# Tucker Balch

**Associate Professor**
**School of Interactive Computing**
**College of Computing**
**Georgia Institute of Technology**
**Atlanta, GA 30332-0280**

January 19, 2011

Items that are new since my last CV update are highlighted

## EDUCATIONAL BACKGROUND

| Degree | Year | University | Field |
|---|---|---|---|
| **Ph.D.** | 1998 | Georgia Institute of Technology | Computer Science |
| **M.S.** | 1988 | University of California, Davis | Computer Science |
| **B.S.** | 1984 | Georgia Institute of Technology | Information and Computer Science |

## EMPLOYMENT HISTORY

| Title | Organization | Dates |
|---|---|---|
| **Quantitative Investment Analyst** | Cerebellum Capital Inc | 2009-2009 |
| **Associate Professor** | College of Computing | 2006-Present |
| **Assistant Professor** | College of Computing<br>Georgia Institute of Technology | 2001-2006 |
| **Adjunct**<br>**Research Scientist** | Robotics Institute<br>Carnegie Mellon University | 2001-2003 |
| **Research Scientist** | Robotics Institute<br>Carnegie Mellon University | 1999-2001 |
| **Postdoctoral Fellow** | Computer Science Department<br>Carnegie Mellon University | 1998-1999 |
| **Fighter Pilot** | United States Air Force | 1988-1996 |

## CURRENT FIELDS OF INTEREST

Dr. Balch has two main sets of research interests: Multi-agent systems, and machine learning for equity trading. With regard multi-agent systems, current research projects include:

- Observing, tracking and modeling the behavior of multi-agent systems, including live social insect colonies.
- Diversity in multi-agent systems.
- Distributed sensing and communication in bandwidth-limited environments.
- Behavior-based strategies for multi-robot cooperation.
- Reinforcement learning in multi-agent systems.

## I. TEACHING

### A. Courses Taught

| *Semester* | *Course Number & Title* | *Enrolled* | *Comments* |
|---|---|---|---|
| **Carnegie Mellon University** | | | |
| Fall 1999 | CS 16-869 Autonomous Multi-Robot Systems | 12 | created |
| Fall 2000 | CS 16-869 Autonomous Multi-Robot Systems | 22 | |
| **Georgia Institute of Technology** | | | |
| Spring 2002 | CS 4631A: Intelligent Robotics and Perception | 15 | retooled |
| Summer 2002 | CS 8803A: Robot System Building | 6 | |
| Fall 2002 | CS 8803L: Autonomous Multi-Robot Systems | 15 | |
| Spring 2003 | CS 4631A: Intelligent Robotics and Perception | 40 | |
| Spring 2004 | CS 4631A: Intelligent Robotics and Perception | 45 | |
| Fall 2004 | CS 1322: Object-Oriented Programming | 186 | |
| Spring 2005 | CS 3630: Introduction to Perception and Robotics | 15 | retooled |
| Fall 2005 | CS 4632: Advanced Intelligent Robotics | 20 | |
| Fall 2006 | CS 8803AIR: Advanced Intelligent Robotics | 19 | |
| Spring 2006 | CS 3630: Introduction to Perception and Robotics | 28 | |
| Spring 2007 | CS 8803AMR: Autonomous Multi-Robot Systems | 9 | |
| Fall 2007 | (recovering from RoboCup) | | |
| Spring 2008 | CS 3650: Art of Prototyping Intelligent Appliances | 12 | created |
| Fall 2008 | CS 4632/7631: Autonomous Multi-Robot Systems | 43 | |
| Spring 2009 | (on leave) | | |
| Fall 2009 | (on leave) | | |
| Spring 2010 | CS 4803/8803: Machine Learning for Trading | 32 | created |
| Fall 2010 | CS 4632/7631: Autonomous Multi-Robot Systems | 49 | |
| | (Taught in Atlanta and broadcast to Korea and France) | | |
| Fall 2010 | CS 4803/8803: Machine Learning for Trading | 46 | |
| **Seminars** | | | |
| Fall 2002 | CS 8001: Computational Perception and Robotics | 40 | |
| Spring 2002 | CS 4801: Hot Topics in C.S. Research | 40 | new course |

### B. Curriculum Development

Professor Balch developed or substantially revised the following courses:

1. **CS 7631: Autonomous Multi-Robot Systems**, 1999, 2000, 2002, 2007, 2010. This course surveys the inspiration and motivation for multi-robot systems, the unique challenges in this field and the wide range of solutions developed thus far. Students learn about the theoretical and algorithmic aspects of multi-agent and multi-robot systems, including communication, coordination and cooperation.

2. **CS 4631 & 3630: Intelligent Robots and Perception**, 2002, 2003, 2004, 2005. This course provides an introduction to the key AI and intelligent systems issues involved in autonomous robot development. It is a "hands-on" class requiring the students to develop and evaluate their own robot control system. The course reviews the foundations of autonomous robot systems, including state-of-the-art perception algorithms, control strategies and learning. This course is appropriate for graduate and advanced undergraduate students with strong programming skills.

3. **CS 3650: The Art of Prototyping Intelligent Appliances**, 2008. Created jointly with Thad Starner and Jay Summet. This is the capstone course for our undergraduate devices thread. Students learn how to build devices with embedded computing and sensing. There's an emphasis on the pragmatics of building physical artifacts (glue, wood, solder, etc.).

4. **CS 8803-FIN: Machine Learning For Trading,** Spring 2010, Fall 2010. Students learn the key concepts of quantitative analysis for trading equities. It is a project-based course in which they build working analytic systems for market analysis. I was inspired in the development of this course by my year long sabbatical at a hedge fund.

## C. Individual Student Guidance

### Graduated Ph.D. Students (Primary Advisor)

1. **Ashley Stroupe,** Robotics, Carnegie Mellon University, 2003.
   Research: Cooperative observation and localization for multi-robot teams.
   *Staff engineer at NASA/JPL*

2. **Matthew Powers,** Computer Science, Georgia Institute of Technology, 2008.
   Research: Interaction between behavior and planning for mobile robots.
   *Robotics Scientist at CMU/NREC*

3. **Sanem Sariel,** Computer Science, Istanbul Technical University, 2008.
   Advised jointly with Nadia Erdogan.
   Research: Planning and re-planning under uncertainty for robot teams.
   *Assistant Professor at Istanbul Technical University*

4. **Adam Feldman,** Computer Science, Georgia Institute of Technology, 2009.
   Research: Tracking multi-agent systems and behavior recognition.
   *Product Manager at Google*

**Current Ph.D. Students (Primary Advisor)**

5. **Keith O'Hara,** Computer Science, Georgia Institute of Technology, enrolled.
   Research: Robot swarms.
   *ABD, Assistant Professor at Bard College.*

6. **Misha Novitzky,** Robotics, Georgia Institute of Technology, enrolled.
   Research: Multi-robot systems.
   GRA with GTRI

7. **Hai Shang,** Computer Science, Georgia Institute of Technology, enrolled.
   Research: Multi-robot systems.

