

Robert M. Zlot

CONTACT INFORMATION

The Robotics Institute
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RESEARCH INTERESTS

My focus is on developing artificial intelligence and coordination techniques to support the goals of building fieldable teams of robots and intelligent teams of software agents. My current research is aimed at finding ways to make multirobot systems behave more efficiently, reliably, and robustly in real-world environments. My interests include industrial, environmental, underwater, ground, space, and science-driven applications. I am currently working on a framework for planning and allocating complex tasks among a robot team using economic principles.

EDUCATION

Carnegie Mellon University, Pittsburgh, Pennsylvania USA

Ph.D., Robotics

October 2006

Dissertation Topic: "Complex Task Allocation for Multirobot Teams"

Advisor: Anthony Stentz

Carnegie Mellon University, Pittsburgh, Pennsylvania USA

M.S., Robotics

Advisor: Anthony Stentz

December 2002

York University, Toronto, Canada

B.Sc., Space and Communications Science (Computer Science Stream)

May 2000

RESEARCH EXPERIENCE

Ph.D. Research, Carnegie Mellon University, Pittsburgh, PA

2000 - Present

My research focuses on coordinating a team of robots using *market-based* techniques. In such an approach, a team of robots is modeled as participants in a virtual economy. Market mechanisms such as auctions enable the efficient allocation of team resources to mission requirements. My thesis work looks at exploiting the structure of complex tasks in order to produce better solutions for decomposing and allocating them. Using a novel auction mechanism, the market can be used to compare individual preferences for task assignments and simultaneously compare diverse plans for achieving abstract tasks. The combination of planning, task allocation, scheduling, and optimization requirements inherent in complex problems provides a rich and challenging domain in which to explore novel solution concepts. Research activities include:

- Design and implementation of a framework for allocating complex tasks among a team of robots more efficiently than the existing state of the art;
- Software design and development on the *TraderBots* market-based multirobot coordination framework. A release version of *TraderBots* is being used by several internal and external research groups for various robotic and non-robotic applications;
- Development of a 3D graphical multirobot simulator;
- Implementation on teams of both indoor and outdoor robots and software agent systems, and in multiple application domains, including: exploration, area reconnaissance, surveillance, distributed sensing, and object pushing.

Videos and images available at: <http://www.cs.cmu.edu/~robz/multimedia.html>

Centre for Research in Earth and Space Technology, Instrument Services Laboratory
(currently Spectral Applied Research Inc.) *Toronto, Canada* **Summer 1999**

I worked with Paul J. Thomas on the development of optical instrument systems for space applications. Research activities included:

- Design and implementation of software for various space applications; including work in signal processing, data analysis, instrument drivers;
- Assisted in conceptual design for a satellite-borne CMOS camera sensor system intended to detect infrequent events on Earth, such as incipient wildfires;
- Thermal modeling of a passive cryocooler that has been launched into orbit on two satellites;
- Performance of laboratory and computer simulation experiments relevant to space and optical instrument technologies.

TEACHING
EXPERIENCE

Teaching Assistant, Carnegie Mellon University, *Pittsburgh, PA*
Course: 15-384, Robotic Manipulation

Fall 2002
Instructor: Matt Mason

Teaching Assistant, York University, *Toronto, Canada*
Course: COSC1020, Introduction to Computer Science I

Fall 1999 and Spring 2000

HONORS AND
AWARDS

2000-Present: Carnegie Mellon Graduate Student Scholarship

2000: Governor-General Of Canada Silver Academic Medal; York University Faculty of Pure and Applied Science Gold Medal for Academic Excellence; National Science and Engineering Research Council of Canada Postgraduate Scholarship; Norman Bethune Masters Prize for Academic Excellence; Allan S. Berg Award in Memory of Nancy Waisbord; Dean's Honour Roll

1999: York University Continuing Student Scholarship; Dean's Honour Roll

1998: York University Continuing Student Scholarship; YUFA Foundation Undergraduate Scholarship; Ruth Hill Memorial Scholarship; President's Honour Roll; Dean's Honour Roll

1997: York University Continuing Student Scholarship; McKittrick Scholarship; Herschel Prize; Dean's Honour Roll

1996: York Entrance Scholarship; York Science Scholarship; York Mills Collegiate Institute Chemistry Departmental Proficiency Award

JOURNAL
ARTICLES

R. Zlot and A. Stentz, *Market-based Multirobot Coordination for Complex Tasks*, International Journal of Robotics Research Special Issue on the 4th International Conference on Field and Service Robotics, Vol. 25, No. 1, January 2006.

M. B. Dias, R. Zlot, N. Kalra, A. Stentz, *Market-based Multirobot Coordination: A Survey and Analysis*, Proceedings of the IEEE Special Issue on Multirobot Systems, 94(7), July 2006.

CONFERENCE
PAPERS

R. Zlot, A. Stentz, *Complex Task Allocation and Execution for Teams of Multiple Autonomous Vehicles*, AUVSI Unmanned Systems North America, 2006.

R. Zlot, A. Stentz, *Complex Task Allocation for Multiple Robots*, IEEE International Conference on Robotics and Automation, 2005.

