Impact of Autonomy Technologies on Space Science Mission," *10th International Symposium on Robotics and Applications*, Seville, Spain, June 2004.
26. A. Howard, et. al, "A Reconfigurable Robotic Exploration Vehicle for Extreme Environments," *10th International Symposium on Robotics and Applications*, Seville, Spain, June 2004.
27. A. Howard, E. Tunstel, "A Self-Contained Traversability Sensor for Safe Mobile Robot Guidance in Unknown Terrain," *9th Online World Conference on Soft Computing in Industrial Applications*, Sept. 2004.
28. A. M. Howard, "A Methodology to Assess Performance of Human-Robotic Systems in Achievement of Collective Tasks," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pgs. 377-382, Edmonton, Canada, August 2005.
29. E. Tunstel, A. Howard, M. Maimone, A. Trebi-Ollenu, "Mars Exploration Rover Baseline for Flight Rover Autonomy Technology Assessment," *8th Int. Symposium on Artificial Intelligence, Robotics and Automation in Space (i-Sairas)*, Munich, Germany, Sept. 2005.
30. A. Howard, B. Werger, H. Seraji, "A human-robot mentor-protégé relationship to learn off-road navigation behavior," *IEEE International Conference on Systems, Man, and Cybernetics*, Waikoloa, Hawaii, Oct. 2005.
31. A. Howard, W. Paul, "A 3D Virtual Environment for Exploratory Learning in Mobile Robot Control," *IEEE International Conference on Systems, Man, and Cybernetics*, Waikoloa, Hawaii, Oct. 2005.