8. **Brian Hrolenek,** Robotics, Georgia Institute of Technology, enrolled.
   Research: Multi-robot systems.

9. **Rahul Sawhney,** Computer Science, Georgia Institute of Technology, enrolled.
   Research: SLAM.

**M.S. Students (Primary Advisor)**

10. **Kevin Sikorski,** MS Robotics, Carnegie Mellon University, 2001.
    Research: reinforcement learning and behavior-based control of robot teams.
    *Now Robotics Architect at CoroWare.*

11. **Rohit Sharma,** MS ISYE, Georgia Institute of Technology, 2003.
    Research: HMM/Baum-Welch.
    *Now Risk Analyst at Morgan Stanley.*

12. **Victor Bigio,** MS Computer Science, Georgia Institute of Technology, 2005.
    Research: distributed control of robot teams.

13. **Eric Dodson,** MS Computer Science, Georgia Institute of Technology, 2005.
    Research: distributed control of robot teams.

14. **Harikrishna Narayanan,** MS CS, Georgia Institute of Technology, 2010.
    Research: ML for trading.
    *Now Developer at Yahoo Finance.*

15. **Shreyas Joshi,** MS CS, Georgia Institute of Technology, enrolled.
    Research: ML for trading.

**Undergraduates**

1. **James Bruce,** BS Computer Science, Carnegie Mellon University, 2001
   Research: color vision based tracking.
   *Completed Ph.D. in C.S. at Carnegie Mellon University. Now at Google.*

2. **Stephen Culpepper,** MS AE, Georgia Institute of Technology, 2002

Research: agent tracking and behavior recognition.

3. **Jason Fortner,** BS Computer Science, Georgia Institute of Technology, 2002
   Research: robot team programming for kids (CS 3911 Project).

4. **Zia Khan,** BS Biology and CS, Carnegie Mellon University, 2002.
   Research: tracking and modeling insect behavior.
   *Now a Ph.D. Student at Princeton.*

5. **Tipp Mosley,** Computer Science, Georgia Institute of Technology, 2003.
   Research: analysis of physical multi-agent behavior (CS 3901 Project).
   *Now a PhD student in Computer Science at the University of Colorado.*

6. **Hank Wilde**, Computer Science, Georgia Institute of Technology, 2003.
   Research: analysis of tracked social animal behavior.
   *Now Robotics Engineer at CMU/NREC.*

7. **John Parish,** Aerospace Engineering, Georgia Institute of Technology, 2004.
   Research: underwater robotics.
   Award: Goldwater Scholarship.

8. **Stephen Ingram,** Computer Science, Georgia Institute of Technology, 2004.
   Research: tracking and labeling insect behavior.
   Awards: Honorable Mention, CRA Outstanding Undergraduate Competition, Second Place, 2004 CoC Undergraduate Research Symposium (UROC)

9. **Richard Guily,** BS Computer Science, Georgia Institute of Technology, 2005.
   Research: machine learning of robot form and control
   Award: Second Place, 2004 CoC Undergraduate Research Symposium (UROC)

10. **Andrew Guillory,** BS Computer Science, Georgia Institute of Technology, 2005.
    Research: automated learning of physical agent controllers
    First Place, 2005 CoC Undergraduate Research Symposium Judges' Award
    First Place, 2005 CoC Undergraduate Research Symposium People's Choice

11. **Drew Bratcher,** BS CS, Georgia Institute of Technology enrolled.
    Research: machine learning for trading

**E. Teaching Honors and Awards**

1. Class of 1969 Teaching Fellow, Georgia Institute of Technology, 2002.

**F. Other Academic and Teaching Activities**

1. **Co-chair of the Undergraduate Research Opportunities in Computing (UROC)** program in the College of Computing, 2002-2004. The UROC program is considered a model for undergraduate research programs at Georgia Tech.

2. **Co-organizer of the Georgia Tech Robotics Initiative**. 2003. This project is focused on raising the visibility of robotics research at Georgia Tech and led to the creation of the RIM Center. See http://www.robotics.gatech.edu .

3. **Member of College of Computing ad hoc committee on the evaluation of teaching for promotion and tenure**. 2003. The committee created a set of recommendations for evaluating and improving teaching in the CoC.

4. **Intelligent Systems Area Coordinator** 2003-2007. Responsible for administration of one of the college's 11 academic areas, including: leading the design of graduate and undergraduate curricula, administering qualifying exams, and advising graduate and undergraduate students in our area.

5. **Member of the College of Computing Graduate Program Committee** 2003-2007.

6. **Co-creator of Devices Thread,** 2007**.**

7. **Co-creator of the Ph.D. in Robotics at Georgia Tech** 2006-2008.

## II. RESEARCH AND CREATIVE SCHOLARSHIP

### A. Ph.D. Thesis

1. ***Behavioral Diversity in Learning Robot Teams,*** Balch, T., Ph.D. Thesis, College of Computing, Georgia Institute of Technology, December, 1998.

### B. Published Journal Articles

#### Peer-Reviewed Journal and Magazine Articles

1. **Communication in Reactive Multiagent Robotic Systems,** Balch, T. and Arkin, R.C., *Autonomous Robots*, 1(1): 27-52, 1995. (ISI impact factor 1.2)

2. **AuRA: Principles and Practice in Review,** Arkin, R.C. and Balch, T., *Journal of Experimental and Theoretical Artificial Intelligence*, 9 175-189, 1997. (ISI Impact factor 0.5)

3. **Behavior-Based Formation Control for Multiagent Robot Teams,** Balch, T. and Arkin, R.C., *IEEE Transactions on Robotics and Automation*, December 1998. (ISI impact factor 2.0)

*4.* **Hierarchic Social Entropy: An Information Theoretic Measure of Robot Team Diversity,** Balch, T., *Autonomous Robots*, July, 2000. (ISI impact factor 1.2)

*5.* **Value-Based Action Selection for Observation with Robot Teams Using Probabilistic Techniques,** Stroupe, A. and Balch, T., *Journal of Robotics and Autonomous Systems.* 2004. (ISI impact factor 1.4)**.**

6. **Niche Selection in Foraging Tasks in Multi-Robot Teams Using Reinforcement Learning.** Ulam, P,. and Balch, T., *Adaptive Behavior* 12 (4). 2004. (ISI impact factor 1.9)

7. **A 3-d Visual Tracking System for the Study of Spatial Navigation and Memory in Rhesus Monkeys,** Z. Khan, R. A. Herman, K. Wallen, and T. Balch, *Behavior Research Methods, Instruments & Computers,* 2004. (ISI impact factor 2.9)

8. **A Human Trainable System for Automated Social Insect Behavior Recognition,** Feldman, A., and Balch, T., *Adaptive Behavior* 12 (4). 2004. (ISI impact factor 1.9)

9. **MCMC-Based Particle Filtering for Tracking a Variable Number of Interacting Targets,** Khan, Z., Balch, T., and Dellaert, F., *IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI). 2005*. (ISI impact factor 4.4)

10. **MCMC data association and sparse factorization updating for real time multi-target tracking with merged and multiple measurements,** Khan, Z., Balch, T., and Dellaert, F., *IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI). 2006.* (ISI impact factor 4.4)

11. **Learning from examples in unstructured, outdoor environments,** Sun, J. and Mehta, T. and Wooden, D. and Powers, M. and Rehg, J. and Balch, T. and Egerstedt, M., *Journal of Field Robotics. Vol 23(11) pp. 1019—1036, 2006*. (ISI impact factor 2.0)

12. **How multirobot systems research will accelerate our understanding of social animal behavior,** Balch, T., Dellaert, F., Feldman, A., Guillory, A., Isbell, C.L., Khan, Z., Pratt, S.C., Stein, A.N., and Wilde, H., *Proceedings of the IEEE. Vol 94(7) pp. 1445--1463, 2006.* (ISI impact factor 4.9)

13. **A modular, hybrid system architecture for autonomous, urban driving**. D. Wooden, M. Powers, M. Egerstedt, H. Christensen, and T. Balch *Journal of Aerospace Computing, Information, and Communication,* 4(12):1047–1058, December 2007.

