HRI 2010

Human-Robot Interaction

5th ACM/IEEE International Conference | March 2–5, 2010 | Osaka, Japan | http://www.hri2010.org

Designed by Bilge Mutlu

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Welcome

It is our great pleasure to welcome you to the 5th ACM/IEEE International Conference on Human-Robot Interaction (HRI 2010). HRI is a single-track, highly selective annual conference that showcases the very best research and thinking in human-robot interaction. HRI is inherently interdisciplinary and multidisciplinary, reflecting work from researchers in robotics, psychology, cognitive science, HCI, human factors, artificial intelligence, organizational behavior, anthropology, and many other fields.

The theme of HRI 2010 is "Grand Technical and Social Challenges in HRI." Robots are increasingly becoming part of people's everyday social lives. In future years, robots may become care-taking assistants for the elderly, or academic tutors for our children, or medical assistants, day care assistants, or psychological counselors. Robots may become our co-workers in factories and offices, or maids in our homes. As we move to create our future with robots, hard problems in human-robot interaction (HRI) exist, both technically and socially. This year's conference seeks to take up grand technical and social challenges in the field - and speak to their integration.

The call for papers attracted 124 full paper submissions from Asia, Europe, the Middle East, and North America. The program committee led by the program co-chairs conducted a rigorous review process for full papers, accepting 26 full papers for oral presentation and publication in the proceedings. This year, taking advantage of having both IEEE and ACM as the sponsor, all papers are archived in both the IEEE Xplore and ACM Digital Library.

Furthermore, 64 late-breaking reports were screened for relevance and accepted for presentation at the HRI conference as posters, exposing a broader perspective of solutions, challenges and issues in HRI. They will be made available in the IEEE Xplore as well as the ACM Digital Library. Finally, a total of 12 videos (out of 23 submissions) were accepted based on importance, novelty and entertainment value and will be shown in a special video session. The accepted presentations cover a variety of topics, including verbal and non-verbal human-robot communication, social learning, social and moral interaction with robots, interface design, and methods for studying human-robot interaction.

This year's local event is "the Drama with Robots", where humanoid robots are used in art. The drama is directed by a famous director Oriza Hirata. It is designed to show how people might have relationships with robots in future society. We hope that visitors experience the interacting capability of robots and methods to express robots' feelings.

Putting together HRI 2010 is a team effort. We thank the keynote speakers, authors, and panelists for providing the content of the program. We would also like to express our gratitude to the program committee and reviewers who worked hard in reviewing papers and providing suggestions for their improvements. We would also like to thank the entire conference committee for all of their efforts over the last months. Finally, we would like to thank our sponsors (ACM SIGCHI, ACM SIGART, IEEE Robotics and Automation, AAAI, HFES, and IEEE Systems, Man, and Cybernetics) for their support of this conference, and the organizations whose donations or grants made this meeting possible. This year, we had generous contributions from Commemorative Organization for the Japan World Exposition '70, and Honda (Platinum Level), Kayamori Foundation of Information Science

Advancement and Willow Garage (Gold Level), MIT Press, Barrett Technology, Inc. and the Association for Unmanned Vehicle Systems International-AUVSI (Silver Level), Vstone and Aldebaran Robotics (Bronze Level). The success of this conference depends on the financial support we receive from our benefactors, contributors, and friends.

We hope that you will find this program interesting and thought-provoking and that the conference will provide you with a valuable opportunity to share ideas with other researchers and practitioners from many disciplines and institutions around the world.

Sincerely,

Pamela Hinds (Stanford University)
General Co-Chair

Hiroshi Ishiguro (Osaka University)
General Co-Chair

Takayuki Kanda (ATR)
Program Co-Chair

Peter Kahn (University of Washington)
Program Co-Chair

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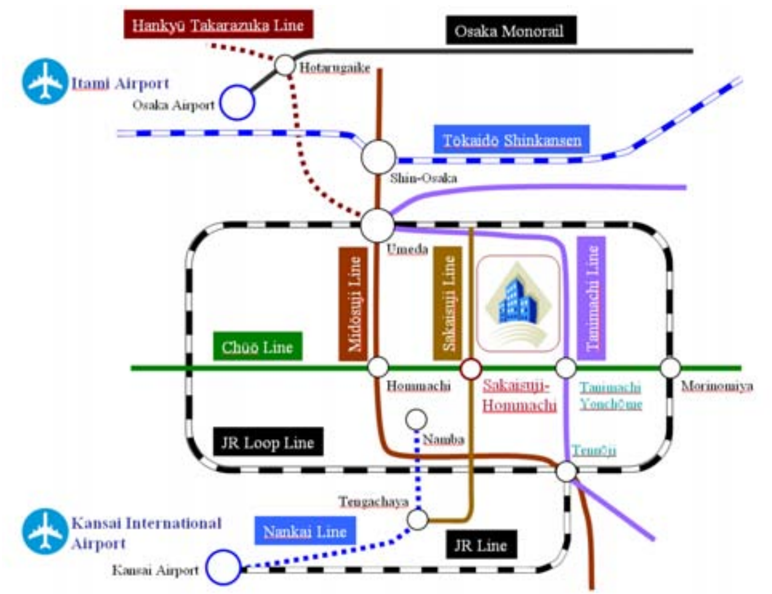

General Information

Conference venue[1]

The 5th ACM/IEEE HRI 2010 will be held in the Business Innovation Center Osaka, which is a venue that provides support to small and medium-sized businesses. It has excellent services and facilities, and is located in the center of downtown Osaka city, easily accessible from Kansai International Airport and JR Kyoto station. Osaka has a convenient transportation network allowing access to many historical institutions such as Osaka Castle, which was built in the end of the 16th century, and Shitennoji Temple, as well as modern entertainment and educational venues such as Universal Studios Japan and the Kaiyukan Aquarium.

1-4-5 Honmachi, Chuo-ku [2]
Osaka 541-0053, Japan
Phone: 81-6-6264-9800

The conference site is conveniently situated, being less than 2 km from both Osaka Castle and Namba, the main shopping and entertainment district of Osaka. In addition, not only is Osaka itself teeming with historical building and monuments, it is only thirty minutes by train from Kyoto, the original capital and cultural cradle of Japan.

The weather in Osaka in March is still cold, with an average temperature range of 41 to 55 degrees Fahrenheit.

Transportation

The nearest station to the conference site is Sakaisuji-Hommachi. The following map shows all major, relevant stations.

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[1] Floorplans for the conference venue are provided in Page 12.

[2] Maps of the area are provided at the end of this booklet.

To avoid confusion, you should be aware that in Osaka there are a number of independent rail networks with separate lines and stations. The main one is JR, but there are others such as Kintetsu, Hankyu and Nankai. Please keep this in mind when traveling.

Travel directions to Sakaisuji-Honmachi

From Kansai International Airport

Line	From	To	Note
Nankai	Kansai Airport	Tengachaya	
Sakaisuji	Tengachaya	Sakaisuji-Hommachi	*Use Exit 12*

From Itami Airport

Line	From	To	Note
Monorail	Osaka Airport	Hotarugaike	
Takarazuka	Hotarugaike	Umeda	
Tanimachi	Higashi-Umeda	Tanimachi Yonchome	*Station name is NOT Umeda*
Chuo	Tanimachi Yonchome	Sakaisuji-Hommachi	*Use Exit 2*

From JR Shin Osaka Station

Line	From	To	Note
Midosuji	Shin Osaka	Hommachi	
Chuo	Tanimachi Yonchome	Sakaisuji-Hommachi	*Use Exit 2*

Restaurants and cafes

Many restaurants are available in walking distance. Please check area maps provided at the end of the booklet for exact locations. Moreover, the navigation site is useful (http://www.gnavi.co.jp/en/kansai/).