32. G. Thomas, A. Howard, A. Williams, A. Alston-Moore, "Multi-Robot Task Allocation in Lunar Mission Construction Scenarios," *IEEE International Conference on Systems, Man, and Cybernetics*, Waikoloa, Hawaii, Oct. 2005.
33. N. Serrano, M. Bajracharya, A. Howard, H. Seraji, "A Novel Tiered Sensor Fusion Approach for Terrain Characterization and Safe Landing Assessment," *IEEE Aerospace Conference*, Big Sky, Montana, March 2006.
34. A. Howard, "Role Allocation in Human-Robot Interaction Schemes for Mission Scenario Execution," *IEEE Int. Conf. on Robotics and Automation (ICRA)*, Orlando, FL, May 2006.
35. B. Jones, A. Howard, "An Imaging Technique for Safe Spacecraft Landing and Autonomous Hazard Avoidance," *IEEE Int. Conf. on Space Mission Challenges for Information Technologies*, Pasadena, CA, July 2006.
36. A. Howard, G. Cruz, "Adapting Human Leadership Approaches for Role Allocation in Human-Robot Navigation Scenarios," *11th Int. Symposium on Robotics and Applications*, Budapest, Hungary, July 2006.
37. A. Howard, "Fuzzy logic selection of surface feature observations for small proximity operations," *6th International Symposium on Soft Computing for Industry*, Budapest, Hungary, July 2006.
38. A. Howard, B. Smith, M. Egerstedt, "Realization of the Sensor Web Concept for Earth Science using Mobile Robotic Platforms," *IEEE Aerospace Conference*, Big Sky, Montana, March 2007.
39. A. Howard, E. Graham, "To Encourage and Excite the Next Generation of Engineers through Human-Robot Interaction Projects for Space Exploration," *American Society for Engineering Education Annual Conference*, Hawaii, June 2007.
40. A. Howard, C. H. Park, "Haptically Guided Teleoperation for Learning Manipulation Tasks," *Robotics: Science and Systems: Workshop on Robot Manipulation*, Atlanta, GA, June 2007.
41. B. Johns, A. Howard, "Stability and Gait Optimization of a Hybrid Legged-Wheeled Rover," *10th International Conference on Climbing and Walking Robots (CLAWAR)*, Singapore, July 2007.
42. B. Smith, M. Egerstedt, A. Howard, "Automatic Generation of Persistent Formations for Mobile Agent Networks," *Int. Conf. on Robot Communication and Coordination*, Athens, Greece, Oct. 2007.
43. A. Howard, L. Parker, "A Hierarchical Strategy for Learning of Robot Walking Strategies in Natural Terrain Environments," *IEEE Int. Conf. on Systems, Man, and Cybernetics*, Montreal, Canada, Oct. 2007.
44. S. Remy, A. Howard, "In Situ Interactive Teaching of Trustworthy Robotic Assistants," *IEEE Int. Conf. on Systems, Man, and Cybernetics*, Montreal, Canada, Oct. 2007.
45. A. Viguria, A. Howard, "Upper-Bound Cost Analysis of a Market-Based Algorithm Applied to the Initial Formation Problem," *IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS)*, San Diego, CA, Oct. 2007.
46. C.H. Park, A. Howard, "Vision-based Force Guidance for Improved Human Performance in a Teleoperative Manipulation System," *IEEE/RSJ Int. Conf. on Intelligent Robots and Systems (IROS)*, San Diego, CA, Oct. 2007.
47. B. Smith, M. Egerstedt, A. Howard, "Automatic Deployment and Formation Control of Decentralized Multi-Agent Networks," *IEEE Int. Conf. on Robotics and Automation (ICRA)*, Pasadena, CA, May 2008.
48. S. Williams, A. Howard, "A Terrain Slope Estimation Technique for Natural Arctic Environments," *IEEE Int. Conf. on Robotics and Automation (ICRA)*, Pasadena, CA, May 2008.
49. A. Howard, S. Remy, H.W. Park, "Learning of Arm Exercise Behaviors: Assistive Therapy based on Therapist-Patient Observation," *RSS: Workshop on Interactive Robot Learning*, Zurich, Switzerland, June 2008.
50. S. Remy, A. Howard, "Quantifying Coherence when Learning Behaviors via Teleoperation," *IEEE Int. Symp. on Robot and Human Interactive Communication (RO-MAN)*, pgs. 471-476, Munich, Germany, August 2008.
51. A. Howard, H.W. Park, C. Kemp, "Extracting Play Primitives for a Robot Playmate by Sequencing Low-Level Motion Behavior," *IEEE Int. Symp. on Robot and Human Interactive Communication (RO-MAN)*, pgs. 360-365, Munich, Germany, August 2008.
52. A. Viguria, A. Howard, "A Probabilistic Model for the Performance Analysis of a Distributed Task Allocation Algorithm," *IEEE Int. Conf. on Robotics and Automation (ICRA)*, Kobe, Japan, May 2009.
53. B. Smith, J. Wang, M. Egerstedt, A. Howard, "Automatic Formation Deployment of Decentralized Heterogeneous Multiple-Robot Networks with Limited Sensing Capabilities," *IEEE Int. Conf. on Robotics and Automation (ICRA)*, Kobe, Japan, May 2009.

