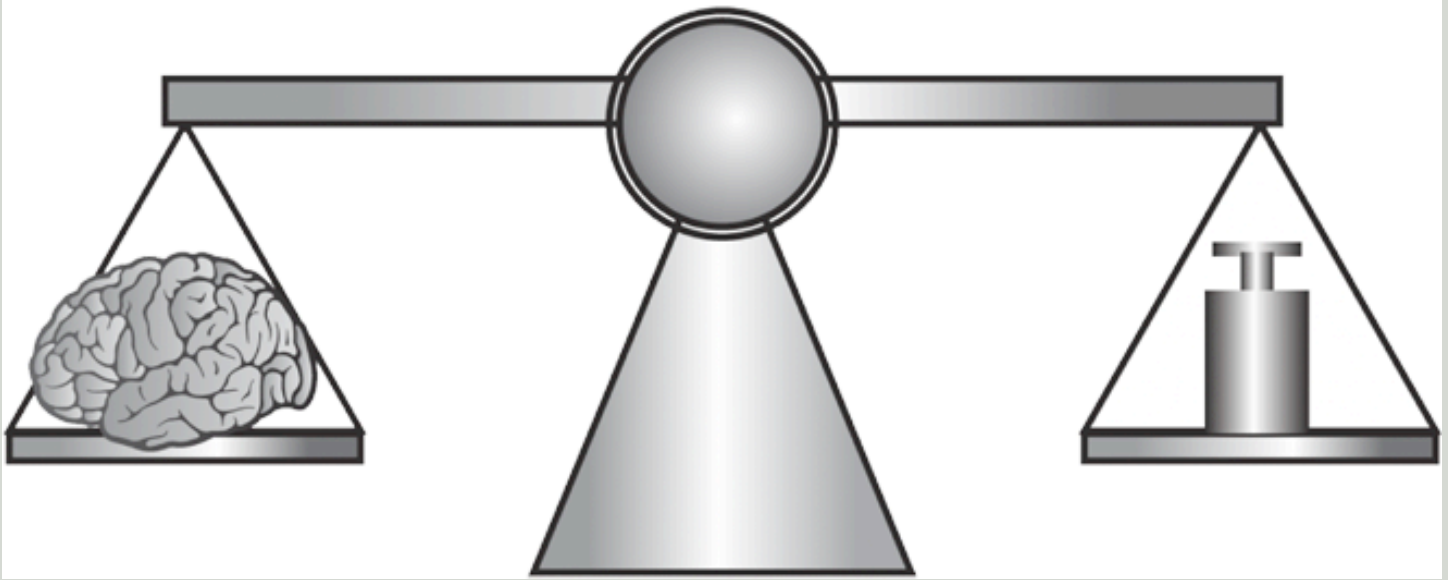


PERFORMANCE METRICS
for
INTELLIGENT SYSTEMS (PerMIS)
WORKSHOP

Hyatt Regency, Baltimore, Maryland USA
September 28 - 30, 2010

10 years
PerMIS



FOREWORD

“It is both in a spirit of scientific enquiry and for pragmatic motivations that we embark on the quest for metrics for intelligence of constructed systems.”

From the White Paper explaining the goals of the Workshop: “Measuring Performance and Intelligence of Systems with Autonomy: Metrics for Intelligence of Constructed Systems,” Messina, E. and Meystel, A., Editors, *Measuring the Performance and Intelligence of Systems: Proceedings of the 2000 PerMIS Workshop*, Gaithersburg, MD, August 14-16, 2000, NIST Special Publication 970.

As the new millennium was upon us in 2000, a group of researchers gathered for the first time seeking to address several issues pertaining to intelligent systems:

- How can we measure the current state of the science and assess progress in the field?
- How can users select among different candidate systems and decide which system will be most suited to their application?
- How can we break the cycle of re-invention and constant initiation of project with blank slates and find ways to reuse existing components?

The first Performance Metrics for Intelligent Systems brought together researchers, developers, and users from disparate academic disciplines and domains of application to share ideas about how to tackle the multi-faceted challenges of defining and measuring intelligence in artificial systems. The intelligent systems could take numerous forms: robots, factory or enterprise control systems, smart homes, decision support systems, etc. A community was formed, which evolved over the years. The workshop series carried on and became an annual event (with the exception of 2005).