Cafés

Seatle's best cofee: (06) 62716313
1-4-5, Honmachi, Chuo-ku, Osaka (the first floor of the building of the conference site)

Dotor coffee: (06) 6264-9980
1-4-13, Honmachi, Chuo-ku, Osaka

Hamadaya: (06) 6262-0688
1-1-3 Honmachi, Chuo-ku, Osaka

Spirale: (06) 6263-7708
1-4-14 Bingo-cho, Chuo-ku, Osaka

Cafe yukiwa: (06) 6264-6201
1-1-3, Honmachi, Chuo-ku, Osaka

Kohikan: (06) 6267-4151
2-1-2, Honmachi, Chuo-ku, Osaka

Traditional Japanese Food (Small Dishes)

Ipponmatsu: (06) 6260-3515
3-2-6, Bingo-cho, Chuo-ku, Osaka

Tsukitei: (06) 4964-2255
2-3-13, Aduchi-cho, Chuo-ku, Osaka

Sushi and Sea foods

Sushi restaurant "Sushikichi": (06) 6209-0777
1-3-6, Awaji-cho, Chuo-ku, Osaka

"Icchou" Honmachi-ten: (06) 6221-3148
1-6-5, Bingo-cho, Chuo-ku, Osaka

Seafood restaurant "Isoji": (06) 6267-1273
2-3-14, Honmachi, Chuo-ku, Osaka

Seafood bar "Jube": (06) 6282-5892
3-4-2, Minamihonmachi, Chuo-ku, Osaka

Seafood bar "Mademoiselle": (06) 6263-0546
2-1, Senbachuo, Chuo-ku, Osaka

Japanese Noodle (Udon)

Tsurutotan Honmachiro: (06) 6232-0333
2-1-13, Kawaramachi, Chuo-ku, Osaka

Japanese Don (Fast Food)

Yoshinoya: (06) 6258-7218
2-6-8, Minamihonmachi, Chuo-ku, Osaka

Matsuya: (06) 6120-0962
3-3-8, Minamihonmachi, Chuo-ku, Osaka

French

La Rochelle: (06) 6281-2323
3-3-5, Honmachi, Chuo-ku, Osaka

Restaurant "mitte": (06) 4705-9050
2-4, Honmachi, Chuo-ku, Osaka

Italian

Pasta & Wine "Convivio": (06) 6264-0772
1-2-1, Honmachi, Chuo-ku, Osaka

Casual Dining Grits: (06) 6281-2228
3-2-1, Honmachi, Chuo-ku, Osaka

Ristorante Ritmo Latino: (06) 7777-8880
2-2-5, Minamikuhoji, Chuo-ku, Osaka

Chinese

Lin: (06) 6125-0808
3-4-15, Honmachi, Chuo-ku, Osaka

Chato-Honten: (06) 6264-7320
3-6-14, Honmachi, Chuo-ku, Osaka

Chinese noodle "Shitenno": (06) 6121-7644
3-3-17, Minamihonmachi, Chuo-ku, Osaka

Korean

Aja: (06) 6262-7077
2-3-4, Honmachi, Chuo-ku, Osaka

Chinmikarubi: (06) 6205-2959
2-1-11, Kawaramachi, Chuo-ku, Osaka

Yamashita: (06) 6262-6768
2-1-2, Minamikuhoji, Chuo-ku, Osaka

Minari: (06) 6260-3711
2-4-11, Minamihonmachi, Chuo-ku, Osaka

Emergency information

In case of an emergency situation that threatens human life or demands immediate attention, call 119 (from hotel telephones, outside call no. + 119).

Ambulance service

Japan Fire and Disaster Management Agency
119 (from hotel telephones, outside call no. + 119).

Hospitals

Japan Red Cross Hospital (Nihon Sekijyuji Byoin)
5-53 Fudegasaki-cho, Tennoji-ku, Osaka, Tel: (06) 6771-5131

Kosei Nenkin Hospital
2-78 Fukushima 4-chome, Fukushima-ku, Osaka, Tel: (06) 6441-5451

Osaka Central Hospital (Osaka Chuo Byoin)
8-2 Sonezaki 2-chomme, Kita-ku, Osaka, Tel: (06) 6313-3461

Sumitomo Hospital
2-2 Nakanoshima 5-chome, Kita-ku, Osaka, Tel: (06) 6443-1261

Yodogawa Christian Hospital
2-9-26, Awaji, Higashi Yodogawa-ku, Osaka, Tel: (06) 6322-2250

Dentists

Ikehata Dental Clinic
1-3-16 Sonezaki Shinchi, Kita-ku, Osaka, Tel: (06) 6341-8148

Kawamura Dental Clinic Umeda Office
Umeda Tokai Bldg. 7F, 2-15-29 Sonezaki, Kita-ku, Osaka, Tel: (06) 6341-8148

Noguchi Dental Clinic
Shin Hankyu Bldg. 7F, 1-12-39 Umeda, Kita-ku, Osaka, Tel: (06) 6345-0561

Pharmacies

Daikoku Drug Senba-yakuten, 2-1-3, Minamihonmachi, (06) 6260-5565

Meruku, 2-6-8, Homachi, (06) 6252-6780

Matsuda Drug, 2-1-1, Higomachi, (06) 6227-1603

For other information, please see

http://www.pacificprime.com/countries/japan/hospitals.php#osaka

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Instructions for Presenters

Full papers
Presentations of full papers at the main conference will have 15 minutes for presentation and 5 minutes for discussion with the audience. Please strictly keep time so that we will be able to open discussion with audiences. Presenters are encouraged to bring their own laptop. A “room volunteer” will be there to help. Presenters are strongly advised to check whether their presentation correctly works with the projector in the room before the session. Please contact the Program Co-chairs in advance if you don’t plan to bring your own laptop.

Late Breaking Reports
LBR presentations will be done during a poster-session. Poster presenters should make sure that their poster are ready by the time the poster session starts. Posters should be less than 42 inches by 30 inches (106.7 cm by 76.2 cm) in size to comfortably fit on the easels and poster boards. We will provide pushpins for mounting posters. Please do not use any other material for mounting purposes (e.g., adhesive or tape). Presenters are responsible for taking down their posters at the end of the poster session.

Before the poster session, presenters will have the chance to introduce their posters to the conference audience during a “teaser session.” During this session, each presenter will be given one minute and a single slide to introduce their posters. We recommend that presenters use this time and visual material creatively to intrigue and invite the audience to see their posters at the poster session instead of to provide a full summary of their research. Presenters will be required to submit their one-slide presentation by March 1st in PDF or PPT formats to the LBR co-chairs by e-mailing it to lbr-chairs@hri2010.org. Presenters should be check in with the co-chairs 15 minutes before the teaser session to prepare for their presentations.