14. **Naval Mine Countermeasure Missions: A Distributed, Incremental Multirobot Task Selection Scheme**, Sanem Sariel, Tucker Balch and Nadia Erdogan, *IEEE Robotics & Automation Magazine, Special Issue on Design, Control, and Applications of Real-World Multirobot Systems*, Vol 15(1), pp. 45-52. 2008. (ISI impact factor 2.1)

15. **Designing personal robots for education: Hardware, software, and curriculum**, Balch, T., Summet, J., Blank, D., Kumar, D., Guzdial, M., O'Hara, K., Walker, D., Sweat, M., Gupta, G., Tansley, S., *IEEE Pervasive Computing*, 2008. (ISI impact factor 3.1)

16. **Physical path planning using a pervasive embedded network**, O'Hara, K.J., Walker, D.B. and Balch, T.R., *IEEE Transactions on Robotics*, Vol 24(3), pp. 741--746. 2008. (ISI impact factor 2.0)

17. **Learning and inferring motion patterns using parametric segmental switching linear dynamic systems**, Oh, S.M., Rehg, J.M., Balch, T., and Dellaert, F., *International Journal of Computer Vision*, Vol 77(1), pp. 103-124. 2008. (ISI impact factor 3.5)

18. **The Multiple Traveling Robot Problem: A Solution Based on Dynamic Task Selection and Robust Execution**, Sanem Sariel-Talay, Tucker Balch and Nadia Erdogan. *IEEE/ASME Transactions on Mechatronics, Special Issue on Mechatronics in Multirobot Systems, Vol 14(2), pp. 198-206*, 2009. (ISI impact factor 2.3)

19. **Executive Decision Support**, X. C. Ding, M. Powers, M. Egerstedt, R. Young, and T. Balch. *IEEE Robotics and Automation Magazine*, 2009. (ISI impact factor 2.0)

20. **Learning outdoor mobile robot behaviors by example**, Roberts, R., Pippin, C., Balch, T. *Journal of Field Robotics, Vol 26(2), pp. 176--195*, 2009. (ISI impact factor 2.0)

21. **Augmenting Live Broadcast Sports with 3D Tracking Information**, Rick Cavallaro, Maria Hybinette, Marvin White, Tucker Balch, IEEE Multimedia, to appear. 2011. (ISI impact factor 1.6)

**Invited Journal Articles and Magazine Articles**

22. **Io, Ganymede and Callisto: A Multiagent Robot Trash-Collecting Team**, Balch, T., Boone, G., Collins, T., Forbes, H., MacKenzie, D. and Santamaria, J., *AI Magazine*, 16(2): 39-53, 1995. (ISI impact factor 1.0)

23. **Grid-Based Navigation for Mobile Robots,** Balch, T., *The Robotics Practitioner,* 2(1), 1996.

24. **Fast obstacle detection via triangulation of light spots,** Matthies, L., Balch, T. and Wilcox, B., *NASA Tech Briefs*, 21(3): 52, 1997. (Also published as conference paper at ICRA-96).

25. **Profile of a winner: Georgia Tech** (a review of our winning multi-robot entry in the AAAI-97 Mobile Robot Competition), Balch, T., *AI Magazine*, Fall, 1998.

26. **Overview of RoboCup-99,** Coradeschi, S., Karlsson, L., Stone, P., Balch, T., Kraetzschmar, G. and Asada, M. *AI Magazine*, 21(3), Fall, 2000. (Invited review article). (ISI impact factor 1.0)

27. **On the Directional Correlation of Axial Rotation in Inverted Felines and Planetary Spin,** Donahoo, M., Boone, G., Balch, T., *Journal of Irreproducible Results,* 44(5), January, 2000. (Scientific humor).

28. **The AAAI 1999 Mobile Robot Competitions and Exhibitions,** Meeden, L., Schultz, A., Balch, T., Bhargava, R., Haigh, K., Bohlen, M., Stein, C. and Miller, D. *AI Magazine,* 21(3), Fall, 2000. (ISI impact factor 1.0)

29. **Guest Editorial**, Balch, T. and Parker, L., *Autonomous Robots Special Issue on Heterogeneous Multi-Robot Systems*, 8(3), 2000. (ISI impact factor 1.2)

30. **The AAAI-98 Mobile Robot Exhibition,** Haigh, K., Balch, T., *AI Magazine*, Spring, 2000. (ISI impact factor 1.0)

31. **RoboCup-2001: The Fifth Robotic Soccer World Championships,** Veloso, M., Balch, T., and Stone, P., *AI Magazine*, Spring, 2002. (ISI impact factor 1.0)

32. **Ten Years of the AAAI Mobile Robot Competition,** Balch, T., Yanco, H., *AI Magazine,* Spring, 2002. (ISI impact factor 1.0)

## C. Books and Parts of Books

### Books

1. ***Robot Teams: From Diversity to Polymorphism*,** Balch, T. and Parker, L. (eds), AK Peters, 2002.

2. ***RoboCup-2000: Robot Soccer World Cup IV*,** Stone, P., Balch, T., Kraetzschmar, G. (eds), Springer-Verlag, 2001.

### Book Chapters

1. **Cooperative Multiagent Robotic Systems,** Arkin, R.C. and Balch, T., *AI-based Mobile Robots: Case Studies of Successful Robot Systems,* D. Kortenkamp, R.P. Bonasso, and R. Murphy (eds), MIT Press, 1998.

2. **Introduction and Overview of RoboCup-99,** Veloso, M., Kitano, H., Pagello, E., Kraetzschmar, G., Stone, P., Balch, T., Asada, M., Coradeschi, S., Karlsson, L. and Fujita, M., in *RoboCup-99: Robot Soccer World Cup III,* Veloso, Pagello, Kitano (eds), Springer-Verlag, 2000.

3. **Intelligent Robots,** Balch, T*., World Book 2001 Science Year,* World Book Encylopedia, 2001.

4. **Communication and Coordination in Reactive Robotic Teams (book chapter),** Arkin, R.C. and Balch, T., in Coordination Theory and Collaboration Technology, Olsen, G. (ed), 2001.