54. D. Brooks, A. Howard, "Mobility Reconfiguration for Terrain Exploration using Human Inspired Perception," *IEEE Int. Conf. on Robotics and Automation (ICRA)*, Kobe, Japan, May 2009.
55. S. Remy, A. Howard, "Predicting the Robot Learning Curve based on Properties of Human Interaction," *AAAI Symp. on Agents that Learn from Human Teachers*, San Jose, CA, March 2009.
56. A. Trevor, H-W Park, A. Howard, C. Kemp, "Playing with Toys: Towards Autonomous Robot Manipulation for Therapeutic Play." *IEEE Int. Conf. on Robotics and Automation (ICRA)*, Kobe, Japan, May 2009.
57. S. Williams, A. Howard, "Towards Visual Arctic Terrain Assessment," *7th Int. Conf. on Field and Service Robotics*, Cambridge, MA, July 2009.
58. S. Remy, C.H. Park, A.M. Howard, "Improving the performance of ANN training with an unsupervised filtering method," *Int. Joint Conf. on Neural Networks*, Atlanta, GA, June 2009.
59. L. Parker, A. Howard, "Assistive Formation Maintenance for Human-Led Multi-Robot Systems," *IEEE Int. Conf. on Systems, Man, and Cybernetics*, San Antonio, TX, Oct. 2009.
60. D. Brooks, A. Howard, "Upper Limb Rehabilitation and Evaluation of Children Using a Humanoid Robot," *2nd Workshop on Child, Computer, and Interaction*, Cambridge, MA, Nov. 2009.
61. C.H. Park, A. Howard, "Towards Real-Time Haptic Exploration using a Mobile Robot as Mediator," *2010 Haptics Symposium*, Cambridge, MA, March 2010.
62. C.H. Park, A. Howard, "Transfer of Robotic Tele-operation Skills between Human Operators through Haptic Training with Robot Coordination," *IEEE Int. Conf. on Robotics and Automation (ICRA)*, Anchorage, AK, May 2010.
63. H.W. Park, A. Howard, "Understanding a Child's play for Robot Interaction by Sequencing Play Primitives using Hidden Markov Models," *IEEE Int. Conf. on Robotics and Automation (ICRA)*, Anchorage, May 2010.
64. S. Williams, S. Remy, A. Howard, "3-D Simulations for Testing and Validating Robotic-Driven Applications for Exploring Lunar Pole," *AIAA Infotech@Aerospace 2010*, Atlanta, GA, April 2010.
65. S. Williams, M. Hurst, A. Howard, "Development of a Mobile Arctic Sensor Node for Earth-Science Data Collection Applications," *AIAA Infotech@Aerospace 2010*, Atlanta, GA, April 2010.
66. L. Parker, B. English, M. Chavis, A. Howard, "Improvements To Satellite-Based Albedo Measurements Using In Situ Robotic Surveying Techniques," *AIAA Infotech@Aerospace 2010*, Atlanta, GA, April 2010.
67. H.W. Park, A. Howard, "Case-Based Reasoning for Planning Turn-Taking Strategy with a Therapeutic Robot Playmate," *IEEE Int. Conf. on Biomedical Robotics and Biomechatronics*, Tokyo, Japan, Sept. 2010.
68. D. Brooks, A. Howard, "A Computational Method for Physical Rehabilitation Assessment," *IEEE Int. Conf. on Biomedical Robotics and Biomechatronics*, Tokyo, Japan, Sept. 2010.
69. S. Williams, A. Howard, "Horizon Line Estimation In Glacial Environments Using Multiple Visual Cues," *IEEE Int. Conf. on Robotics and Automation (ICRA)*, Shanghai, China, May 2011, *accepted*.
70. C. H. Park, S. Remy, A. Howard, "Visualize Your Robot with Your Eyes Closed: A Multi-modal Interactive Approach Using Environmental Feedback," *IEEE Int. Conf. on Robotics and Automation (ICRA)*, Shanghai, China, May 2011, *accepted*.
71. G. Drayer, A. Howard, "A FAM-based Human-Oriented Approach to Multi-Agent Integration of Autonomous Systems," *IEEE Conference on Cognitive Methods in Situation Awareness and Decision Support*, Feb. 2011, *accepted*.
72. R. Dorsey, A. Howard, "Measuring the Effectiveness of Robotics Activities in Underserved K-12 Communities outside the Classroom," *American Society for Engineering Education Annual Conference*, Vancouver, Canada, June 2011, *accepted*.
73. R. Dorsey, A. Howard, "Examining the Effects of Technology-Based Learning on Children with Autism: A Case Study," *IEEE International Conference on Advanced Learning Technologies*, Athens, GA, June 2011, *accepted*.

III.B.3. Refereed Conference Posters

1. A. Howard, H. Seraji, B. Werger, "Fuzzy Terrain-Based Path Planning for Planetary Rovers," *9th International Symposium on Robotics and Applications*, Honolulu, HI, May 2002.
2. E. Graham, A. Howard, "An Internship Model for Culturally Relevant Success for Native American High School Students," *American Geophysical Union (AGU) Fall Meeting*, San Francisco, CA, December 2004.

3. J. Walls, A. Howard, A. Homaifar, B. Kimiaghali, "A Generalized Framework for Autonomous Formation Reconfiguration of Multiple Spacecrafts," *IEEE Aerospace Conference*, Big Sky, Montana, March 2005.
4. A. Howard, E. Graham, "Crossing the technology gap between higher-learning and the classroom environment," *American Association for Higher Education National Conference*, Atlanta, March 2005.
5. A. Howard, D. Brooks, Y.P. Chen, "Non-contact Robotic Assessment of Upper Limb Movement," North American Rehabilitation Symposium, Atlanta, GA, August 2010.