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ROBOT LABORATORY

Tuesday, March 2

- 09:30 Registration opens
- 09:45 Tutorial: "Cognitive Analysis Methods Applied to HRI" Room 5-A — 13:00 End
- 09:45 Workshop: "What Do Collaborations with the Arts Have to Say about HRI?" Room 5-B — 18:00 End
- 09:45 Workshop: "Learning and Adaptation of Humans in HRI" Room 5-C — 18:00 End
- 09:45 Workshop: "HRI Pioneers" Room 6-B — 19:30 End
- 14:00 Workshop: "Interaction Science Perspective on HRI: Designing Robot Morphology" Room 5-A — 17:30 End

Wednesday, March 3

- 09:30 Registration opens
- 09:50 Welcome
- 10:00 Panel: "Grand Technical and Social Challenges in HRI"
- 11:10 Break
- 11:30 Paper Session 1: "Robots in Daily Life"
- 12:30 Lunch
- 13:30 Paper Session 2: "Affect from Appearance & Motion"
- 14:50 Poster Teasers 1
- 15:20 Break
- 15:50 Poster Teasers 2
- 16:30 Company Talks: "Current Directions of Robotic Research in Industry"
- 17:50 Reception & Poster Session (3rd floor)

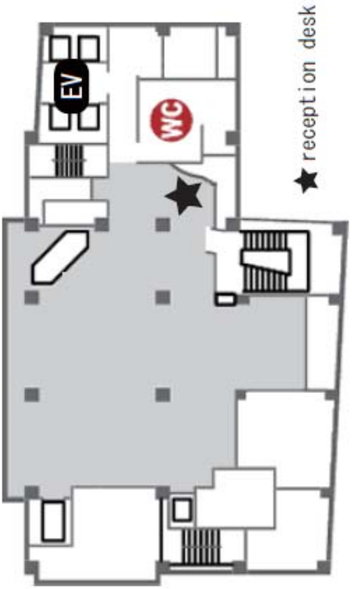
Thursday, March 4

- 09:30 Registration opens
- 09:50 Announcements
- 10:00 Keynote: Dr. Kazuhiro Kosuge
- 11:10 Break
- 11:30 Paper Session 3: "Social & Moral Interaction with Robots"
- 12:30 Lunch
- 13:30 Panel: "Social Responsibility in HRI"
- 14:50 Break
- 15:20 Paper Session 4: "Teleoperation"
- 16:20 Paper Session 5: "Natural Language Interaction"
- 17:50 Walk to a "Noh" Theater
- 18:30 Robot Drama at the "Noh" Theater

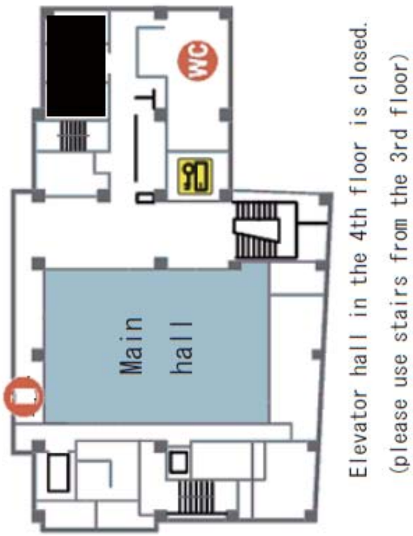
Friday, March 5

- 09:30 Registration opens
- 09:50 Announcements
- 10:00 Keynote: Dr. Josep Call
- 11:10 Break
- 11:30 Paper Session 6: "Nonverbal Interaction"
- 12:30 Lunch
- 13:30 Paper Session 7: "Evaluation of Interaction"
- 14:30 Video Session
- 15:10 Break
- 15:40 Paper Session 8: "Social Learning"
- 16:40 Closing, Awards

3rd floor



4th floor



5th floor

6th floor

Paper Sessions, Wednesday, March 3

Paper Session 1: Robots in Daily Life — 11:30

Session Chair: Vanessa Evers, *University of Amsterdam*

MeBot: A Robotic Platform for Socially Embodied presence
Sigurdur Adalgeirsson, Cynthia Breazeal

Robots Asking for Directions : The Willingness of Passers-by to Support Robots
Astrid Weiss, Judith Igelsböck, Manfred Tscheligi, Andrea Bauer, Kolja Kühnlenz, Dirk Wollherr, Martin Buss

A Larger Audience, Please! Encouraging people to listen to a guide robot
Masahiro Shiomi, Takayuki Kanda, Hiroshi Ishiguro, Norihiro Hagita

Paper Session 2: Affect from Appearance & Motion — 13:30

Session Chair: Miguel Salichs, *Universidad Carlos III*

A Study of a Retro-Projected Robotic Face and its Effectiveness for Gaze Reading by Humans
Frederic Delaunay, Joachim de Greeff, Tony Belpaeme

Judging a Bot By Its Cover: An Experiment on Expectation Setting for Personal Robots
Steffi Paepcke, Leila Takayama

Perception of Affect Elicited by Robot Motion
Martin Saerbeck, Christoph Bartneck

Cooperative Gestures: Effective Signaling for Humanoid Robots
Laurel D. Riek, Tal-Chen Rabinowitch, Paul Bremner, Anthony G. Pipe, Mike Fraser, Peter Robinson

Paper Sessions, Thursday, March 4

Paper Session 3: Social & Moral Interaction with Robots — 11:30

Session Chair: Selma Sabanovic, *Indiana University*

Gracefully Mitigating Breakdowns in Robotic Services
Min Kyung Lee, Sara Kiesler, Jodi Forlizzi, Siddhartha Srinivasa, Paul Rybski

Critic, Compatriot, or Chump?: Responses to Robot Blame Attribution
Victoria Groom, Jimmy Chen, Theresa Johnson, F. Arda Kara, Clifford Nass

denotes best paper, LBR, and video nominees.

No Fair!! An Interaction with a Cheating Robot
Elaine Short, Justin Hart, Michelle Vu, Brian Scassellati

Paper Session 4: Teleoperation — 15:20

Session Chair: Jennifer Burke, *SA Technologies, Inc.*

UAV Video Coverage Quality Maps and Prioritized Indexing for Wilderness Search and Rescue
Bryan Morse, Cameron Engh, Michael Goodrich

Single Operator, Multiple Robots: An Eye Movement Based Theoretic Model of Operator Situation Awareness
Raj Ratwani, J. Malcolm McCurry, J. Gregory Trafton

Multimodal Interaction with an Autonomous Forklift
Andrew Correa, Matthew Walter, Luke Fletcher, Jim Glass, Seth Teller, Randall Davis

Paper Session 5: Natural Language Interaction — 16:20

Session Chair: Tony Belpaeme, *University of Plymouth*

Following Directions Using Statistical Machine Translation
Cynthia Matuszek, Dieter Fox, Karl Koscher

Toward Understanding Natural Language Directions
Thomas Kollar, Stefanie Tellex, Deb Roy, Nicholas Roy

Robot-Directed Speech: Using language to assess First-Time users' conceptualizations of a Robot
Sarah Kriz, Gregory Anderson, J. Gregory Trafton

Robust Spoken Instruction Understanding for HRI
Rehj Cantrell, Matthias Scheutz, Paul Schermerhorn, Xuan Wu

Paper Sessions, Friday, March 5

Paper Session 6: Nonverbal Interaction — 11:30

Session Chair: Sara Kiesler, *Carnegie Mellon University*

Reconfiguring Spatial Formation Arrangement by Robot Body Orientation
Hideaki Kuzuoka, Yuya Suzuki, Jun Yamashita, Keiichi Yamazaki

Head Motions during Dialogue Speech and Nod Timing Control in Humanoid Robots
Carlos Ishi, Chaoran Liu, Hiroshi Ishiguro, Norihiro Hagita

Pointing to Space: Modeling of Deictic Interaction Referring to Regions
Yasuhiko Hato, Satoru Satake, Takayuki Kanda, Michita Imai, Norihiro Hagita

Paper Session 7: Evaluation of Interaction — 13:30

Session Chair: Rachid Alami, *LAAS*

When in Rome: The Role of Culture & Context in Adherence to Robot Recommendations
Lin Wang, Pei-Luen Patrick Rau, Vanessa Evers, Benjamin Krisper Robinson, Pamela Hinds

Lead Me by the Hand: Evaluation of a Direct Physical Interface for Nursing Assistant Robots
Tiffany Chen, Charlie Kemp

Recognizing Engagement in Human-Robot Interaction
Charles Rich, Brett Ponsler, Aaron Holroyd, Candace Sidner

Paper Session 8: Social Learning — 15:40

Session Chair: Yukie Nagai, *Osaka University*

Investigating Multimodal Real-Time Patterns of Joint Attention in an HRI Word Learning Task
Chen Yu, Matthias Scheutz, Paul Schermerhorn

Transparent Active Learning for Robots
Crystal Chao, Maya Cakmak, Andrea Thomaz

From Manipulation to Communicative Gesture
Shichao Ou, Roderic Grupen

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Conference Program

Tuesday, March 2

Tutorial: Cognitive Analysis Methods Applied to Human-Robot Interaction — 9:45, 5-A

Start:	9:45
Morning Break:	11:00 - 11:30
End:	13:00
Location:	Room 5-A

Organizers:
Julie A. Adams, *Vanderbilt University*
Robin R. Murphy, *Texas A&M University*

Abstract:
This half-day tutorial will cover topics related to conducting cognitive task analysis and cognitive work analysis for purposes of informing human-robot interaction design and development. The goal of the tutorial is to provide attendees with an overview and comparison of various cognitive task analysis and cognitive work analysis methods, an understanding of how to conduct these types of analyses, collect the necessary data for analysis, and provide real-world case studies for specific cognitive task analysis and cognitive work analysis. The tutorial will include examples from actual analyses and data collection activities.