5. **Mission-Relevant Collaborative Observation and Localization,** Stroupe, A., Balch, T., in Schultz, A. and Parker, L. (eds) *Multi-Robot Systems: From Swarms to Intelligent Automata*, Klewer, 2002.

6. **Taxonomies of Multi-Robot Task and Reward,** Balch, T., in *Robot Teams: From Diversity to Polymorphism,* Balch, T. and Parker, L. (eds), AK Peters, 2002.

7. **Communication, Diversity and Learning: Cornerstones of Swarm Behavior,** Balch, T., in *Swarm Robotics,* Sahin E., and Spears, W. (eds). Springer Verlag. 2005.

**D. Edited Proceedings and Edited Journal Special Issues**

1. **Special Issue on Heterogeneous Multi-Robot Systems,** *Autonomous Robots,* Balch, T. and Parker, L. (eds), vol. 8, no. 3, July, 2000.

2. **Proceedings of the 2nd International Workshop on the Mathematics and Algorithms of Social Insects,** Balch, T., Anderson, C. (eds), 2003.

3. **Special Issue on the Mathematics of Social Insects**, Adaptive Behavior (Journal), 12 (4), Anderson, C., and Balch, T. (eds), December 2004.

**E. Conference Presentations and Publications**

**Keynotes**

1. **From Insects to Robots and Back,** Balch, T., *Autonomous Minirobots for Edutainment (AmiRE-2001)*, Paderborn, Germany, 2001.

2. **Social Insects: A Domain for AI Research,** Balch, T., *Brazilian Symposium for Artificial Intelligence (SBAI),* Bauru Brazil, 2003.

3. **How can AI and robotics help us understand social animal behavior?,** Balch, T., *2005 National Conference on AI (AAAI-05).*

**Papers at Strongly Refereed Peer Reviewed Conferences**

4. **Avoiding the Past: A Simple but Effective Strategy for Reactive Navigation,** Balch, T. and Arkin R.C., *IEEE International Conference on Robots and Automation (ICRA-93),* Atlanta, May 1993, 678-685.

5. **Communication of Behavioral State in Multi-Agent Retrieval Tasks,** Arkin, R.C., Balch, T. and Nitz, E., *IEEE International Conference on Robots and Automation (ICRA-93),* Atlanta, May 1993.

6. **Motor Schema-Based Formation Control for Multiagent Robot Teams,** Balch, T. and Arkin R.C., *IEEE International Conference on Multiagent Systems (ICMAS-95),* San Francisco, April 1995.

7. **Fast Optical Hazard Detection for Planetary Rovers Using Multiple Spot Laser Triangulation,** Matthies, L., Balch, T. and Wilcox B., *IEEE International Conference on Robots and Automation (ICRA-97),* Albuquerque, NM, April 1997.

8. **The Impact of Diversity on Performance in Robot Foraging,** Balch, T., *Autonomous Agents (Agents-99),* Seattle, WA, May, 1999.

9. **Vision-Servoed Localization and Behaviors for an Autonomous Quadruped Legged Robot**, Veloso, M., Winner, E., Lenser, S., Bruce, J., and Balch, T., *Artificial Intelligence Planning Systems (AIPS-2000),* 2000.

10. **Integrating Information, Planning, and Execution Monitoring Agents,** Veloso, M., Balch, T., and Lenser, S., *Autonomous Agents (Agents-2000),* Barcelona, 2000.

11. **Social Potentials for Scalable Multirobot Formations,** Balch, T. and Hybinette, M., *IEEE International Conference on Robotics and Automation (ICRA-2000),* San Francisco, 2000.

12. **Fast and Inexpensive Color Image Segmentation for Interactive Robots, Bruce,** J., Balch, T. and Veloso, M., *IEEE Intelligent Robot Systems (IROS-2000).* 2000.

13. **Behavior-Based Coordination of Large-Scale Robot Formations,** Balch, T. and Hybinette, M., *IEEE International Conference on Multiagent Systems (ICMAS-2000),* Boston, 2000.

14. **Behavior-Based Control of a Non-Holonomic Robot in Pushing Tasks,** Emery, R. and Balch, T., *IEEE International Conference on Robotics and Automation (ICRA-2001),* Seoul, 2001.

15. **Distributed Sensor Fusion for Object Position Estimation by Multi-Robot Systems.** Ashley W. Stroupe, Martin C. Martin and Tucker Balch. *IEEE International Conference on Robotics and Automation (ICRA-2001).* Seoul, May 2001.

16. **Symmetry in Markov Decision Problems and implications for Single and Multiagent Learning.** Zinkevich, M. and Balch, T., *IEEE International Conference on Machine Learning (ICML-2001).* 2001.

17. **Automatically Tracking and Analyzing the Behavior of Live Insect Colonies,** Balch, T., Khan, Z. and Veloso, M., *ACM Autonomous Agents (Agents 2001),* Montreal, 2001.

18. **Protocols for Collaboration, Coordination and Dynamic Role Assignment in a Robot Team,** Emery, R., Sikorski, K., and and Balch, T*., IEEE International Conference on Robotics and Automation (ICRA-2002).* Washington D.C., 2002.

19. **Collaborative Constraint-Based Multi-Robot Localization.** Stroupe, A., and Balch, T. *IEEE Intelligent Robot Systems (IROS-2002).* Lausanne, 2002.

20. **Value-Based Observation with Robot Teams (VBORT) Using Probabilistic Techniques.** Stroupe, A., and Balch, T., *2003 International Conference on Advanced Robotics (ICAR 2003)*.

21. **Efficient Particle Filter-Based Tracking of Multiple Interacting Targets Using an MRF-based Motion Model,** Khan, Z., Balch, T., Dellaert, F., *Proceedings of the 2003 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS'03),* 2003.

22. **An MCMC-Based Particle Filter for Tracking Multiple Interacting Targets,** Khan, Z., Balch, T., and Dellaert, F., *European Conference on Computer Vision (ECCV-04)*. 2004.

23. **Value-Based Action Selection for Exploration and Dynamic Target Observation with Robot Teams,** Stroupe, A., Ravichandran, R., and Balch, T., *2004 IEEE International Conference on Robotics and Automation (ICRA-04),* 2004.

24. **Value-Based Communication Preservation for Mobile Robots,** Powers, M., and Balch, T. *Proceedings of 7th International Symposium on Distributed Autonomous Robotic Systems (DARS-04).* Toulouse, France. 2004.

25. **A Rao-Blackwellized Particle Filter for EigenTracking,** Z. Khan, T. Balch, and F. Dellaert, IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'04), 2004.

26. **Pervasive Sensor-less Networks for Cooperative Multi-Robot Tasks,** O'Hara, K, and Balch, T., *Seventh International Symposium on Distributed Autonomous Robot Systems (DARS-04).* 2004.

27. **Distributed Path Planning for Robots in Dynamic Environments Using a Pervasive Embedded Network.** O'Hara, K., and Balch, T. Proceedings of *Third International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS).* July 2004.