Intelligent systems are becoming more of a reality with each passing year and the questions raised in the first workshop are still relevant. Additional questions have been raised, such as “how does one specify the requirements for the performance of an intelligent system?” and “how can concrete performance goals and good measures of performance help spur and focus innovation?” Over the years, the center of gravity of the program shifted more towards applied measures, rather than theoretical discussions about the general nature of intelligence. Many communities have availed themselves of the special sessions to focus on their particular interests and create mini-workshops. The concept of performance evaluation being an integral part of any research and acquisition program has become accepted. Many of the papers published in the PerMIS proceedings have been highly-referenced and provide the communities with good starting points for establishing measurements for new projects and programs. We are extremely grateful to the numerous colleagues who have supported PerMIS throughout the years. Without their dedication and hard work, this series would not have survived for a decade.

In this 10th workshop, we focus our attention to systems which are designed to work closely with humans. The theme of PerMIS’10 is **key role of performance assessment in developing intelligent systems that can co-exist with humans** towards improving the quality of our lives intertwined with automation. Adaptability to human-centered collaboration, the ability to cope with unstructured, dynamic environments, and keeping humans out of harm’s way have been widely accepted as critical prerequisites. Designing such flexible,

smart, and safe systems requires that their performance be quantifiable thereby facilitating emerging technologies and societal acceptance.

PerMIS'10 is sponsored by NIST, DARPA and NSF, with technical co-sponsorship of the IEEE Washington Section Sensors Council Chapter, and in cooperation with the Association for Computing Machinery (ACM) Special Interest Group on Artificial Intelligence (SIGART). The Defense Advanced Research Projects Agency Information Processing Technology Office graciously provided funding to help support the workshop. Special thanks are due to the National Science Foundation for providing funding to allow undergraduate and graduate students to participate in a special poster session this year. We also thank Professor Holly Yanco of the University of Massachusetts – Lowell for organizing the student poster grants program. We gratefully acknowledge the support of our sponsors.

We thank the special session organizers for proposing interesting topics and assembling researchers related to their sessions. These focused sessions provide an opportunity to delve deeper into specialized topics and to hear from experts in the field. Our thanks are also due to the Program Committee members for publicizing the workshop and the reviewers for providing feedback to the authors, and for helping us to put together an exciting program.

The proceedings of PerMIS will be indexed by INSPEC and Compendex and will be available through ACM's Digital Library, as well as being released as a NIST Special Publication. Outstanding papers from this year's proceedings will be considered for inclusion, in an expanded form, in a special issue of the *International Journal of Intelligent Control and Systems*.

It is our sincere hope that you will enjoy the presentations, the social programs, renew old relationships, and forge new ones at PerMIS'10!

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General Chair

[Raj Madhavan](#)
Program Chair

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PLENARY SPEAKERS

Prof. Gregory Dudek, McGill University, Canada

Building Interfaces for Robotic Data Collection and Human-Robot Collaboration Underwater and Outdoors

Tue. 8:30 am

ABSTRACT

In outdoor environments robots are ready to serve as tools for scientific data collection as well as assistants for human operators. Typically, however, a robotic system is subservient to a human operator and needs to respond to commands and constraints that may be issued in the field. On the other hand, keyboard entry and reprogramming is not appropriate user-interface mechanisms, even for technical users, when they are on a field expedition. Our lab has been developing human-robot interaction methods that allow a scuba diver to interact with a robotic assistant while underwater. This has entailed both the development of an amphibious robotic device with emphasis on gait selection, locomotion modes and software infrastructure, and on a communication language based on optical sensing of fiducial markers. A key part of this has been measuring the performance of the vehicle underwater and, more significantly, attempting to develop a communication paradigm for use underwater that is at once both expressive but also manageable. Due to the substantial logistic overheads in doing work underwater, developing terrestrial surrogate tests to evaluate out work has also been an important requirement. Finally, we are working towards integrating the activities of our underwater vehicles with an amphibious mode of operation, a robotic boat, and a fixed-wing robotic aircraft. While we have made some progress towards our objectives, several challenges remain.