Workshop: Interaction Science Perspective on HRI: Designing Robot Morphology — 14:00, 5-A

Start:	14:00
Afternoon Break:	15:30 - 16:00
End:	17:30
Location:	Room 5-A

Organizers:
Angel P. del Pobil, *Universitat Jaume I*
S. Shyam Sundar, *The Pennsylvania State University*

Abstract:
This workshop will address the impact of robot morphology on HRI from the perspective of Interaction Science, which encompasses theory and design of human interaction with technology. Anthropomorphic designs, which are common, have to be balanced with the "uncanny valley effect," since different morphologies suggest different affordances to users, triggering a variety of cognitive heuristics and thereby shaping their interactions with robots. We

expect progress towards more human-acceptable interactions with robots by understanding the cognitive, behavioral, organizational, and contextual factors of morphology in HRI, as well as new meta-theories and design guidelines. We emphasize a highly multi-disciplinary approach, by involving participants from social sciences, engineering, and design.

Workshop: What Do Collaborations with the Arts Have to Say about HRI? — 9:45, 5-B

Start:	9:45
Morning Break:	11:00 - 11:30
Afternoon Break:	15:30 - 16:00
End:	18:00
Location:	Room 5-B

Organizers:
William D. Smart, *Washington University in St. Louis*
Annamaria Pileggi, *Washington University in St. Louis*
Leila Takayama, *Willow Garage*

Abstract:
Human-Robot Interaction researchers are beginning to reach out to fields not traditionally associated with interaction research, such as the performing arts, cartooning, and animation. These collaborations offer the potential for novel insights about how to get robots and people to interact more effectively, but they also involve a number of unique challenges. This full-day workshop will offer a venue for HRI researchers and their collaborators from these diverse fields to report on their work, share insights about the collaboration process, and to help begin to define an exciting new area in HRI.

Workshop: Learning and Adaptation of Humans in HRI — 9:45, 5-C

Start:	9:45
Morning Break:	11:00 - 11:30
Afternoon Break:	15:30 - 16:00
End:	18:00
Location:	Room 5-C

Organizers:
Hiroshi Ishiguro, *Osaka University*
Robin Murphy, *Texas A&M University*
Tatsuya Nomura, *Ryukoku University*

Abstract:
On the current situation where robots having functions of communication with humans begin to appear in daily-life fields, it should be consideredhow symbiosis of humans and robots can be

achieved. Many existing studies have focused on how robots can learn from and adapt for humans. This full-day workshop focuses not only on this classical theme but also on how humans can learn in and adapt for environments where robots are acting. In particular, human learning from and adaptation for robots should be covered by interdisciplinary research fields including robotics, computerscience, psychology, sociology, and pedagogy.

Workshop: HRI Pioneers — 9:45, 6-B

Start:	9:45
Morning Break:	11:00 - 11:30
Afternoon Break:	15:30 - 16:00
End:	19:30
Location:	Room 6-B

Organizers:
Kate Tsui, *University of Massachusetts - Lowell*
Henriette Cramer, *University of Amsterdam*
Dr. Osawa Hirotaka, *Keio University*
Min Kyung Lee, *Carnegie Mellon University*
Laurel Riek, *University of Cambridge*
Dr. Satoru Satake, *ATR*
Dr. Kristen Stubbs, *iRobot Corporation*
Ja-Young Sung, *Georgia Institute of Technology*

Abstract:
The Human-Robot Interaction (HRI) Young Pioneers 2010 Workshop aims to bring together graduate students from diverse research communities relating to HRI (including computer science and engineering, psychology, cognitive science, robotics, human factors, human-computer interaction design, and communications) to present their current research to an audience of their peers in an informal setting. The workshop will feature oral presentations, an interactive poster presentation session, and a hands-on breakout session involving experimental design. The workshop will also feature a Career Panel with senior HRI researchers who will share insights about their own careers and answer career path questions posed by the organizers and participants.

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Wednesday, March 3

Panel: Grand Technical and Social Challenges in Human-Robot Interaction — 10:00

Session Chair: Nathan Freier, *Rensselaer Polytechnic Institute*

Abstract:
Robots are becoming part of people's everyday social lives - and will increasingly become so. In future years, robots may become caretaking assistants for the elderly, or academic tutors for our children, or medical assistants, day care assistants, or psychological counselors. Robots may become our co-workers in factories and offices, or maids in our homes. They may become our friends. As we move to create our future with robots, hard problems in HRI exist, both technically and socially. The Fifth Annual Conference on HRI seeks to take up grand technical and social challenges in the field - and speak to their integration. This panel brings together 4 leading experts in the field of HRI to speak on this topic.

Panelists:
Minoru Asada, *Osaka University*
Pamela Hinds, *Stanford University*
Gerhard Sagerer, *Bielefeld University*
Greg Trafton, *Navy Research Laboratory*

Paper Session 1: Robots in Daily Life — 11:30

Session Chair: Vanessa Evers, *University of Amsterdam*

MeBot: A Robotic Platform for Socially Embodied presence
Sigurdur Adalgeirsson, Cynthia Breazeal
Massachusetts Institute of Technology

Telepresence refers to a set of technologies that allow users to feel present at a distant location; telerobotics is a subfield of telepresence. This paper presents the design and evaluation of a telepresence robot which allows for social expression. Our hypothesis is that a telerobot that communicates more than simply audio or video but also expressive gestures, body pose and proxemics, will allow for a more engaging and enjoyable interaction. An iterative design process of the MeBot platform is described in detail, as well as the design of supporting systems and various control interfaces. We conducted a human subject study where the effects of expressivity were measured. Our results show that a socially expressive robot was found to be more engaging and likable than a static one. It was also found that expressiveness contributes to more psychological involvement and better cooperation.

Robots Asking for Directions : The Willingness of Passers-by to Support Robots
Astrid Weiss[1], Judith Igeslböck[1], Manfred Tscheligi[1], Andrea Bauer[2], Kolja Kühnlenz[2], Dirk Wollherr[2], Martin Buss[2]
(1) University of Salzburg, (2) Technical University Munich

This paper reports about a human-robot interaction field trial conducted with the autonomous mobile robot ACE (Autonomous City Explorer) in a public place, where the ACE robot needs the support of human passers-by to find its way to a target location. Since the robot does not possess any prior map knowledge or GPS support, it has to acquire missing information through interaction with humans. The robot thus has to initiate communication by asking for the way, and retrieves information from passers-by showing the way by gestures (pointing) and marking goal positions on a still image on the touch screen of the robot. The aims of the field trial where threefold: (1) Investigating the suitability of the navigation architecture, (2) evaluating the intuitiveness of the interaction concept for the passers-by, (3) assessing people's willingness to support the ACE robot in its task, i.e. assessing the social acceptability. The field trial demonstrates that the architecture enables successful autonomous path finding without any prior map knowledge just by route directions given by passers-by. An additional street survey and observational data moreover attests the intuitiveness of the interaction paradigm and the high acceptability of the ACE robot in the public place.