28. **Improving Multirobot Multitarget Tracking by Communicating Negative Information.** Powers, M., Ravichandran, R., and Balch, T. *Third International Multi-Robot Systems Workshop.* Washington, D.C. March 2005.

29. **The GNATs -- Low-Cost Embedded Networks for Supporting Mobile Robots,** O'Hara, K, and Balch, T. *Third International Multi-Robot Systems Workshop.* Washington, D.C., March 2005.

30. **What Are the Ants Doing? Vision-Based Tracking and Reconstruction of Control Programs.** Egerstedt, M., Balch, T., Dellaert, F., Delmotte, F., and Khan, Z. *2005 IEEE International Conference on Robotics and Automation,* Barcelona, Spain, Apr. 2005.

31. **Physical Path Planning Using the GNATs,** K.J. O'Hara and V.L. Bigio and E.R. Dodson and A. Irani and D.B. Walker and T.R. Balch. 2005 IEEE International Conference on Robotics and Automation, Barcelona, Spain, Apr. 2005.

32. **Data-Driven MCMC for Learning and Inference in Switching Linear Dynamic Systems,** Oh, S. M., Rehg, J., Balch, T., Dellaert, F., *2005 National Conference on AI (AAAI-05),* Pittsburgh, July 2005.

33. **A Distributed Multi-Robot Cooperation Framework for Real Time Task Achievement**, Sanem Sariel and Tucker Balch, *Distributed Autonomous Robotic Systems (DARS)* 7, pp. 187-196, 2006.

34. **Learning executable agent behaviors from observation**, Guillory, A., Nguyen, H., Balch, T. and Isbell Jr, C.L., *ACM Conference on Autonomous agents and multiagent systems (AAMAS)*, pp. 795--797, 2006.

35. **Empirical Evaluation of Auction-Based Coordination of AUVs in a Realistic Simulated Mine Countermeasure Task**, Sanem Sariel, Tucker Balch and Jason Stack, *Distributed Autonomous Robotic Systems (DARS) 7,* Springer Verlag ISBN:4431358781, pp. 197-206, 2006.

36. **Autopower: Toward energy-aware software systems for distributed mobile robots**, O'Hara, K.J., Nathuji, R., Raj, H., Schwan, K. and Balch, T., *2006 IEEE International Conference on Robotics and Automation (ICRA),* 2006.

37. **Control-driven mapping and planning**, . Wooden, M. Powers, D. C. MacKenzie, T. Balch, and M. Egerstedt., *2007 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2007.

38. **Compatpm: Enabling energy efficient multimedia workloads for distributed mobile platforms**, Nathuji, R., O'Hara, K., Schwan, K. and Balch, T., *ACM Multimedia Computing and Networking Conference (MMCN)*, 2007.

39. **A Tracker for Multiple Dynamic Targets Using Multiple Sensors.** Feldman, A., Hybinette, M, Balch, T., *2007 IEEE International Conference on Robotics and Automation (ICRA),* 2007.

40. **Value-based communication preservation for mobile robots**, Powers, M. and Balch, T., *2007 Distributed Autonomous Robotic Systems 6 (DARS)*, 2007.

41. **Pervasive sensor-less networks for cooperative multi-robot tasks**, O'Hara, K.J. and Balch, T., *2007 Distributed Autonomous Robotic Systems 6 (DARS)*, 2007.

42. **Incremental Multi-Robot Task Selection for Resource Constrained and Interrelated Tasks**, Sanem Sariel, Tucker Balch and Nadia Erdogan, *2007 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 2314-2319, 2007.

43. **Cost based planning with RRT in outdoor environments**, Lee, J., Pippin, C. and Balch, T., *2008 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2008.

44. **Memory-based learning for visual odometry.** Roberts, R., Nguyen, H., Krishnamurthi, N. and Balch, T., *2008 IEEE International Conference on Robotics and Automation (ICRA),* 2008.

45. **Personalizing CS1 with robots**, Summet, J., Kumar, D., O'Hara, K., Walker, D., Ni, L., Blank, D. and Balch, T., *ACM technical symposium on Computer science education (SIGCSE)*, 2009.

46. **An optimal timing approach to controlling multiple UAVs**, X-C. Ding, M. Powers, M. Egerstedt, and R. Young. *American Control Conference*, 2009.

47. **Graph-based planning using local information for unknown outdoor environments.** Lee, J., Mottaghi, R., Pippin, C., and Balch, T., *2009 IEEE International Conference on Robotics and Automation (ICRA),* 2009.

48. **A learning approach to integration of layers of a hybrid control architecture**, M. Powers and T. Balch, *2009 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2009

49. **Incremental adaptive integration of layers of a hybrid control architecture**, M. Powers and T. Balch, *2010 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2010

**Papers at Peer-Reviewed Conferences and Workshops**

50. **Buzz: An Instantiation of a Schema-Based Reactive Robotic System,** Arkin, R.C., Balch, T.,Collins, T., Henshaw, A., MacKenzie, D., Nitz, E., Rodriguez, R., and Ward, K.,. *International Conference on Intelligent Autonomous Systems: IAS-3,* Pittsburgh, Feb. 1993, 418-427.

51. **Making a Clean Sweep: Behavior-Based Vacuuming,** MacKenzie, D. and Balch, T., *AAAI Fall Symposium: Instantiating Real-world Agents,* Raleigh, NC, March 1993.

52. **Dynamic Scheduling for Mobile Robots,** Balch, T., Forbes, H., and Schwan, K., *6th EUROMICRO Workshop on Real-time Systems,* Vasteraas, Sweden, June 1994.

53. **Lessons Learned in the Implementation of a Multirobot Trash-Collecting Team,** Balch, T., *AAAI 1995 Spring Symposium,* Stanford, March 1995.

54. **Social Entropy: A New Metric for Learning Multirobot Teams,** Balch, T., *10th International FLAIRS Conference (FLAIRS-97),* Daytona, 1997.

55. **Lightweight Rovers for Mars Science Exploration and Sample Return,** Schenker, P., Sword, L., Ganino, A., Bickler, D., Hickey, G., Brown, D.,

Baumgartner, E., Matthies, L., Wilcox, B., Balch, T., Aghazarian, H. and M. S. Garrett, *SPIE Intelligent Robotics and Computer Vision XVI,* SPIE Proc. 320, Pittsburgh, Oct. 14-17, 1997.

56. **Design and Implementation of a Teleautonomous Hummer,** Bentivegna, D.C., Ali, K.S., Arkin, R.C., Balch, T., *SPIE Conference on Mobile Robots XII,* Pittsburgh, Oct 1997.

57. **Learning Roles: Behavioral Diversity in Robot Teams,** Balch, T., Proc. Of the 1997 AAAI Workshop on Multiagent Learning, Providence RI, July 1997.

58. **JavaBots,** Balch, T., *Video Proceedings of the 1998 AAAI Mobile Robot Exhibition,* AAAI. Madison WI, July 1998.

59. **Integrating Robotics Research with JavaBots,** Balch, T. and Ram, A., 1998. Working Notes of theAAAI 1998 Spring Symposium, Stanford.