BIOGRAPHY

Gregory Dudek is a Professor with the School of Computer Science and a member of the McGill Research Centre for Intelligent Machines (CIM) and an Associate member of the Dept. of Electrical Engineering at McGill University. In 9/2008 he became the Director of the McGill School of Computer Science. He is the former Director of McGill's Research Center for Intelligent Machines, a 25 year old inter-faculty research facility. In 2002 he was named a William Dawson Scholar. In 2008 he was made James McGill Chair. In 2010 he was awarded the Fessenden Professorship in Science Innovation. In 2010 he was also awarded the Canadian Image Processing and Pattern Recognition Award for Research Excellence and also for Service to the Research Community. He directs the McGill Mobile Robotics Laboratory. He has been on the organizing and/or program committees of Robotics: Systems and Science, the IEEE International Conference on Robotics and Automation (ICRA), the IEEE/RSJ International Conference on Intelligent Robotics and Systems (IROS), the International Joint Conference on Artificial Intelligence (IJCAI), Computer and Robot Vision, IEEE International Conference on Mechatronics and International Conference on Hands-on Intelligent Mechatronics and Automation among other bodies. He is president of CIPPRS, the Canadian Information Processing and Pattern Recognition Society, an ICPR national affiliate. He was on leave in 2000-2001 as Visiting Associate Professor at the Department of Computer Science at Stanford University and at Xerox Palo Alto Research Center (PARC). During his sabbatical in 2007-2008 he visited the Massachusetts Institute of technology and co-founded the company Independent Robotics Inc. He obtained his PhD in computer science (computational vision) from the University of Toronto, his MSc in computer science (systems) at the University of Toronto and his BSc in computer science and physics at Queen's University. He has published over 170 research papers on subjects including visual object description and recognition, robotic navigation and map construction, distributed system design and biological perception. This includes a book entitled "Computational Principles of Mobile Robotics" co-authored with Michael Jenkin and published by Cambridge University Press. He has chaired and been otherwise involved in numerous national and international conferences and professional activities concerned with Robotics, Machine Sensing and Computer Vision. He research interests include perception for mobile robotics, navigation and position estimation, environment and shape modelling, computational vision and collaborative filtering. He grew up in Montreal and favors light food. With his children he is re-discovering model rocketry, rollerblading, and has discovered he's not good at surfing but loves it.

Prof. Herman Bruyninckx, Katholieke Universiteit Leuven, Belgium

Benchmarking Reusability and Composability in Complex Software Systems—The Open Source Opportunity

Tue. 2:00 pm

ABSTRACT

Designers of current and future robot systems are confronted with an increasing amount of complexity, not only with respect to the richness of the desired end-user functionalities in these systems, but also with respect to the hardware and software infrastructure required to realise these functionalities. The domain of robotics has passed the tipping point beyond which it is not possible anymore for one single organization or company to develop robot systems completely in house.

Hence, system designers must find ways to integrate third-party components into their designs, reliably, predictably and effectively. This talk defines the concepts of reusability and composability on this context of complex systems design in a multi-sourcing world, and discusses a dozen or so aspects that system designers can use to benchmark reusability and composability of components, their own as well as those from third-party providers. Throughout the presentation, the role and importance of free and open source software will be motivated, and illustrated via a number of (un)successful real-world examples.

BIOGRAPHY

Dr. Bruyninckx obtained the Masters degrees in Mathematics (Licentiate, 1984), Computer Science (Burgerlijk Ingenieur, 1987) and Mechatronics (1988), all from the Katholieke Universiteit Leuven, Belgium. In 1995 he obtained his Doctoral Degree in Engineering from the same university, where he is now professor with research interests in on-line Bayesian estimation of model uncertainties in sensor-based robot tasks, kinematics and dynamics of robots and humans, and the software engineering of large-scale robot control systems. In 2001, he started the Free Software ("open source") project Orocos, to support his research interests, and to facilitate their industrial exploitation.

Prof. Ken Goldberg, University of California, Berkeley, USA

Putting the Turing into Manufacturing: Recent Developments in Algorithmic Automation

Wed. 8:30 am

ABSTRACT

Automation for manufacturing today is where computer technology was in the early 1960's, a patchwork of ad-hoc solutions lacking a rigorous scientific methodology. CAD provides detailed models of part geometry. What's missing is formal models of part behavior, frameworks for the systematic design of automated systems that handle (e.g. assemble, inspect, sort, feed) parts, and tools for rigorous specification, analysis, and synthesis.

In 1937, Alan Turing introduced an elegant model of computing with precise vocabulary and operations that formalized concepts of equivalence, correctness, completeness, and complexity. Can we develop similar models for manufacturing?

"Algorithmic Automation" introduces abstractions that allow the functionality of automation to be designed independent of the underlying implementation and can provide the foundation for formal specification and analysis, algorithmic design, and consistency checking. Algorithmic Automation can facilitate integrity, reliability, interoperability, and maintainability and upgrading of automation. Researchers are developing a variety of algorithmic models. I'll present results from my lab and others on specific problems in part feeding and fixturing, including a framework for fixturing deformable parts and new geometric primitives for vibratory bowl feeders, and propose open problems for future research..