III.C. Presentations

III.C.1 Invited Keynote Addresses

1. Tinker AFB: "The Souls of Black Folk (100th Anniversary)," Oklahoma, March 2003.
2. UC San Diego: "Preparing for the Excitement in Engineering," California, Oct. 2004.
3. Lexmark Corp: "From the Spacecraft to the Desktop - Technological Advances in Everyday Life," Kentucky, Sept. 2004.
4. "Lessons Learned Traversing Through the Robotics World of Research," HBCU-UP National Research Conference, Atlanta, GA, Oct 2009.
5. "Traversing Through the Robotics World of Research," Louis Stokes Alliance for Minority Participation Research Symposium, Roanoke, WV, April 2009.

III.C.2. Seminar Presentations

1. Tutorial: "Robotics in the 21st Century," Society of Women Engineers Regional Conference, Santa Monica, CA, February 2000.
2. Tutorial: "Hybrid Systems: Effective ways to combine genetic algorithms, neural networks, and fuzzy systems for real-world applications," World Automation Congress, Maui, HI, June 2000.
3. "Robotics and Artificial Intelligence," Santa Monica City College, March/Sept. 2000.
4. "Robotics Research at JPL," North Carolina A&T Computer Science Colloquium, Greensboro, NC, Sept. 2001.
5. "Neural Networks, Robotics, Fuzzy Logic, Machine Vision, What's It All About?" 2nd Annual Careers in Math, Science, and Technology Conference, Pasadena, CA, Jan 2003.
6. "Women Working on Mars," Panelist, National Engineers Week WebCast, Pasadena, CA, Jan 2003.
7. "Doing Business with Private and Governmental Space Agencies," California Space Authority, San Luis Obispo, CA, Feb. 2003.
8. "Robots in Space," Astronomy Guest Lecture Series, Santa Monica College, CA, May 2003.
9. Workshop: "Going to Mars ... JPL Style," National Society of Black Engineers National Conference, Anaheim, CA, March 2003.
10. "Autonomous Systems for Space Exploration," Astronomy Colloquium, California State University, Los Angeles, CA, October 2003.
11. Workshop: "Space Explorers-Exploring the Universe," Young African American Women's Conf., Nov. 2003.
12. *Invited*: "Smart Robots for Space Exploration," Pacific Science Center Space Lecture Series, Seattle, WA, Dec. 2003.
13. *Invited*: "Robots for Space Exploration," Chabot Science Center Distinguished Lecture Series, Oakland, CA, Feb. 2004.
14. "Artificial Intelligence for Autonomous Control in Space," von Karmen Lecture Series, Pasadena, CA, April 2004.
15. "Human-Inspired Techniques for Exploring Space," Mt. Wilson Observatory Lecture Series, CA, April 2004.
16. *Invited*: "Research in Behavior-Based Navigation Strategies for Planetary Robots," Robotics, Controls, and Mechatronics Colloquium, University of Washington, May 2004.
17. "The Supersmart Robots are Coming," Panelist, Technology Summit for Business Solutions, Los Angeles, CA, June 2004.
18. "Innovation and Transformation: Big New Ideas," Panelist, ideaFestival, Lexington, KY, Sept. 2004.
19. "Artificial Intelligence for Space Robotics: How Smart is Smart?" University of Southern California, March 2004.
20. "Life after High School Panel," Panelist, Governor's Conference on Women and Families, CA, Dec. 2004.
21. *Invited*: "Applying Human-Based Intelligence Techniques to Space Robotics," Rowan University, Dec. 2004.
22. *Invited*: "Robot Learning: Human-Inspired Techniques for Space and Field Robotics," Annual National Academy of Engineering Meeting, April 2006.
23. "Human-Inspired Techniques for Robotic Control," Neuromorphic Engineering Workshop, Telluride, CO, July

2006.