60. **Integrating RL and Behavior-Based Control for Soccer,** Balch, T*., RoboCup-97: Proceedings of the First Robot World Cup Soccer Games and Conferences,* Springer-Verlag, 1998.

61. **JavaSoccer,** Balch, T., RoboCup-97: Proceedings of the First Robot World Cup Soccer Games and Conferences, Springer-Verlag, 1998.

62. **Robots Move** (position paper on robot simulation), Balch, T., 1998. Working Notes of the AAAI 1998 Spring Symposium, Stanford. 1998.

63. **Reward and Diversity in Multirobot Foraging,** Balch, T., IJCAI-99 Workshop on Agents Learning About and with Other Agents, Stockholm, 1999.

64. **Behavioral Diversity as Multiagent Cooperation,** Balch, T., *SPIE '99 Workshop on Multiagent Systems*, Boston, 1999.

65. **Progress in RoboCup Soccer Research in 2000,** M. Asada, A. Birk, E. Pagello, M. Fujita, I. Noda,S. Tadokoro D. Duhaut, P. Stone, M. Veloso, T. Balch, H. Kitano, B. Thomas. *International Symposium on Experimental Robotics,* Honolulu, Dec, 2000.

*66.* **Hierarchic Social Entropy and Behavioral Difference: New Measures of Robot Group Diversity,** Balch, T., *NIST Workshop on Metrics for Intelligent Systems,* Gaithersburg, July, 2000.

*67.* **Model-based and Model-free Learning in Markovian and non-Markovian Domains,** Sikorski, K. and Balch, T., *Autonomous Agents (Agents 2001) Workshop on Learning Agents,* Montreal, 2001.

*68.* **Merging Gaussian Distributions for Object Localization in Multi-Robot Systems.** Stroupe, A., Martin, M., and Balch, T. *Experimental Robotics VII (Proceedings ISER 2000).* Rus and Singh (Eds). Springer, March 2001.

69. **Mission-Relevant Collaborative Observation and Localization.** Stroupe, A. and Balch, T. A.C. Schultz and L.E. Parker (eds) *Multi-Robot Systems: From Swarms to Intelligent Automata,* Kluwer, 2002.

70. **Constraint-Based Landmark Localization**. Ashley W. Stroupe, Kevin Sikorski, and Tucker Balch. *2002 RoboCup Symposium,* 2002.

71. **Niche Selection for Foraging Tasks in Multi-Robot Teams Using Reinforcement Learning.** Ulam, P., and Balch, T., *Proceedings of the 2nd International Workshop on the Mathematics and Algorithms of Social Insects, 2003.*

72. **Efficient Bids on Task Allocation for Multi Robot Exploration***,* Sanem Sariel and Tucker Balch, *The 19th International Florida Artificial Intelligence Research Society (FLAIRS) Conference*, pp. 116-121, 2006

73. **Dynamic and Distributed Allocation of Resource Constrained Project Tasks to Robots***, Sanem Sariel and Tucker Balch, Multi-Agent Robotic Systems (MARS) Workshop at the Third International Conference on Informatics in Control, Automation and Robotics*, 2006, pp. 34-43. Also presented at the *AAAI Workshop on Auction Mechanisms for Robot Coordination*, 2006

74. **An Integrated Approach To Solving the Real-World Multiple Traveling Robot Problem,** Sanem Sariel, Nadia Erdogan and Tucker Balch, 5th International Conference on Electrical and Electronics Engineering (ELECO), pp.381-385, 2007.

**Presentations without Proceedings**

75. **The AAAI Mobile Robot Competition and Exhibition Panel,** (organizer and panelist), *AAAI National Conference on AI,* Edmonton, Canda, 2002.

76. **Mixture Trees for Density Estimation and Fast Conditional Sampling.** Dellaert, F, Khan, Z., and Tucker Balch. *Snowbird* 2003.

## F. Other

### F.1. Submitted Journal Articles

1. **The Multi-ICP Tracker: An Online Algorithm for Tracking Multiple Interacting Targets,** Feldman, A, Balch, T, Hybinette, M., Cavallaro, R., in submission.

### F.2. Software

1. **TeamBots:** Tucker Balch is the lead designer of TeamBots, a collection of application programs and libraries designed to support multiagent mobile robotics research. The system is used by a number of universities and other institutions for education and research. TeamBots supports simulation of robot control systems and execution of the same control systems on mobile robots. The

simulation can execute complex scenarios involving multiple heterogeneous, possibly adversarial agents. The robot executive runs on several popular commercially available robot platforms including Nomadic Technologies' Nomad 150 robot, Personal Robotics' Cye robot, ActivMedia's AmigoBot, and RWI's ATRV series. In addition to simulation and real robot execution, the TeamBots environment includes a communications package (RoboComm), and Clay, a library to support coding of behavior-based control system. TeamBots is available online: http://www.teambots.org

2. **CMVision:** Balch assisted James Bruce (the lead designer) in the development of this real-time color-based computer vision tracking system. CMVision is widely used in the RoboCup robot soccer community. CMVision is available online: http://www-2.cs.cmu.edu/~jbruce/cmvision/

3. **TeamBots Junior:** This is a special version of TeamBots designed for education. TeamBots Junior enables children to program simulated robot soccer teams. This software was developed in conjunction with an undergraduate software engineering project at Georgia Tech. TeamBots Junior is available online at: http://www.cc.gatech.edu/~borg/teambotsjunior/

4. **QuantSoftware Toolkit:** This is an open-source toolkit for quantitative equity management. I created it with students and TAs for my courses on machine learning for trading: http://wiki.quantsoftware.org/wiki/QSToolKit

5. **Antennate:** This is an open-source toolkit for animal tracking (with Jim Rehg, Matt Flagg and Andrew Quitmeyer). We have released this to biologists interested in animal tracking.

### F.4. Technical Reports and Other Publications (non-refereed)

1. **CMU Hammerheads** (a description of our robot team entry in RoboCup-2000), Emery, R., Stroupe, A., Shern, R., Sikorski, K., and Balch, T., in *RoboCup-2000: Robot Soccer World Cup IV,* Stone, P., Balch, T., Kraetzschmar, G. (eds), Springer-Verlag, 2001.

2. **CMU Hammerheads 2001** (a description of our robot team entry in RoboCup-2001), Stancliff, S., Emery, R., Stroupe, A., Sikorski, K., and Balch, T., in *RoboCup-2001: Robot Soccer World Cup V,* Birk, A., Coradeschi, S. and Tadokoro, S. (eds), Springer-Verlag, 2002.

3. **Teaming Up: Georgia Tech's Multirobot Competition Teams,** Collins, T. and Balch, T., *AAAI National Conference on A.I. (AAAI-97),* Providence, July 1997, 785-86.

4. **Energy-Optimal Trajectories for Overactuated Robots,** Balasubramanian, R., and Balch, T., technical report CMU-RI-TR-02-17, Robotics Institute, Carnegie Mellon University, July, 2002.

## G. Research Proposals and Grants

Funding for proposals with Professor Balch as an investigator total $18.9M. As lead principal investigator his awards total $5.6M.