BIOGRAPHY

Ken Goldberg is Professor of IEOR, EECS, and the iSchool at UC Berkeley, and craigslist Distinguished Professor of New Media. He served two terms as Vice-President of Technical Activities for the IEEE Robotics and Automation Society. His research addresses robot manipulation, geometric algorithms for automation, and networked robots. More information on his work is available at: <http://goldberg.berkeley.edu/>

Dr. Jonathan A. Bornstein, Army Research Laboratory, USA

ARL Autonomous Systems Enterprise

Wed. 2:00 pm

BIOGRAPHY

Dr. Bornstein has been intimately involved in robotics for over a decade. He has served as Chief of the Autonomous Systems Division, Vehicle Technology Directorate, Army Research Laboratory since January 2010. He has responsibility for a group of approximately 30 Government and contractor personnel conducting research in perception and intelligence research for unmanned vehicle systems and a micromechanics group. He is the Collaborative Alliance Manager for the new Robotics CTA and has responsibility for coordination of autonomous systems research throughout ARL. He previously served as Chief of the Army Research Laboratory Robotics Program Office (RPO) and Collaborative Alliance Manager for the Robotics Collaborative Technology Alliance (CTA) (since April 2006) and as an engineer in the RPO since 1997. From 1995 through 1996 he served as a Program Manager at the Defense Advanced Research Projects Agency (DARPA) with responsibility for the Demo II Unmanned Ground Vehicle Program.

Dr. Bornstein received his PhD. in Aeronautics & Astronautics from the Polytechnic Institute of New York in 1976. From 1975 through 1985 he was a member of the Fluid Mechanics Group at the Corporate Research Labs of Brown, Boveri & Cie, AG in Baden, Switzerland. In 1985, he joined the Fluid Physics Branch of the U.S. Army Ballistics Research Laboratory conducting research in projectile launch dynamics. With the formation of the Army Research Laboratory in 1992, his technical focus shifted from dynamics to weapons systems and ultimately robotics technology. He received a U.S. Army Research & Development Achievement Award in 1989 and Army Superior Civilian Service Award in 1997. He is a registered Professional Engineer in Maryland.

Ms. Helen Greiner, CEO of CyPhy Works and Founder of iRobot, USA

Thur. 8:30 am

BIOGRAPHY

Helen Greiner is CEO of CyPhy Works, Inc, a startup company whose mission is to be a "SkunkWorks" for robotics. She is a co-founder of iRobot, a ~\$300Million business and the global leader of practical robots. Ms Greiner served as President of iRobot until 2004, Chairman until October 2008, and currently serves on the iRobot Board. While at iRobot, she developed the strategy for and led iRobot's entry into the military market place. She served as the Principal Investigator on the DARPA program that created the original PackBot Tactical Mobile Robot, of which over 3,000 have now been deployed. At iRobot, she helped create a culture of practical innovation and performance that led to the creation of the iRobot Warrior, PackBot EOD, SUGV, and successful participation in many other DARPA, Army and Navy research programs. Ms. Greiner also ran iRobot's financing projects which included raising \$35M venture capital and a \$70M initial public offering. Before starting her new venture, she led iRobot's investment in a deployable Flash LADAR and acquisition of Nekton, an Unmanned Underwater Vehicle (UUV) company. Greiner holds a bachelor's degree in mechanical engineering and a master's degree in computer science, both from MIT. She was presented with an honorary PhD by WPI in 2009.

Ms. Greiner is highly decorated for her contributions in technology innovation and business leadership. She was named by the Kennedy School at Harvard in conjunction with the U.S. News and World Report as one of America's Best Leaders and was honored by the Association for Unmanned Vehicle Systems International (AUVSI) with the prestigious Pioneer Award. She has also been honored as a Technology Review Magazine "Innovator for the Next Century," invited to the World Economic Forum as a Global Leader of Tomorrow, and has been awarded the DEMO God Award at the DEMO Conference. In 2003, she was named one of the Ernst and Young New England Entrepreneurs of the Year and has been inducted in the Women in Technology International (WITI) Hall of Fame. Her 20+ years of experience in robotic technology includes work at NASA's Jet Propulsion Laboratory and MIT's Artificial Intelligence Laboratory. Ms. Greiner is a Trustee of the Boston Museum Science, Massachusetts Institute of Technology (MIT), National Defense Industrial Association (NDIA), Autonomous Unmanned Systems Vehicle International (AUVSI), the Massachusetts Technology Leadership Council (MTLC), and the US Army War College Board of Visitors. Ms. Greiner serves as the elected President and Board Member of the Robotics Technology Consortium (RTC) - a 180 member industrial/academic group.