24. *Invited*: “Human-Inspired Techniques: Smart Robots for Space Exploration,” Buena Vista University, Storm Lake, IA, Nov. 2006.
25. “Robot Learning: Humanized Intelligence for Space and Field Robotics,” NAE German-American Frontiers of Engineering Conference, Hamburg, Germany, April 2007.
26. “Career Choice – Research in Space Robotics,” California Institute of Technology Targeted Minority Student Education Speaker Series, Nov. 2007.
27. *Invited*: “The Design of Robotics and Their Societal Usefulness,” CUSP Conference, Chicago, Illinois, September 2008.
28. *Invited*: “Intelligent robotics for assistive healthcare and Therapy,” Morehouse MBRS Lecture Series, Atlanta, GA, Oct. 2009.
29. *Invited*: “Robots and Climate Change: Using a Science Network of Mobility Operators that Explore in Snow (SnoMotes),” University of Seville, Seville, Spain, Nov. 2009.
30. *Panel Speaker*: “Work-Life Flexibility for Faculty,” University of Washington, On-Ramps into Academia Workshop, Oct. 2009.
31. Gilbreth Lectureship: “Robot Learning: Humanized Intelligence for Space and Field Robotics,” National Academy of Engineering’s National Meeting, Washington, DC, Feb 2010.
32. *Invited*: “SnoMotes - Robotic Scientific Explorers for Understanding Climate Change,” CRA-W/CDC Distinguished Lecture Series, Carolinas Women in Computing Conference, Columbia, SC, Nov. 2010.
33. Virtual Scientist Series: “SnoMotes” Boston Public High School (Match, English, John O’Bryant), May 2010.

III.C.3. Media Interviews

1. Science@NASA, “Brainy ‘Bots,” http://science.nasa.gov/headlines/y2001/ast29may_1.htm, May 2001.
2. Space Daily, “Send in the Robots,” <http://www.spacer.com/news/robot-01b.html>, May 2001.
3. NASA Tech Briefs, “Who’s Who at NASA,” August 2001.
4. Mars Exploration Program, Mars Today, “JPL’s Bionic Woman, Dr. Ayanna Howard,” <http://marsprogram.jpl.nasa.gov/spotlight/ayannaHoward01.html>, August 2002.
5. Imagiverse Online Interview, “An Interview with Ayanna Howard,” http://www.imagiverse.org/interviews/ayannahoward/ayanna_howard_16_08_02.htm, August 2002.
6. NASA TV Live Interview, “JPL’s Mechanical Women: Dr. Ayanna Howard,” March 2003.
7. NASA First Person, “JPL robotics engineer Dr. Ayanna Howard,” <http://www.jpl.nasa.gov/news/profiles/first-person.cfm>, August 2003.
8. MIT Technology Review Magazine, “Top 100 Young Bold Innovators of 2003,” Oct. 2003.
9. Apogee Book Space Series, “Women of Space: Cool Careers on the Final Frontier,” October 2003.
10. Brown University Daily Herald, “Brown graduate bridges human-machine divide,” Nov. 2003.
11. Science Next Wave Online Magazine, “Fuzzy Logic: Adventures in Artificial Intelligence,” Nov. 2003.
12. Diversity Careers Magazine, “Dr. Ayanna Howard, JPL Robotics Expert,” January 2004.
13. NSBE Magazine, “JPL Engineer in a Class of Her Own,” January/February 2004.
14. NASA Connect Video Series, “PSA: The Astronaut’s Helper,” <http://connect.larc.nasa.gov/programs/2003-2004/psa/index.html>, January 2004.
15. PBS Dragonfly TV, “Episodes of Scientific Adventures: Space,” <http://pbskids.org/dragonflytv>, May 2004.
16. NASA Space Science and Technology Series, “Robots with Brains,” http://www.nasa.gov/missions/science/f_robotics.html, June 2004.
17. TIME Magazine, “Innovators/Artificial Intelligence: Forging the Future,” <http://www.time.com/time/magazine/article/0,9171,1101040614-646372,00.html>, June 14, 2004.
18. IEEE Spectrum, “Dream Jobs 2005,” February 2005.
19. CRISIS Magazine, “The Visionaries,” May/June 2006.
20. CEISMC Gazette, “Georgia Tech’s Bionic Woman,” http://www.ceismc.gatech.edu/gazette/2006_11/2006_11_howard.aspx, November 2006.
21. PBS (KCTS Television), “The Innovators: Designing the Future,” September 2007.
22. Associated Press, “New breed of robots could soon wander Antarctica” (recast at CNN, Washington Post, NPR, Fox News, Discovery Channel, Wired, CBSNews.com, and most popular read item at Yahoo!News in late May), Press Release: <http://www.gatech.edu/newsroom/release.html?id=1905&ga=1>, May 2008.
23. USA Today, “SnoMotes go to Ends of the Earth,” November 2008.
24. Diverse Issues in Higher Education, “Emerging Scholars,” January 2009.