A Larger Audience, Please! Encouraging people to listen to a guide robot

Masahiro Shiomi[1], Takayuki Kanda[1], Hiroshi Ishiguro[1,2], Norihiro Hagita[1]
(1) *ATR, (2) Osaka University*

Tour guidance is a common task of social robots. Such a robot must be able to encourage the participation of people who are not directly interacting with it. We are particularly interested in encouraging people to overhear its interaction with others, since it has often been observed that even people who hesitate to interact with a robot are willing to observe its activity. To encourage such participation as bystanders, we developed a robot that walks backwards based on observations of human tour guides. Our developed system uses a robust human tracking system that enables a robot to guide people by walking forward/backward and allows us to scrutinize people's behavior after the experiment. We conducted a field experiment to compare the ratios of overhearing in "walking forward" and "walking backward." The experimental results revealed that in fact people do more often overhear the robot's conversation in the "walking backward" condition.

Paper Session 2: Affect from Appearance & Motion — 13:30

Session Chair: Miguel Salichs, *Universidad Carlos III*

A Study of a Retro-Projected Robotic Face and its Effectiveness for Gaze Reading by Humans

Frederic Delaunay, Joachim de Greeff, Tony Belpaeme
University of Plymouth

Reading gaze direction is important in human-robot interactions as it supports, among others, joint attention and non-linguistic interaction. While most previous work focuses on implementing gaze direction reading on the robot, little is known about how the human partner in a human-robot interaction is able to read gaze direction from a robot. The purpose of this paper is twofold: (1) to introduce a new technology to implement robotic face using retro-projected animated faces and (2) to test how well this technology supports gaze reading by humans.

We briefly discuss the robot design and discuss parameters influencing the ability to read gaze direction. We present an experiment assessing the user's ability to read gaze direction for a selection of different robotic face designs, using an actual human face as baseline. Results indicate that it is hard to recreate human-human interaction performance. If the robot face is implemented as a semi sphere, performance is worst. While robot faces having a human-like physiognomy and, perhaps surprisingly, video projected on a flat screen perform equally well and seem to suggest that these are the best candidates to implement joint attention in HRI.

Judging a Bot By Its Cover: An Experiment on Expectation Setting for Personal Robots
Steffi Paepcke, Leila Takayama
Willow Garage

Managing user expectations of personal robots becomes particularly challenging when the end-user just wants to know what the robot can do, and neither understands nor cares about its technical specifications. In describing what a robot can do to such an end-user, we explored the questions of (a) whether or not such users would respond to expectation setting about personal robots and, if so, (b) how such expectation setting would influence human-robot interactions and people's perceptions of the robots. Using a 2 (robot type: Pleo vs. AIBO) x 2 (expectation setting: high vs. low) between-participants experiment (N=24), we examined these questions. We found that people's initial beliefs about the robot's capabilities are indeed influenced by expectation setting tactics. Contrary to the hypotheses predicted by the Self-Fulfilling Prophecy and Confirmation Bias, we found that erring on the side of setting expectations lower rather than higher led to less disappointment and more positive appraisals of the robot's competence.

Perception of Affect Elicited by Robot Motion
Martin Saerbeck[1], Christoph Bartneck[2]
(1) Philips Research, (2) Eindhoven University of Technology

Nonverbal behaviors serve as a rich source of information in inter human communication. In particular, motion cues can reveal details on a person's current physical and mental state. Research has shown, that people do not only interpret motion cues of humans in this terms, but also the motion of animals and inanimate devices such as robots. In order to successfully integrate mobile robots in domestic environments, designers have therefore to take into account how the device will be perceived by the user.

In this study we analyzed the relationship between motion characteristics of a robot and perceived affect. Based on a literature study we selected two motion characteristics, namely acceleration and curvature, that appear to be most influential for how motion is perceived. We systematically varied these motion parameters and recorded participants interpretations in terms of affective content. Our results suggest a strong relation between motion parameters and attribution of affect, while the type of embodiment had no effect. Furthermore, we found that the level of acceleration can be used to predict perceived arousal and that valence information is at least partly encoded in an interaction between acceleration and curvature. These findings are important for the design of behaviors for future autonomous household robots.

Cooperative Gestures: Effective Signaling for Humanoid Robots

Laurel D. Riek[1], Tal-Chen Rabinowitch[1], Paul Bremner[2], Anthony G. Pipe[2], Mike Fraser[2], Peter Robinson[1]
(1) University of Cambridge, (2) Bristol Robotics Laboratory

Cooperative gestures are a key aspect of human-human pro-social interaction. Thus, it is reasonable to expect that endowing humanoid robots with the ability to use such gestures when interacting with humans would be useful. However, while people are used to responding to such gestures expressed by other humans, it is unclear how they might react to a robot making them. To address this research topic, we conducted a 3 x 2 x 2 within-subjects, video-based laboratory experiment, measuring time to cooperate with a humanoid robot making interactional gestures. We manipulated the gesture type (beckon, give, shake hands), the gesture style (smooth, abrupt), and the gesture orientation (front, side). Our results show that people cooperate with abrupt gestures more quickly than with smooth ones, that orientation affects cooperation time for some gestures, and that people's speed of decoding robot gestures is strongly correlated with their ability to decode human gestures.

Poster Teaser Session 1: Late-Breaking Reports — 14:50

Session Co-chairs: Bilge Mutlu, *University of Wisconsin - Madison* & Andrea Thomaz, *Georgia Institute of Technology*

This year's Human Robot Interaction Conference (HRI 2010) welcomed contributions from the research community in the form of late-breaking reports. The LBR track invites broad participation and provides researchers with a peer-reviewed, archival medium to present preliminary, ongoing research and discuss research-related, social, and organizational issues concerning human-robot interaction.

We screened this year's LBR submissions for their relevance for human-robot interaction and accepted 64 abstracts. These abstracts will be presented in two teaser sessions and during a poster session on the first day of the conference. The teasers will provide authors an opportunity to invite conference attendees to visit their poster presentations. We hope that the poster presentations will spur interesting discussions between presenters and attendees, provide presenters with feedback on their work, and inspire new research directions and collaborations for the human-robot interaction community.

Towards Robust Human Robot Collaboration in Industrial Environments

Batu Akan, Baran Curuklu, Giacomo Spampinato, Lars Asplund
Malardalen University

Similarities and Differences in Users' Interaction with a Humanoid and a Pet Robot

Anja Austermann[1], Seiji Yamada[1,2], Kotaro Funakoshi[3], Mikio Nakano[3]
(1) National Institute of Informatics, (2) The Graduate University for Advanced Studies, (3) Honda Research Institute Japan

Create Children, Not Robots!
Christoph Bartneck
Eindhoven University of Technology

Robots, Children, and Helping: Do Children Help a Robot in Need?
Tanya Beran, Alejandro Ramirez-Serrano
University of Calgary

Learning Context-based Feature Descriptors for Object Tracking
Ali Borji, Simone Frintrop
Rheinische Friedrich-Wilhelms-Universitat

RoboLeader: An Agent for Supervisory Control of Multiple Robots
Jessie Chen[1], Michael Barnes[1], Zhihua Qu[2],
(1) US Army Research Laboratory , (2) University of Central Florida

Evaluation of On Screen Navigational Methods for a Touch Screen Device
Andrew Ho Siyong[1], Chua Wei Liang Kenny[2]
(1) Nnyang Technological University, (2) DSO National Laboratories

Towards Industrial Robots with Human Like Moral Responsibilities
Baran Cürüklü, Gordana Dodig-Crnkovic, Batu Akan
Mälardalen University

Neel: An intelligent shopping guide
Chandan Datta[1], Ritukar Vijay[2]
(1) University of Auckland, (2) Hitech Robotic Systemz India