Tuesday September 28		Wednesday September 29		Thursday September 30	
8:00-8:30	Welcome/Opening Remarks	Overview		Overview	
8:30-9:30	Plenary 1: Gregory Dudek	Plenary 3: Ken Goldberg		Plenary 5: Helen Greiner	
9:30-10:00	Coffee Break	Coffee Break		Coffee Break	
10:00 -12:30	TUE-AM1: Measures and Metrics	WED-AM1: Testing and Evaluation of Intelligent Systems	WED-AM2: Evaluation of Human Detection and Tracking for Robot Safety, Collaboration and Interaction	THU-AM1: Human-Machine Interaction and Collaboration	THU-AM2: Evaluation of Sensors for Object Pose Estimation in Manufacturing Applications
12:30-14:00	Lunch	Lunch		Lunch	
14:00 - 15:00	Plenary 2: Herman Bruyninckx	Plenary 4: Jon Bornstein		(14:00-16:00) THU-PM1: Integrated Performance Assessment Through Experimentation	(14:00-16:00) THU-PM2: Performance Evaluation for Mapping & Navigation in Unstructured Environments
15:00-15:30	Coffee Break	Coffee Break		Coffee Break 16:00-16:30	
15:30 -17:30	TUE-PM1: Interoperability and Sustainability	WED-PM: Co-X Panel Discussion		THU-PM2: Performance Evaluation for Mapping & Navigation in Unstructured Environments	
	TUE-PM2: Unmanned and Autonomous System Test Technology				
	Reception & Poster Session (18:30-20:30)	Banquet (Dinner Cruise) (18:30 – 22:00)		Adjourn 16:30	

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TUESDAY

08:00	Welcome & Opening Remarks - Howard Harary, Acting Director, MEL, NIST
08:30	Plenary Presentation: Gregory Dudek Building Interfaces for Robotic Data Collection and Human-Robot Collaboration Underwater and Outdoors
09:30	Coffee Break
10:00	TUE-AM1 Measures & Metrics <i>Chairs: Hui-Min Huang and Seungbin Moon</i> <ul style="list-style-type: none"> • Visual Metrics for the Evaluation of Sensor Data Quality in Outdoor Perception [Christopher Brunner, Thierry Peynot] • Proposals for New UGV, UMV, UAV, and HRI Standards for Rescue Robots [Robin Murphy] • Metric Selection for Evaluating Human Supervisory Control of Unmanned Vehicles [Birsen Donmez, M. L. Cummings] • Performance Measures Framework for Unmanned Systems (PerMFUS): Models for Contextual Metrics [Hui-Min Huang, Elena Messina, Adam Jacoff, Robert Wade, Michael McNair] • Towards Standardization of Metrics for Evaluation of Artificial Visual Attention [M. Zaheer Aziz, Bärbel Mertsching] • Performance Evaluation Procedure for Vision Based Object Feature Extraction Algorithms [Minku Kang, Wonkook Choo, Seungbin Moon] • Benchmarks, Performance Evaluation and Contests for 3D Shape Retrieval [Afzal Godil, Zhouhui Lian, Helin Dutagaci, Rui Fang, Vanamali ThiruvadandamPorethi, Chun Pan Cheung]
12:30	Lunch
14:00	Plenary Presentation: Herman Bruyninckx Benchmarking Reusability and Composability in Complex Software Systems–The Open Source Opportunity
15:00	Coffee Break
15:30	TUE-PM1 Interoperability & Sustainability <i>Chairs: John Horst and Ani Hsieh</i> <ul style="list-style-type: none"> • Modeling and Simulation Analysis Types for Sustainable Manufacturing [Deogratias Kibira, Guodong Shao, Tina Lee] • Metrics for the Cost of Proprietary Information Exchange Languages in Intelligent Systems [John Horst, Nathan Hartman, George Wong] • Component Models in Robotics Software [Azamat Shakhimardanov, Nico Hochgeschwender, Gerhard Kraetzschmar] • Benchmarking Production System, Process Energy, and Facility Energy Performance Using a Systems Approach [Jorge Arinez, Stephan Biller, Kevin Lyons, Swee Leong, Goudong Shao, B.E. Lee, John Michaloski] • Complexity Measures for Distributed Assembly Tasks [Ani Hsieh, Joshua Rogoff] • Advanced Sensing Towards Improved Forklift Safety [Roger Bostelman, Will Shackelford]
18:30	Reception & Student Poster Session