### G.1. Approved and Funded as lead Principal Investigator

**Reconnaisance, Surveillance and Targeting Unmanned Ground Combat Vehicle.**
Sponsor: UGCV Program, DARPA.
Investigators: Catalan, M. (Battelle), Dodson, M. (Battelle), and Balch, T.
Amount: $100,000 over six months for Balch. $500K total.
Submitted September 2000. Funded: November 2000.

**TeamBots as a RoboCup Junior Simulation Platform,**
Sponsor: Kitano Symbiotic
Investigator: Balch, T.
Amount: $40,000.
*Submitted: Spring 2000. Funded: Spring 2000.*

**Robot Swarms.**
Sponsor: Northrop-Grumman.
Investigators: Balch, T. and Choset, H.
Amount: $50,000.
*Submitted: Fall 2000. Funded: Fall 2000.*

**Intel Equipment Grant.**
Sponsor: Intel.
Investigators: Balch, T. and Dellaert, F.
Amount: $25,000 (equipment).
*Submitted: Spring 2002. Funded: Spring 2002.*

**Observing, Tracking and Modeling Social Multi-agent Systems**
Sponsor: ITR Program, National Science Foundation.
Investigators: Balch, T. and Dellaert, F.
Amount: $450,000 over three years.
*Submitted Fall 2001. Funded: Fall 2002.*

**Sun Microsystems Equipment Grant.**
Sponsor: Sun Microsystems.
Investigators: Balch, T.
Amount: $70,000 (equipment).
*Submitted: Fall 2002. Funded: Spring 2003.*

**NSF CAREER: Learning Executable Models of Physical Social Agent Behavior**
Sponsor: NSF
Investigator: Balch, T.
Amount: $500,000 over five years.
*Submitted: Fall 2003. Funded Spring 2004.*

**Learning Visual Feature Graphs, Vision and Control for Ground Robots**
Sponsor: DARPA/LAGR
Investigators: Balch, T., Dellaert, F., Egerstedt, M., Rehg, J.
Amount: $2,000,000 over three years.
*Submitted: Summer 2004. Funded Fall 2004.*

**Multiagent Control for Intelligent Minefields**
Sponsor: Naval Surface Warfare Center
Investigator: Balch, T.
Amount: $60,000
*Submitted: Fall 2004. Funded Fall 2004.*

**Personal Robots for CS Education**
Sponsor: Microsoft
Investigators: Balch, T., Guzdial, M., Kumar, D., Blank, D.
Amount: $1,500,000 over three years (contract + gifts)
*Submitted: 2006. Funded 2007.*

**G.2. Approved and Funded as Co-Principal Investigator**

**Teams of Autonomous, Cooperative and Adaptive Agents.**
Sponsor: Mobile Autonomous Robot Software Program, DARPA.
Investigators: Veloso, M., Balch, T., and Browning, B.
Amount: $1,200,000 over three years.
Submitted: Spring 1999. Funded: Summer 1999.

**Learning Structure, Reusability, and Real-time Modeling in Teams of Autonomous Robots.**
Sponsor: Control of Agent Based Systems Program, DARPA.
Investigators: Veloso, M., Balch, T., Kaminka, G.
Amount: $1,500,000 over four years.
*Submitted: Spring 1998. Funded Summer 1998.*

**TEAMS: Communication Sensitive Behaviors for Teams of Mobile Robots.**
Sponsor: MARS 2020 Program, DARPA.
Investigators: Kumar, V., Arkin, R., Balch, T., Sukhatme, G., Reddy, J.
Amount: $4,500,000 over three years.
*Submitted Spring 2002. Funded Fall 2002.*

**ITR: Morphable Software Services: Self-Modifying Programs for Distributed Embedded Systems**
Sponsor: NSF ITR.
Investigators: Schwan, K., Balch, T., Eisenhauer, G., Pande, S., Pu, C., and Gupta, R. (U of Arizona)
Amount: $3,000,000 over 5 years.
*Submitted: Spring 2003. Funded: Fall 2003.*

**Heterogeneous Unmanned Teams (ONR HUNT)**
Sponsor: ONR

Investigators: Arkin, R., Balch, T., Egerstedt, M.
Amount: $1,000,000 over 5 years (estimate, need to confirm)
*Funded 2008.*

**The Accessible Aquarium**
Sponsor: NSF
Investigators: Walker, B., Bobick, A., Balch, T.
Amount: $750,000 over 4 years (estimate, need to confirm)
*Funded 2008.*

**Deploying Robots for CS-1 Education**
Sponsor: NSF / CCLI
Investigators: Guzdial, M., Balch, T., Blank, D., Kumar, D. (joint with Bryn Mawr College)
Amount: $500,000 over 2 years
*Funded 2009.*

**Insect Behavior Imaging**
Sponsor: NSF / ABI
Investigators: Rehg, J., Balch, T., Pratt, S. (joint with Arizona State)
Amount: $750,000 over 3 years (estimate, need to confirm)
*Funded 2010.*

**Rhesus Monkey Tracking**
Sponsor: NIH
Investigators: Wallen, K., Balch, T., Rehg, J., Essa, I., (joint with Emory)
Amount: $250,000 over 1 year
*Funded 2010.*

### I. Research Honors and Awards

1. **First Place, AAAI Mobile Robot Competition,** American Association for Artificial Intelligence, Clean Up the Office Event, 1994.

2. **First Place, AAAI Mobile Robot Competition**, American Association for Artificial Intelligence, Find Life on Mars Event, 1997.

3. **Outstanding Graduate Research Assistant,** College of Computing, Georgia Tech, 1996.

4. **NASA Award for Technical Innovation,** Jet Propulsion Laboratory, 1997.

5. **NSF CAREER Award,** National Science Foundation, 2004.

## III. SERVICE

### A. Professional Activities

#### A.1. Memberships and Activities in Professional Societies

- Board of Trustees, The RoboCup Federation.
- Member, Institute of Electrical and Electronics Engineers (IEEE).
- Member, American Association for Artificial Intelligence (AAAI).
- Member, Association for Computing Machinery (ACM).

**A.2. Conference Committee Activities**

- Co-Chair, RoboCup Small Robot League 1998.
- Chair, RoboCup Small Robot League 1999,2000.
- Chair and Organizer, Workshop on Interactive Robotics and Entertainment 2000.
- Co-Chair, AAAI Mobile Robot Competition and Exhibition 1998,1999,2000.
- Co-Chair, RoboCup Workshop 2000.
- Associate Chair for Robot Events, RoboCup-2001.
- Chair, AAAI Mobile Robot Competition and Exhibition 2001, 2002.
- Co-Chair, RoboCup American Open, 2003.
- Chair and Organizer, International Workshop on the Algorithms and Mathematics of Social Insects, 2003.
- Chair, 2005 RoboCup U.S. Open, held at Georgia Tech, May 2005

**B. On-Campus Committees**

- Chair, Graduate Student Admissions Committee, Robotics, Carnegie Mellon University, 2001.
- Member, Graduate Student Admissions Committee, Robotics, Carnegie Mellon University, 2000.
- Co-Chair, Undergraduate Research Opportunities in Computing (UROC), College of Computing, Georgia Institute of Technology, 2001-2003.