An Adaptive Probabilistic Graphical Model for Representing Skills in PbD Settings
Haris Dindo, Guido Schillaci
University of Palermo

A Midsummer Night's Dream: Social proof in HRI
Brittany Duncan, Robin Murphy, Dylan Shell, Amy Hopper
Texas A&M University

iForgot - A Model of Forgetting in Robotic Memories
Cathal Gurrin[1], Hyowon Lee[1], Jer Hayes[2]
(1) Dublin City University, (2) IBM

Exploring Emotive Actuation and Its Role in Human-Robot Interaction
John Harris, Ehud Sharlin
University of Calgary

Multi-Touch Interaction for Tasking Robots
Sean Hayes, Eli Hooten, Julie Adams
Vanderbilt University

Active Navigation Landmarks for a Service Robot in a Home Environment
Kentaro Ishii[1], Akihiko Ishida[1], Greg Saul[1], Masahiko Inami[1,2], Takeo Igarashi[1,3]
(1) JST, ERATO, IGARASHI Design Interface Project, (2) Keio University, (3) University of Tokyo

Toward Coactivity
Matthew Johnson[1], Jeffrey Bradshaw[1], Paul Feltovich[1], Catholijn Jonker[2], Maarten Sierhuis[3], Birna van Riemsdijk[2]
(1) IHMC, (2) TU Delft, (3) NASA Ames

A Code Of Ethics for Robotics Engineers
Daniel Jones, Andrew Lewis, Brandon Ingram, Matthew Richards, Charles Rich, Lance Schachterle
Worcester Polytechnic Institute

Sociable Dining Table: The Effectiveness of a "KonKon" Interface for Reciprocal Adaptation
Yuki Kado, Takanori Kamoda, Yuta Yoshiike, De Silva P. Ravindra, Michio Okada
Interactions and Communication Design Lab

Effects of Intergroup Relations on People's Acceptance of Robots
Yunkyung Kim, Sonya S. Kwak - KAIST, Myung-suk Kim
KAIST (Korea Advanced Institute of Science and Technology)

Choosing Answerers by Observing Gaze Responses for Museum Guide Robots
Yoshinori Kobayashi, Takashi Shibata, Yosuke Hoshi, Yoshinori Kuno, Mai Okada, Keiichi Yamazaki
Saitama University

From Cartoons to Robots: Facial Regions as Cues to Recognize Emotions
Tomoko Koda[1], Zsofia Ruttkay[2], Yuka Nakagawa[1], Kyota Tabuchi[1]
(1) Osaka Institute of Technology, (2) Moholy-Nagy University of Art and Design

Human Training Using HRI Approach based on Fuzzy ARTMap Networks
Felipe Machorro-Fernández, Vicente Parra-Vega, I. Lopez-Juarez
Cintestav

Robot-assisted upper-limb rehabilitation platform
Matteo Malosio, Nicola Pedrocchi, Lorenzo Molinari Tosatti
National Research Council, Milan

The development of small size Humanoid Robot which is easy to use
Hirofumi Niimi, Minoru Koike, Seiichi Takeuchi, Noriyoshi Douhara
College of Industrial Technology

Application of Unexpectedness to the Behavioral Design of an Entertainment Robot
Hyojung Oh, Sonya S Kwak, Myung-Suk Kim
KAIST (Korea Advanced Institute of Science and Technology)

Design Guidelines for Industrial Power Assist Robots for Lifting Heavy Objects Based on Human's Weight Perception for Better HRI
S.M.Mizanoor Rahman, Ryojun Ikeura, Masaya Nobe, Hideki Sawai
Mie University

Psychological Intimacy with Robots? Using interaction patterns to uncover depth of relation
Peter H. Kahn, Jr.[1], Jolina H. Ruckert[1], Takayuki Kanda[2], Hiroshi Ishiguro[2,3], Aimee L. Reichert[1], Heather Gary[1], Solace Shen[1]
(1) University of Washington, (2) ATR, (3) Osaka University

Exploring Interruption in HRI using Wizard of Oz
Paul Saulnier, Ehud Sharlin, Saul Greenberg
University of Calgary

Survivor Buddy and SciGirls: Affect, Outreach, and Questions
Robin Murphy[1], Vasant Srinivasan[1], Negar Rashidi[1], Brittany Duncan[1], Aaron Rice[1], Zachary Henkel[1], Marco Garza[1], Clifford Nass[2], Victoria Groom[2], Takis Zourntos[1], Roozbeh Daneshvar[1], Sharath Prasad[1]
(1) Texas A&M University, (2) Stanford University

Considering the Bystander's Perspective for Indirect Human-Robot Interaction
Katherine Tsui, Munjal Desai, Holly Yanco
University of Massachusetts Lowell

Interactive Story Creation for Knowledge Acquisition
Shohei Yoshioka[1], Yasushi Hirano[1], Shoji Kajita[1], Kenji Mase[1,2], Takuya Maekawa[3]
(1) Nagoya University, (2) JST-CREST, (3) NTT Communication Science Laboratories

Showing Robots how to Follow People using a Broomstick Interface
James Young[1,2], Kentaro Ishii[3], Takeo Igarashi[2,3], Ehud Sharlin[1]
(1) University of Calgary, (2) University of Tokyo, (3) JST Erato

Cues for Sociable PC: Coordinate and Synchronize Its Cues based on User Attention and Activities on Display
Yuta Yoshiike, P. Ravindra De Silva, Michio Okada
Toyohashi University of Technology

Poster Teaser Session 2: Late-Breaking Reports — 15:50

Session Co-chairs: Bilge Mutlu, *University of Wisconsin - Madison* & Andrea Thomaz, *Georgia Institute of Technology*

Do Children Perceive Robots as Alive? Children's Attributions of Human Characteristics
Tanya Beran, Alejandro Ramirez-Serrano
University of Calgary

Effects of Operator Spatial Ability on UAV-Guided Ground Navigation
Jessie Chen
US Army Research Laboratory

Effects of (in)accurate empathy and situational valence on attitudes towards robots
Henriette Cramer[1,2], Jorrit Goddijn[1], Bob Wielinga[1], Vanessa Evers[1]
(1) University of Amsterdam, (2) SICS & Mobile Life Centre

Using Proxemics to Evaluate Human-Robot Interaction
David Feil-Seifer, Maja Mataric
University of Southern California

Is a telepresence-system an effective alternative to manned missions?
Lena Geiger[1], Jordi Artigas[2], Philipp Kremer[2], Michael Popp[1], Berthold Färber[1]
(1) Federal Armed Forces University Munich, (2) German Aerospace Center (DLR)

Specialization, Fan-Out, and Multi-Human/Multi-Robot Supervisory Control
Jonathan Whetten, Michael Goodrich
Brigham Young University

Practical Evaluation of Robots for elderly in Denmark - an overview
Søren Tranberg Hansen[1], Hans Jørgen Andersen[2], Thomas Bak[2]
(1) Danish Technological Institute, (2) Aalborg University

Human Performance Moderator Functions for Human-Robot Peer-Based Teams
Caroline Harriott, Julie Adams
Vanderbilt University

Photograph-Based Interaction for Teaching Object Delivery Tasks to Robots
Sunao Hashimoto[1],Andrei Ostanin[2], Masahiko Inami[3], Takeo Igarashi[4]
(1) Japan Science and Technology Agency, (2) University of Utah, (3) Keio University, (4) University of Tokyo

Human-Robot Collaboration for a Shared Mission
Abir Beatrice Karami, Laurent Jeanpierre, Abdel-Illah Mouaddib
University of Caen

Humanoid Robot vs. Projector Robot: Exploring an Indirect Approach to Human Robot Interaction
Gerard Kim, Eun Kwon
Korea University