08:00	Welcome & Opening Remarks - Howard Harary, Acting Director, MEL, NIST
08:30	Plenary Presentation: Gregory Dudek Building Interfaces for Robotic Data Collection and Human-Robot Collaboration Underwater and Outdoors
09:30	Coffee Break
10:00	TUE-AM2 Special Session I: Performance Metrics for Mixed Palletizing Operations <i>Organizers: Stephen Balakirsky and Henrik Christensen</i> <ul style="list-style-type: none"> Mixed Palletizing in Transformed Supply Chains: Operational Requirements and Technical Challenges [Larry Sweet] Industrial Robots in Warehousing and Distribution Operations [Don Faulkner and Sean Murphy] Planning in Logistics: A Survey [Pushkar Kolhe, Henrik Christensen] Metrics for Mixed Pallet Stacking [Stephen Balakirsky, Tom Kramer, Fred Proctor] Panel Discussion
12:30	Lunch
14:00	Plenary Presentation: Herman Bruyninckx Benchmarking Reusability and Composability in Complex Software Systems–The Open Source Opportunity
15:00	Coffee Break
15:30	TUE-PM2 Special Session II: Unmanned and Autonomous System Test Technology <i>Organizer: Robert Heilman</i> <ul style="list-style-type: none"> Unmanned and Autonomous Systems Test Technology [Rob Heilman] A Multi-Vehicle Testbed for Underwater Motion Coordination [Nitin Sydney, Seth Napora, Derek Paley] Measurement of Autonomous Operations [Bill Hamel] DCF® – A JAUS and TENA Compliant Agent-based Framework for UAS Performance Evaluation [Nicholas Lenzi, Benjamin Bachrach, Vikram Manikonda] Testing and Evaluation Aspects of Integration of Unmanned Air Systems into the National Air Space [Mauricio Castillo-Effen, Nikita Visnevski]
18:30	Reception & Student Poster Session

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WEDNESDAY

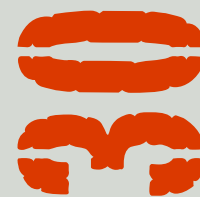
08:15	Overview
08:30	Plenary Presentation: Ken Goldberg Putting the Turing into Manufacturing: Recent Developments in Algorithmic Automation
09:30	Coffee Break
10:00	WED-AM1 Testing & Evaluation of Intelligent Systems <i>Chairs: Brian Weiss and James Gunderson</i> <ul style="list-style-type: none"> • Evaluating Intelligent Systems with Performance Uncertainty in Large Test Spaces [Miles Thompson] • The Multi-Relationship Evaluation Design Framework: Creating Evaluation Blueprints to Assess Advanced and Intelligent Technologies [Brian Weiss, Linda Schmidt] • Implementation and Application of Maximum Likelihood Reliability Estimation from Subsystem and Full System Tests [Coire Maranzano, James Spall] • “What do you do with a drunken robot?” In Situ Performance Measurements of Intelligent Mobile Robots [James Gunderson, Louise Gunderson] • Comprehensive Standard Test Suites for the Performance Evaluation of Mobile Robots [Adam Jacoff, Hui-Min Huang, Elena Messina, Ann Virts, Tony Downs] • Towards a Standardized Test for Intelligent Wheelchairs [Joelle Pineau, Robert West, Amin Atrash, Julien Villemure, Francois Routhier] • Evaluation of Ultra-Wideband Technology for Use in 3-D Locating Systems [Adam Kopp, Kamel Saidi, Hiam Khoury]
12:30	Lunch
14:00	Plenary Presentation: Jon Bornstein ARL Autonomous Systems Enterprise
15:00	Coffee Break
15:30	WED-PM Co-X Panel Discussion
18:30	Banquet Dinner Cruise

08:15	Overview
08:30	Plenary Presentation: Ken Goldberg Putting the Turing into Manufacturing: Recent Developments in Algorithmic Automation
09:30	Coffee Break
10:00	WED-AM2 Special Session III: Evaluation of Human Detection and Tracking for Robot Safety, Collaboration and Interaction <i>Organizers: Tsai Hong and Roger Eastman</i> <ul style="list-style-type: none"> • An Overview of Human and Machine Performance on Face Recognition [Jonathon Phillips] • Detecting Humans under Partial Occlusion using Markov Logic Networks [Raghuraman Gopalan, William Schwartz] • Transitional or Partnership Human and Robot Collaboration for Automotive Assembly [Jane Shi, Roland Menassa] • Performance Assessment of Face Recognition Using Super-Resolution [Shuowen Hu, Robert Maschal, Susan Young, Tsai Hong, Jonathon Phillips] • Inexpensive Ground Truth and Performance Evaluation for Human Tracking using Multiple Laser Measurement Sensors [William Shackelford, Tsai Hong, Tommy Chang] • Development of Performance Metrics and Test Methods for First Responder Location and Tracking Systems [Francine Amon, Camillo Gentile, Kate Remley] • Automated Gross and Sub-pixel Registration Accuracy of Visible and Thermal Imagery [Stephen Won, S. Susan Young, Gunasekaran Seetharaman]
12:30	Lunch
14:00	Plenary Presentation: Jon Bornstein ARL Autonomous Systems Enterprise
15:00	Coffee Break
15:30	WED-PM Co-X Panel Discussion
18:30	Banquet Dinner Cruise