25. GT Alumni Magazine, "Faculty Profile: Office Space", July 2009.
26. Upscale Magazine, "Design Essentials," Sept/Oct 2009.

IV. SERVICE

IV.A. PROFESSIONAL CONTRIBUTIONS

IV.A.1. Membership on Editorial Boards

1. Associate Editor, *Int. Journal of Intelligent Automation and Soft Computing*, 2000-present
2. Associate Editor, IEEE Robotics and Automation Conference Editorial Board, 2006-present
3. Associate Editor, IEEE Transactions on Systems, Man, and Cybernetics, 2010 - present

IV.A.2. Review Panels

1. Reviewer, NASA NRA Cross Enterprise Technology Development Program (CETDP), 2000
2. NASA Faculty Awards for Research (FAR) Program, 2002
3. Reviewer, Louisiana Board of Regents R&D Grants Program, 2002, 2003, 2010, 2011
4. NASA SBIR Sub-topic Manager for Mars In-situ Robotics Technology, 2003 – 2005
5. NSF Review Panels, 2004-2010
6. Reviewer, NASA Idaho EPSCoR Program, 2007
7. National Research Council Committee on the Scientific Context for the Exploration of the Moon, 2006-2007
8. NSERC College of Reviewers, Canada Research Chairs Program, 2007
9. Reviewer, Health Systems Institute Seed Grant Program, 2007-2009
10. Grace Hopper Celebration of Women in Computing Scholarship Reviewer, 2007, 2008
11. National Research Council Study on NASA's Exploration Technology Development Programs, 2007-2008
12. Peer Reviewer, British Columbia Innovation Council, 2009
13. Reviewer, AAAS Research Competitiveness Program, 2009
14. National Research Council Study on NASA's Planetary Science Decadel, 2009-2010
15. Board Member, NASA's Mars Exploration Rover/Spirit Review Board, 2009

IV.A.3. Reviewing Papers for Journals:

1. *Journal of Intelligent Automation and Soft Computing*, 2002-2010
2. *Autonomous Robots*, 2003-2006, 2010
3. *EURASIP Journal on Applied Signal Processing*, 2003-2004
4. *IEEE Transactions on Robotics (and Automation)*, 2004-2010
5. *IEEE Transactions on Mobile Computing*, 2004
6. *IEEE Transactions on Evolutionary Computation*, 2004
7. *IEEE/ASME Transactions on Mechatronics*, 2004, 2008
8. *IEEE Transactions on Neural Networks*, 2005 - 2006
9. *Journal of Field Robotics*, 2006-2010
10. *IEEE Aerospace and Systems*, 2006
11. *Annals of Mathematics and Artificial Intelligence*, 2007
12. *IEEE Transactions on Systems, Man, and Cybernetics*, 2007 – 2010
13. *IEEE Transactions on Control Systems Technology*, 2008
14. *Educational Technology & Society Journal*, 2009

IV.A.4. Reviewing Papers for Conferences:

1. IEEE International Conference on Robotics and Automation, 2002-2010
2. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2004-2010
3. International Conference on Advanced Robotics (ICAR), 2005, 2009
4. IEEE Int. Conference on Systems, Man, and Cybernetics, 2005-2006, 2010
5. International Joint Conference on Artificial Intelligence, 2006
6. Conference on Human-Robot Interaction, 2006-2010
7. International Conf. on Robot Communication and Coordination, 2007
8. IEEE International Conference on System of Systems Engineering, 2007
9. Int. Joint Conference on Neural Networks, 2009