R. Zlot, A. Stentz, *Market-based Complex Task Allocation For Multirobot Teams*, Army Science Conference, 2004.

A. Stentz, M. B. Dias, R. Zlot, N. Kalra, *Market-Based Approaches for Coordination of Multi-Robot Teams at Different Granularities of Interaction*, American Nuclear Society 10th International Conference on Robotics and Remote Systems for Hazardous Environments, 2004.

M. B. Dias, M. Zinck, R. Zlot, A. Stentz, *Robust Multirobot Coordination in Dynamic Environments*, IEEE International Conference on Robotics and Automation, 2004.

M. B. Dias, R. Zlot, M. Zinck, J. P. Gonzalez, A. Stentz, *A Versatile Implementation of the Trader-Bots Approach for Multirobot Coordination*, the 8th International Conference on Intelligent Autonomous Systems, 2004.

R. Zlot, A. Stentz, *Market-based Multirobot Coordination Using Task Abstraction*, International Conference on Field and Service Robotics, 2003.

R. Zlot, A. Stentz, *Multirobot Control Using Task Abstraction In a Market Framework*, Collaborative Technology Alliances Conference, 2003.

R. Zlot, A. Stentz, M. B. Dias, S. Thayer, *Multi-Robot Exploration Controlled By A Market Economy*, IEEE International Conference on Robotics and Automation, 2002.

R. Simmons, T. Smith, M. B. Dias, D. Goldberg, D. Hershberger, A. Stentz, R. Zlot, *A Layered Architecture for Coordination of Mobile Robots*. In *Multi-Robot Systems: From Swarms to Intelligent Automata*, NRL Workshop on Multi-Robot Systems, Kluwer Academic Publishers, 2002.

P. J. Thomas, R. Hornsey, C. Hong, M. Mullins, R. Zlot, G. Iourtchenko, *Adaptive Distributed Infrared Remote Sensing Instrument Concept for Microsatellites*, Proceedings of SPIE Volume 3759, Infrared Spaceborne Remote Sensing VII, 1999.

POSTER
PRESENTATIONS

R. Zlot, *Complex Task Allocation and Execution for Multirobot Teams*, Fourth Americas School on Agents and Multiagent Systems, July, 2005.

A. Stentz, *CD*: A Real-time Resolution Optimal Re-planner for Globally Constrained Problems*, The Seventeenth National Conference On Artificial Intelligence (AAAI-02), July, 2002.

TECHNICAL
REPORTS

M. B. Dias, R. Zlot, N. Kalra, A. Stentz *Market-based Multirobot Coordination: A Survey and Analysis*, CMU-RI-TR-05-13, The Robotics Institute, Carnegie Mellon University, April, 2005.

R. Zlot, A. Stentz, M. B. Dias, S. Thayer, *Market-driven Multi-Robot Exploration*, CMU-RI-TR-02-02, The Robotics Institute, Carnegie Mellon University, January, 2002.

PROFESSIONAL
ACTIVITIES

WORKSHOPS

Program Committee, *Auction Mechanisms for Robot Coordination*, The Twenty-first National Conference on Artificial Intelligence (AAAI-06); July 17, 2006.

CONFERENCE TUTORIALS

Presenter, *Auction-Based Agent Coordination*, The Fifth International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS 2006); May 9, 2006.

Contributor, *Auction-Based Agent Coordination*, The IEEE International Conference on Robotics and Automation (ICRA); May 15, 2006.

Presenter, *Auction-Based Agent Coordination*, The Twenty-first National Conference on Artificial Intelligence (AAAI-06); July 16, 2006.

ADVISING

Served on *Masters* and *Ph.D.* Qualifier Committees for: Rahul Singh, Juan Pablo Gonzalez, Andr es Santiago Perez-Bergquist; CMU Robotics Institute, 2000-present.

Advised and supervised Undergraduate Researchers, rCommerce Lab, CMU, 2005-present.

OTHER ACTIVITIES

Reviewer for conferences and journals, including: Robotics and Autonomous Systems, IEEE International Conference on Robotics and Automation (ICRA), Robotics: Science and Systems, Autonomous Agents and Multiagent Systems (AAMAS), National Conference on Artificial Intelligence (AAAI), Neural Information Processing Systems (NIPS), International Joint Conference on Artificial Intelligence (IJCAI), RoboCup Symposium.

Member of IEEE and AAAI.

Served on robotics graduate student organization as a Class Representative (2000-2002, 2005-2006) and Department Tour Coordinator (2001-2002).

Member of York University ACM International Collegiate Programming Competition Team, 1999.

PERSONAL

Canoeing and kayaking: Summer Program Director and Instructor at Camp Winnebago, Huntsville, Ontario, Canada from 1995-1998, 2000.

Music and dance: DJ at WRCT Pittsburgh 2002-2004, guitar, lindy hop.

Sport: distance running, weightlifting, cycling.

Other: Canadian citizen, proficient in French.

REFERENCES

Dr. Anthony Stentz (Ph.D. advisor) tony+@cmu.edu
Research Professor/Associate Director of the National Robotics Engineering Center
Carnegie Mellon University, Pittsburgh, PA

Dr. M. Bernardine Dias mbdias@ri.cmu.edu
Research Scientist
Carnegie Mellon University, Pittsburgh, PA

Additional references available upon request.