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THURSDAY

08:15	Overview
08:30	Plenary Presentation: Helen Greiner
09:30	Coffee Break
10:00	<p>THU-AM1 Human-Machine Interaction and Collaboration <i>Chairs: Craig Schlenoff and Paul Oh</i></p> <ul style="list-style-type: none"> • An Indoor Study to Evaluate a Mixed-Reality Interface For Unmanned Aerial Vehicle Operations in Near Earth Environments [James Hing, Justin Menda, Kurtulus Izzetoglu, Paul Oh] • A Network-based Approach for Assessing Co-Operating Manned and Unmanned Systems (MUMS) [Lora Weiss] • Lessons Learned in Evaluating DARPA Advanced Military Technologies [Craig Schlenoff, Brian Weiss, Michelle Steves] • Modified Cooper Harper Scales for Assessing Unmanned Vehicle Displays [Birsen Donmez, M. L. Cummings, Amy Brzezinski, Hudson Graham] • Using the “Negative Attitude Towards Robots Scale” with Telepresence Robots [Katherine Tsui, Munjal Desai, Holly Yanco, Henriette Cramer, Nicander Kemp] • Teams Organization and Performance Analysis in Autonomous Human-Robot Teams [Huadong Wang, Michael Lewis, Shih-Yi Chien] • Intentions and Intention Recognition in Intelligent Agents [Gary Berg-Cross, Christopher Crick]
12:30	Lunch
14:00	<p>THU-PM1 Special Session V: Integrated Performance Assessment Through Experimentation <i>Organizer: Marshal Childers</i></p> <ul style="list-style-type: none"> • Evaluating Hierarchical Planner Performance through Field Experiments and Simulation [Juan Pablo Gonzalez, Marshal Childers, Barry Bodt] • Evaluating the Performance of Unmanned Ground Vehicle Water Detection [Arturo Rankin, Tonislav Ivanov, Shane Brennan] • Autonomous Mobility for Areas with Large Number of Pedestrians [Alberto Lacaze, Karl Murphy, Nenad Uzunovic, Joseph Putney] • Observations on Single Operator Performance Controlling Two UGVs in a Field Assessment [Susan Hill] • Assessing Unmanned Ground Vehicle Tactical Behaviors Performance [Marshal Childers, Barry Bodt, Richard Camden]
16:00	Coffee Break
16:30	Adjourn



08:15	Overview
08:30	Plenary Presentation: Helen Greiner
09:30	Coffee Break
10:00	<p>THU-AM2 Special Session IV: Evaluation of Sensors for Object Pose Estimation in Manufacturing Applications</p> <p><i>Organizers: Roger Eastman, Tsai Hong, and Hui-Min Huang</i></p> <ul style="list-style-type: none"> • 6-DOF Pose Estimation: The Need for Standardization in Industrial Applications [Shaun Edwards, William Flannigan, Paul Evans] • Flexible Robotic Assembly in Dynamic Environments [Jane Shi, Roland Menassa] • Smart Sensing for Real-Time Pose Estimation, Assembly and Inspection using 3D Laser Scanning Systems [Chad English] • Dynamic Performance Evaluation of 6D Laser Tracker Sensor [Kam Lau, Yubing Yang, Yuangun Liu, Henry Song] • Methodology for Evaluating Static Six-degree-of-freedom (6DoF) Perception Systems [Tommy Chang, Tsai Hong, Mike Shneier, Mili Shah, Roger Eastman] • Panel Discussion
12:30	Lunch
14:00	<p>THU-PM2 Special Session VI: Performance Evaluation for Mapping & Navigation in Unstructured Environments</p> <p><i>Organizers: Rolf Lakaemper and Raj Madhavan</i></p> <ul style="list-style-type: none"> • Evaluation Criteria for Appearance Based Maps [Gorkem Erinc, Stefano Carpin] • Evaluation of Maps using Fixed Shapes: The Fiducial Map Metric [Sören Schwertfeger, Adam Jacoff, Chris Scrapper, Johannes Pellenz, Alexander Kleiner] • The Platform- and Hardware-in-the-loop Simulator for Multi-Robot Cooperation [Tomonari Furukawa, Lin Chi Mak, Kunjin Ryu, Xianqiao Tong] • World Modeling for Autonomous Navigation in Unstructured and Dynamic Environments [Rolf Lakaemper, Raj Madhavan] • Discussion
16:00	Coffee Break
16:30	Adjourn