Dona: Urban Donation Motivating Robot
Min Su Kim[1], Byung Keun Cha[2], Dong Min Park[1], Sae Mee Lee[3], Sonya Kwak[4], Min Kyung Lee[5]
(1) Hong Ik University, (2) LG Electronics, (3) YonSei University, (4) KAIST, (5) Carnegie Mellon University

Design Targeting Voice Interface Robot Capable of Active Listening
Yuka Kobayashi, Daisuke Yamamoto, Toshiyuki Koga, Sachie Yokoyama, Miwako Doi
Toshiba Corporation

Users' reactions toward an on-screen agent appearing on different media
Takanori Komatsu, Yuuki Seki
Shinshu University

5W Viewpoints Associative Topic Search for Networked Conversation Support System
Yukitaka Kusumura, Hironori Mizuguchi, Dai Kusui, Yoshio Ishizawa, Yusuke Muraoka
NEC, Common Platforms Software Research Laboratories

Dialogue Patterns of an Arabic Robot Receptionist
Maxim Makatchev[1], Imran Fanaswala[2], Ameer Abdulsalam[2], Brett Browning[1], Wael Ghazzawi[2], Majd Sakr[2], Reid Simmons[1]
(1) Carnegie Mellon University, (2) Carnegie Mellon University in Qatar

Modular Control for Human Motion Analysis and Classification in Human-Robot Interaction
Juan Alberto Rivera-Bautista, Ana Cristina Ramirez-Hernandez,Virginia Angelica Garcia, Antonio Marin-Hernadez
Universidad Veracruzana

A Panoramic Vision System for Human-Robot Interaction
Ester Martínez, Angel P. del Pobil
Jaume-I University

Multimodal Human-Humanoid Interaction Using Motions, Brain NIRS and Spike Trains
Yasuo Matsuyama, Nimiko Ochiai, Takashi Hatakeyama, Keita Noguchi
Waseda University

Changes of Utterances in the Skill Acquisition of Collaborative Conveyer Task
Shuichi Nakata, Harumi Kobayashi, Satoshi Suzuki, Hiroshi Igarashi
Tokyo Denki University

Intuitive Multimodal Interaction for Service Robots
Matthias Nieuwenhuisen, Jörg Stückler, Sven Behnke
University of Bonn

Toward the Body Image Horizon: How Do Users Recognize the Body of a Robot?
Hirotaka Osawa[1], Keio University[2], Yuji Matsuda[1], Ren Ohmura[1], Michita Imai[1]
(1) *Keio University, (2) Video Group, Broadcast Technical Center, Asahi National Broadcasting Co., Ltd.*

Solving Ambiguities with Perspective Taking
Raquel Ros[1], E. Akin Sisbot[1], Rachid Alami[1], Jasmin Steinwender[2], Katharina Hamann[2], Felix Warneken[3]
(1) LAAS-CNRS, (2) Max Planck Insitute of Evolutionary Anthropology, (3) Harvard University

Validating Interaction Patterns in HRI
Peter H. Kahn, Jr.[1], Brian T. Gill[2], Aimee L. Reichert[1], Takayuki Kanda[3], Hiroshi Ishiguro[3,4], Jolina H. Ruckert[1]
(1) University of Washington, (2) Seattle Pacific University, (3) ATR, (4) Osaka University

A study of three interfaces allowing non-expert users to teach new visual objects to a robot and their impact on learning efficiency
Pierre Rouanet[1], Pierre-Yves Oudeyer[1], David Filliat[2]
(1) INRIA, (2) UEI - ENSTA ParisTech

Help Me Help You: Interfaces for Personal Robots
Ian Goodfellow, Nathan Koenig, Marius Muja, Caroline Pantofaru, Alex Sorokin, Leila Takayama
Willow Garage

The hesitation of a robot: a delay in its motion increases learning efficiency and impresses humans as teachable
Kazuaki Tanaka, Motoyuki Ozeki, Natsuki Oka
Kyoto Institute of Technology

Can a robot deceive humans?
Kazunori Terada, Akira Ito
Gifu University

Developing Heuristics for Assistive Robotics
Katherine Tsui, Kareem Abu-Zahra, Renato Casipe, Jason M'Sadoques, Jill Drury
University of Massachusetts Lowell

Effect of Social Robot's Behavior in Collaborative Learning
Hirohide Ushida
Kinjo Gakuin University

STB: Human-Dependent Sociable Trash Box
Yuto Yamaji, Taisuke Miyake, Yuta Yoshiike, De Silva P. Pavindra, Michio Okada
Interactions and Communication Design Lab

Relationships between User Experiences and Children's Perceptions of the Education Robot
Hyunmin Yoon, Eunja Hyun, Sooryun Son
University of Sungkyunkwan

Company Talks: Current Directions of Robotic Research in Industry — 16:30

Session Chair: Yuichiro Yoshikawa, *Osaka University*

Abstract:
The aim of the company panel is (1) to provide a good picture about forefront technologies about robots related to human-robot interaction, and (2) to provide a opportunity to connect researchers and people from industries. Seven companies gives 8 minutes talk to present their cutting-edge technologies. Instead of having Q&A time after each presentation, researchers and company presenters are encouraged to communicate with each other during reception just after company talk, where research posters will be presented.

Invited companies (speakers and contact information):

Hitachi	Honda R&D	Kokoro	Panasonic
			
Y. Hosoda	N. Sumida	T. Mita	Y. Matsukawa
yuji.hosoda.hj@hitachi.com	Naoaki_Sumida@n.w.rd.honda.co.jp	mita@kokoro-dreams.co.jp	matsukawa.yoshihiko@jp.panasonic.com

Toshiba	VStone	Willow Garage
		
D. Yamamoto	N. Shibatani	L. Takayama
daisuke2.yamamoto@toshiba.co.jp	shibatani@vstone.co.jp	takayama@willowgarage.com

Thursday, March 4

Keynote: Dance Partner Robot - An Engineering Approach to Human-robot Interaction — 10:00

Kazuhiro Kosuge, *Tohoku University*

Abstract

A Dance Partner Robot, PBDR (Partner Ball Room Dance Robot), dances a waltz as a female dancer together with a human male dancer. The waltz, a ball room dance, is usually performed by a male dancer and a female dancer, and consists of a certain number of steps, and transition of the steps,. The dance is lead by the male dancer based on the transition rule of the dance. The female dance partner estimates the following step through physical interactions with the male dancer. The dance partner robot has a database about the waltz and its transition rule for estimating the following dance step and generating an appropriate step motion. The step estimation is done based on the time-series data of the force/torque applied by the male dancer to the robot upper body. The robot motion is generated for the estimated step using the step motion in the database compliantly against the interface force/moment between the human dancer and the robot in real time. The development of the dance partner robot has suggested us a lot of important issues for robots having interaction with a human. Why we are developing the dance partner robot and how the concept will be applied to other robot systems will be discussed in the presentation.

Bio

Dr. Kazuhiro Kosuge is a Professor in the Department of Bioengineering and Robotics at Tohoku University, Japan. He received the B.S., M.S., and Ph.D. in control engineering from the Tokyo Institute of Technology, in 1978, 1980, and 1988 respectively. From 1980 through 1982, he was a Research Staff in the Production Engineering Department, Nippon Denso Co., Ltd. (DENSO Co., Ltd. at present). From 1982 through 1990, he was a Research Associate in the Department of Control Engineering at Tokyo Institute of Technology. From 1990 to 1995, he was an Associate Professor at Nagoya University. From 1995, he has been at Tohoku University. He received the

JSME Awards for the best papers from the Japan Society of Mechanical Engineers in 2002 and 2005, the RSJ Award for the best papers from the Robotics Society of Japan in 2005. He is an IEEE Fellow, a JSME Fellow, RSJ Fellow, and a SICE Fellow. He is President or the IEEE Robotics and Automation Society for 2010-2011.