IV.A.5. Program Committees

1. Co-Organizer, AAAI Symposium on Accessible Hands-on AI and Robotics Education Workshop, 2004
2. Tutorial Chair, Program Committee Member, IEEE Int. Conference on Systems, Man and Cybernetics, 2005
3. Program Committee Member, International Conference on Advanced Robotics (ICAR), 2005, 2007, 2009
4. Program Committee Member, IEEE/RSJ International Conference on Intelligent Robots, 2005, 2006
5. Program Committee Member, FLAIRS AI Education, 2006, 2007
6. Poster Program Committee, IEEE Int. Conference on Robotics and Automation, 2006
7. Program Committee Member, Int. Joint Conf. on Artificial Intelligence (IJCAI), 2007
8. Program Committee Member, IEEE Conference on System of Systems Engineering, 2007
9. Co-Organizer, IEEE ICRA Workshop on Robotics in Challenging and Hazardous Environments, 2007
10. Program Committee Member, Int. Conf. on Robot Communication and Coordination, 2007, 2009
11. Organizing Committee, BIRS Workshop on Mentoring for Engineering Academia, 2006-2007
12. Finance Chair, 2008 IEEE International Conference on Robotics and Automation, 2006 – 2008
13. Local Organizing Chair, 2009 International Joint Conference on Neural Networks, 2008-2009
14. Program Committee, International School in Robotics and Intelligent Systems, 2009
15. Space Exploration Track Chair, 2010 Aerospace Systems Conference, 2008 – present
16. Program Committee Member, 2009 Robotics: Science and Systems Conference, 2008 – 2009
17. Chair, HRI ICRA Robot Challenge, 2009
18. Local Organizing Chair, 2011 IEEE Int. Symp. on Robot and Human Interactive Communication, 2009-2011
19. Program Committee Member, Int. Symposium on Distributed Autonomous Robotic Systems, 2010
20. Program Committee Member, IEEE Int. Conference on Systems, Man and Cybernetics, 2006, 2007, 2011

IV.A.6. Membership in Professional Organizations

1. IEEE Senior Member, IEEE Robotics and Automation Society, 1999 - present
2. Member, American Association of Artificial Intelligence, 2002 - present
3. Senior Member, Society of Women Engineers, 2001 - 2005
4. Member, Georgia Electronic Design Center, 2005 – present
5. Alumni Member, National Society of Black Engineers (NSBE), 2007 - present

IV.B. CAMPUS CONTRIBUTIONS

IV.B.1. NASA JPL

1. Council Member, JPL Director's Advisory Council for Women, 1999 – 2001
2. Technical Reviewer, JPL Director's Research and Development Fund, 2003, 2004
3. Reviewer, NASA Small Business Innovative Research Proposals, 2002 – 2004
4. Proposal Reviewer, NASA Graduate Student Research Program, 2004
5. Board Member, JPL Minority Education Initiatives Advisory Board, 2002 – 2005
6. Technical Recruiter, Jet Propulsion Laboratory, 1999 - 2005
7. JPL National Society of Black Engineers (NSBE) Convention Planning Team, 2003 – 2004
8. Speakers Bureau, Jet Propulsion Laboratory, 1998 – 2005

IV.B.2. School of ECE, Georgia Institute of Technology

1. ECE Representative, Georgia Tech Engineering and Computing Career Conference, 2005, 2006
2. Georgia Tech Women in ECE (WECE) Talk on Graduate Schools, 2005
3. Member, ECE Undergraduate Committee, 2005, 2009-2010
4. ECE Representative, Family Affair, 2006
5. Speaker, GT Mars Society, 2006
6. Speaker, GT AASU Success Panel, 2006
7. Speaker, GT Women's Resource Center Summer Speaker Series, 2006
8. Instructor, ECE HOT Days Camp, 2006-2007
9. ECE Hightower Chair Search Committee, 2006
10. Presenter, ECE FIRST LEGO League Camp, 2007
11. Instructor, COE Technology, Engineering and Computing Camp, 2007
12. Keynote Speaker, Introduce a Girl to Engineering Day, 2006, 2008
13. Academic Senate/General Faculty Representative, 2006-2008
14. ECE Strategic Plan Steering Committee, 2007
15. ECE Representative, PhD in Robotics Graduate Committee, 2006-2010
16. Lunch Keynote Speaker, College of Engineering Tech Camp, 2008