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Bodt, B.	THU-PM1	Hong, T.	WED-AM2	Murphy, K.	THU-PM1
Bodt, B.	THU-PM1	Hong, T.	WED-AM2	Murphy, R.	TUE-AM1
Brennan, S.	THU-PM1	Hong, T.	THU-AM2	Murphy, S.	TUE-AM2
Brunner, C.	TUE-AM1	Horst, J.	TUE-PM1	Napora, S.	TUE-PM2
Brzezinski, A.	THU-AM1	Hsieh, A.	TUE-PM1	Oh, P.	THU-AM1
Camden, R.	THU-PM1	Hu, S.	WED-AM2	Paley, D.	TUE-PM2
Carpin, S.	THU-PM2	Huang, H.M.	TUE-AM1	Pellenz, P.	THU-PM2
Castillo-Effen, M.	TUE-PM2	Huang, H.M.	WED-AM1	Peynot, T.	TUE-AM1
Chang, T.	WED-AM2	Ivanov, T.	THU-PM1	Phillips, J.	WED-AM2
Chang, T.	THU-AM2	Izzetoglu, K.	THU-AM1	Phillips, J.	WED-AM2
Cheung, C.P.	TUE-AM1	Jacoff, A.	TUE-AM1	Pineau, J.	WED-AM1
Chien, S.Y.	THU-AM1	Jacoff, A.	WED-AM1	Proctor, P.	TUE-AM2
Childers, M.	THU-PM1	Jacoff, A.	THU-PM2	Putney, J.	THU-PM1
Childers, M.	THU-PM1	Kang, M.	TUE-AM1	Rankin, A.	THU-PM1
Choo, W.	TUE-AM1	Kemp, N.	THU-AM1	Remley, K.	WED-AM2
Christensen, H.	TUE-AM2	Khoury, H.	WED-AM1	Rogoff, J.	TUE-PM1
Cramer, H.	THU-AM1	Kibira, D.	TUE-PM1	Routhier, F.	WED-AM1
Crick, C.	THU-AM1	Kleiner, A.	THU-PM2	Ryu, K.	THU-PM2
Cummings, M.L.	TUE-AM1	Kolhe, P.	TUE-AM2	Saidi, K.	WED-AM1
Cummings, M.L.	THU-AM1	Kopp, A.	WED-AM1	Schmidt, L.	WED-AM1
Desai, M.	THU-AM1	Kraetzschmar, G.	TUE-PM1	Schwartz, W.	WED-AM2
Donmez, B.	THU-AM1	Kramer, T.	TUE-AM2	Schwertfeger, S.	THU-PM2
Downs, T.	WED-AM1	Lacaze, A.	THU-PM1	Schlenoff, C.	THU-AM1
Dutagaci, H.	TUE-AM1	Lakaemper, R.	THU-PM2	Scraper, C.	THU-PM2
Eastman, R.	THU-AM2	Lau, K.	THU-AM2	Seetharaman, G.	WED-AM2
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Furukawa, T.	THU-PM2	Liu, Y.	THU-AM2	Shi, J.	THU-AM2
Gentile, C.	WED-AM2	Lyons, K.	TUE-PM1	Shah, M.	THU-AM2
Godil, A.	TUE-AM1	Madhavan, R.	THU-PM2	Shneier, M.	THU-AM2
Gonzalez, J.P.	THU-PM1	Mak, L.C.	THU-PM2	Song, H.	THU-AM2
		Manikonda, V.	TUE-PM2	Spall, J.	WED-AM1
		Maranzano, C.	WED-AM1	Steves, M.	THU-AM1
				Sweet, L.	TUE-AM2

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ThiruvadandamPorethi,
V.TUE-AM1
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West, R.WED-AM1
Won, S.WED-AM2
Wong, G.TUE-PM1
Yanco, H.THU-AM1
Yang, Y.THU-AM2
Young, S.WED-AM2
Young, S.WED-AM2

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