**C. External Member of Ph.D. Examining Committees**

**C.1. Ph.D. Qualifying Exam Committees - Georgia Tech:**

- **Amin Atrash,** College of Computing, Spring 2002.
- **Eric Martinsen,** College of Computing, Fall 2002.
- **Lilia Moshkina,** College of Computing, Fall 2002.

- **Yochiro Endo,** College of Computing, Fall 2002.
- **Tracy Westyn,** College of Computing, Spring 2004.
- **Alan Wagner,** College of Computing, Fall 2004.
- **Ananth Ranganathan,** College of Computing, Fall 2004.

**C.2. Ph.D. Proposal Committees – Georgia Tech:**

- **Darrin Bentivegna,** College of Computing, Spring 2002.
- **Alex Stoychev,** College of Computing, Spring 2003.
- **Robert Zlot,** CMU, Spring 2004.

**C.3. External Member of Ph.D. Examining Committee:**

- **Brett Browning,** Ph.D. 2001, University of Queensland, Australia.
- **Ashley Tews,** Ph.D. 2002, University of Queensland, Australia.
- **Daniel Rodic,** University of Pretoria, South Africa.

**E. Research Project Reviewer**

- **Proposal Review Panelist,** FCT Portugal (similar to NSF), 2001.
- **NSF ITR Panel,** 2003.
- **NSF State of US Robotics Evaluation Panel,** 2004.

**F. Civic Service**

- **City of Suwanee Zoning Board of Appeals,** Member, 2003-Present.
- **City of Suwanee Zoning Board of Appeals,** Chair, January 2004.

## IV. NATIONAL AND INTERNATIONAL PROFESSIONAL RECOGNITION

### A. Editorial and Reviewer for Technical Journals and Publishers

- Editorial Board: Swarm Intelligence
- Editorial Board: Pervasive Computing
- Reviewer: Autonomous Robots.
- Reviewer IEEE Transactions on Robotics and Automation.
- Reviewer: IEEE Transactions on Robotics.

- Reviewer IEEE Transactions on Systems, Man and Cybernetics.
- Reviewer: Robotics and Autonomous Systems.
- Reviewer: ACM SIGGRAPH.

**B. Military Honors**

- Distinguished Graduate USAF Pilot Training, 1989.
- Top Instrument Pilot USAF Pilot Training, 1989.
- National Defense Service Medal 1991.
- Top Gun Team 128th Fighter Squadron, 1991, 1992.
- Air Force Achievement Medal 1993.
- Air Force Outstanding Unit Award 1991, 1992, 1995.
- Air Force Commendation Medal 1992, 1995.

**C. Media Coverage**

**C.1. Print**

- **The Associated Press,** "Computers, Robots Set to Play Soccer," August, 2000.
- **The Associated Press,** "Rescue Robots: Competition Tests Robot's Life-Saving Abilities," Connie Mabin, July 31, 2000.
- **New York Times,** Robots Learn Soccer (and the Game of Life) November 27, 2001,Yudhijit Bhattacharjee.
- **New Scientist Magazine,** "Follow that Ant," Catherine Zandonella, June, 2001.
- **Atlanta Journal Constitution,** “Research Wags the Robot Dog at Georgia Tech,” Rebecca MacCarthy, December 7, 2002.
- **Washington Post,** “The Games Robots Play,” Guy Gugliotta, May 13, 2003.
- **Associated Press,** “Artificial Athletes Compete in RoboCup,” Eliott McLaughlin, May 10, 2005. Carried by: Sports Illustrated, ABC News, Washington Post, L.A. Times.
- **BBC News Online,** “Robots compete in football league,” May 11, 2005.

**C.2. Radio**

- **National Public Radio,** story about soccer robots, Lee Gutkind, July, 2001.

- **National Public Radio,** story about the RoboCup US Open, May 11, 2005.
- **WABE Atlanta,** story about the RoboCup US Open, Ted Vigodsky, May 26, 2005.

### C.3. Television

- **Scientific American Frontiers (PBS),** "Natural Born Robots," November 2, 1999.
- **Public Broadcasting System,** "Beyond Human," Thomas Lucas Productions, May, 2001.
- **CNN,** “Robot Dog Soccer,” June 2, 2003.
- **CNN,** “Honey Bee Dancing,” September 2003.
- **CNN,** “New Explorers,” Fall 2004.
- **Reuters TV,** “RoboCup US Open,” May 15, 2005. Carried by BBC World.

## V. OTHER CONTRIBUTIONS

### A. Invited Talks

1. **Royal Institute of Technology (Sweden), Robotics Seminar, Invited Speaker,** Stockholm, Sweden, 1998.
2. **AAAI-98 Robot Competition Workshop, Invited Panelist,** Madison, WI, 1998.
3. **CMU VASC Seminar, Invited Speaker,** Pittsburgh, 1999.
4. **Westinghouse High School Initiative, Invited Speaker,** Pittsburgh,January, 2000.
5. **CMU Robotics Institute Seminar, Educating with and about Robots, (organizer and speaker),** Pittsburgh, December, 2000.
6. **CMU Seminar on Robotics Education, Invited Speaker,** Pittsburgh, June, 2000.
7. **ICRA-2000 Workshop on Sensor-based Navigation, Invited Speaker,** San Francisco, April, 2000.
8. **NIST Workshop on Performance Metrics for Intelligent Systems, Invited Speaker,** Gaithersburg, August, 2000.
9. **Autonomous Minirobots for Research and Edutainment, Keynote Speaker,** Paderborn, Germany,December, 2001.
10. **Smithsonian Institution, Invited Demonstration** of soccer robots, December, 2000.

11. **Navy Center for Applied Research in Artificial Intelligence Seminar Series, Invited Speaker,** Washington, DC, February, 2002.

12. **Stanford Research Institute, AI Seminar Series,** Invited Speaker, Stanford, CA, November, 2002.

13. **NATO Workshop on Multi-Robot Systems,** Invited Speaker. Naval Research Lab, Washington, D.C., March 2003.

14. **Robotics Institute Seminar,** Invited Speaker. CMU, February 2004.

15. **National Conference on AI**, Plenary Speaker, Pittsburgh, July 2005.

16. **Gordon Research Conference,** Invited Speaker, Oxford University, July 2005.

17. **Swarm Robotics Workshop,** Invited Speaker, Napa Valley, August 2005.

18. **Harvard University,** Invited Speaker, Computer Science Seminar, December 2010.

## VI. PERSONAL DATA

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|---|---|
| Born: | July 4, Miami, Florida. |
| Telephone: | 678-482-6595 |
| Wife: | Maria Hybinette (Associate Professor, C.S., University of Georgia). |
| Children: | Gunnar, Tucker, Emmy |
| Citizenship: | USA |
| Email: | tucker@cc.gatech.edu |
| WWW: | http://www.cc.gatech.edu/~tucker |