17. ECE Academic Career Panel, 2009
18. IEEE Faculty Presentation, December 2009
19. Freshman Experience - Hot Topic Dinner Speaker, April 2010
20. ThinkBig Faculty Leader, Techie-Trekie, Aug. 2010 – 2011
21. ECE Faculty Presentation, September 2010
22. Chair, PhD Robotics program, August 2010 – present
23. GT X-College Committee, November 2010 - present

IV.C. OTHER CONTRIBUTIONS

1. Engineering Advisor, FIRST (2001-2002) - Nonprofit founded to inspire students through participation in annual robotics competitions.
4. Space Expert, Challenger Center for Space Science Education, Space Day 2002 - Program designed to encourage students through interaction with visiting space experts.
5. Computer Tutor, Restore, Inc. (1998-2002) - Provide computer training for a battered women shelter.
6. Founder, Pasadena Delta Academy (2001-2004) - Mentoring program for young teen girls focused on math, science, and technology education.
7. Co-Founder, JUMP (JPL Undergraduate Mentoring Program for Women) (2001-2005) - Provides mentoring support to undergraduate engineering students.
8. Consulting: WonderPlanet, Inc., Los Angeles, CA - Developed GUI application for customization of operating environments, 1999.
9. Consulting: Bitstar International, Seattle, WA - Developed neural network software package for financial forecasting, 2001.
10. Consulting: Veritouch Ltd., New York - Developed information security system using biometrics for database mining. Patent Filed “Reprise Encryption System for Digital Data” in 2003.
11. NSF ADVANCE Visiting Scholar, Electrical Engineering Department (Robotics, Automation, Control, and Mechatronics Group), University of Washington. Host: Dr. D. Denton/Dr. E. Riskin, May 2004.
12. Presenter: “Cool Jobs in Engineering,” IEEE Engineers Week Global Marathon, March 2006.
13. Academic Mentor, Committee on Status of Women in Computing Research Distributed Mentor Project, 2007.
14. Career Coach, NSF ADVANCE Cross-Disciplinary Initiative for Minority Women Faculty Conf., April 2008.
15. Advisory Board Member, On-Ramps into Academia NSF project, 2009-2012
16. Virtual Scientist guest lecturer - Match Charter Schools, English High School, John D. O’ Bryant School Math and Science, Boston, MA., March 2010.

V. HONORS AND AWARDS

1. JPL Technology and Applications Program (TAP) Honor Award, 2000
2. Low Allen Award of Excellence for significant technical contributions, 2001
3. NASA Honor Award for Safe Robotic Navigation Task, 2002
4. San Francisco Airport Museum Honoree, African-American technology trailblazers in Calif., 2002
5. Best Paper Award, 9th International Symposium on Robotics and Applications, 2002
6. NASA Space Act Award for Path Planning Graphical User Interface, 2003
7. MIT Technology Review Top 100 Young Innovators of the Year, 2003
8. Engineer of the Year Award, Los Angeles Council of Engineers and Scientists, 2004
9. Allstate Insurance Distinguished Honoree for achievement in science, 2004
10. Selected participant, NAE Symposium on Frontiers of Engineering, 2004
11. NASA Space Act Award for Fuzzy Logic Engine for Space Applications, 2004
12. Selected presenter, National Academy of Science Frontiers of Science Symposium, 2005
13. California Women in Business Award for Science and Technology, 2005
14. IEEE Early Career Award in Robotics and Automation, 2005
15. 2006 Class of Young Global Leaders, 2006
16. Selected participant, NAE German-American Frontiers in Engineering Symposium, 2007
17. GT-ECE Outreach Award, 2008
18. GT-Faculty woman of Distinction Award, 2008
19. NSBE Janice Lampkin Educator of the Year Award, 2009