Paper Session 3: Social & Moral Interaction with Robots — 11:30

Session Chair: Selma Sabanovic, *Indiana University*

Gracefully Mitigating Breakdowns in Robotic Services
Min Kyung Lee, Sara Kiesler, Jodi Forlizzi, Siddhartha Srinivasa, Paul Rybski
Carnegie Mellon University

Robots that operate in the real world will make mistakes, and those who design and build systems will need to understand how best to provide ways for robots to mitigate those mistakes. Building on diverse research literatures, we consider how to mitigate breakdowns in services provided by robots. Expectancy-setting strategies forewarn people of a robot's limitations so people will expect mistakes. Recovery strategies, including apologies, compensation, and options for the user, aim to reduce the negative consequence of breakdowns. We tested these strategies in an online scenario study with 317 participants. A breakdown in robotic service had severe impact on evaluations of the service and the robot, but forewarning and recovery strategies reduced the negative impact of the breakdown. People's orientation toward services influenced which recovery strategy worked best. Those with a relational orientation responded best to the apology; those with a utilitarian orientation responded best to the compensation. We discuss robotic service design to mitigate service problems.

Critic, Compatriot, or Chump?: Responses to Robot Blame Attribution
Victoria Groom, Jimmy Chen, Theresa Johnson, F. Arda Kara, Clifford Nass
Stanford University

As their abilities improve, robots will be placed in roles of greater responsibility and specialization. In these contexts, robots may attribute blame to humans in order to identify problems and help humans make sense of complex information. In a between-participants experiment with a single factor (blame target) and three levels (human blame vs. team blame vs. self blame) participants interacted with a robot in a learning context, teaching it their personal preferences. The robot performed poorly, then attributed blame to either the human, the team, or itself. Participants demonstrated a powerful and consistent negative response to the human-blaming robot. Participants preferred the self-blaming robot over both the human and team blame robots. Implications for theory and design are discussed.

No Fair!! An Interaction with a Cheating Robot
Elaine Short, Justin Hart, Michelle Vu, Brian Scassellati
Yale University

"Rock, paper, scissors" is a widely known children's game that has a fixed set of rules and a familiar play paradigm. In this paper, human participants play "rock, paper, scissors" against a child-sized upper-torso humanoid robot. To manipulate the degree and complexity of social interaction, the robot cheats in one of two ways: by saying he has won when he actually has not, or by changing his throw in order to win, thus breaking the expected paradigm of play. We examine the level of engagement people have the robot, in each of these conditions, as well as the degree to which they attribute mental state to him. Using a questionnaire administered to the participants after the interaction, we confirm that they perceive a robot which incorrectly announces the outcome as a malfunctioning robot, while they see a robot that changes its throw as deliberately cheating. We find that participants are more engaged in the interaction when the robot cheats, and they attribute more mental state to a robot that cheats by changing its throw.

Panel: Social Responsibility in Human-Robot Interaction — 13:30

Session Chair: Nathan Freier, *Rensselaer Polytechnic Institute*

Abstract:
At the 2008 ACM/IEEE Conference on Human-Robot Interaction, a provocative panel was held to discuss the complicated ethical issues that abound in the field of human-robot interaction. The panel members and the audience participation made it clear that the HRI community desires – indeed, is in need of – an ongoing discussion on the nature of social responsibility in the field of human-robot interaction. At the 2010 Conference, we will hold a panel on the issues of social responsibility in HRI, focusing on the unique features of robotic interaction that call for responsible action (e.g., value-specific domains such as autonomy, accountability, trust, and/or human dignity; and application areas such as military applications, domestic care, entertainment, and/or communication). As a young and rapidly growing field, we have a responsibility to conduct our research in such a way that it leads to human-robot interaction outcomes that promote rather than hinder the flourishing of humans across society. What does social responsibility within the HRI field look like, and how do we conduct our work while adhering to such an obligation? The panelists will be asked to address this and related questions as a means of continuing an ongoing conversation on social responsibility in human-robot interaction.

Panelists:
Aude Billard, *EPFL*
Hiroshi Ishiguro, *Osaka University & ATR*
Illah Nourbakhsh, *Carnegie Mellon University*

Paper Session 4: Teleoperation — 15:20

Session Chair: Jennifer Burke, *SA Technologies, Inc.*

UAV Video Coverage Quality Maps and Prioritized Indexing for Wilderness Search and Rescue
Bryan Morse, Cameron Engh, Michael Goodrich
Brigham Young University

Video-equipped mini unmanned aerial vehicles (mini-UAVs) are becoming increasingly popular for surveillance, remote sensing, law enforcement, and search and rescue operations, all of which rely on thorough coverage of a target observation area. However, coverage is not simply a matter of seeing the area (visibility) but of seeing it well enough to allow detection of targets of interest, a quality we here call ``see-ability". Video flashlights, mosaics, or other geospatial compositions of the video may help place the video in context and convey that an area was observed, but not necessarily how well or how often. This paper presents a method for using UAV-acquired video georegistered to terrain and aerial reference imagery to create geospatial video coverage quality maps and indices that indicate relative video quality based on detection factors such as image resolution, number of observations, and variety of viewing angles. When used for offline post-analysis of the video, or for online review, these maps also enable geospatial quality-filtered or prioritized non-sequential access to the video. We present examples of static and dynamic see-ability coverage maps in wilderness search-and-rescue scenarios, along with examples of prioritized non-sequential video access. We also present the results of a user study demonstrating the correlation between see-ability computation and human detection performance.

Single Operator, Multiple Robots: An Eye Movement Based Theoretic Model of Operator Situation Awareness

Raj Ratwani[1], J. Malcolm McCurry[2], J. Gregory Trafton[2]
(1) Perceptronics Solutions Inc., (2) Naval Research Laboratory

For a single operator to effectively control multiple robots, operator situation awareness is a critical component of the human-robot system. There are three levels of situation awareness: perception, comprehension, and projection into the future [1]. We focus on the perception level to develop a theoretic model of the perceptual-cognitive processes underlying situation awareness. Eye movement measures were developed as indicators of cognitive processing and these measures were used to account for operator situation awareness on a supervisory control task. The eye movement based model emphasizes the importance of visual scanning and attention allocation as the cognitive processes that lead to operator situation awareness and the model lays the groundwork for real-time prediction of operator situation awareness.

Multimodal Interaction with an Autonomous Forklift

Andrew Correa, Matthew Walter, Luke Fletcher, Jim Glass, Seth Teller, Randall Davis
MIT

We describe a multimodal framework for interacting with an autonomous robotic forklift. An important element of this interaction is a wireless, handheld tablet with which a human supervisor can give commands to the forklift using speech and sketch. Most current sketch interfaces treat the canvas as a blank slate. In contrast, our interface uses live and synthesized cameras from the forklift as a canvas, and augments them with object and obstacle information from the world. This connection enables users to ``draw on the world" to enable a simpler and more natural set of sketched gestures.

In addition to the supervisor's interface, our framework incorporates external signaling to interact with humans near the vehicle. The robot utilizes audible and visual annunciation to convey its current state and intended actions. Further, our system enables the user to take control of the forklift by entering its cabin and controlling it as though it were a normal forklift. The forklift then behaves like a manned forklift until the human exits.

Our interface supports commands that include the summoning the forklift and directing it to lift, transport, and place pallets loaded with cargo. We describe a preliminary user study that demonstrates the usability and effectiveness of the interface.

Paper Session 5: Natural Language Interaction — 16:20

Session Chair: Tony Belpaeme, *University of Plymouth*

Following Directions Using Statistical Machine Translation

Cynthia Matuszek, Dieter Fox, Karl Koscher
University of Washington

Mobile robots that interact with humans in an intuitive way must be able to follow directions provided by humans in unconstrained natural language. In this paper we investigate how statistical machine translation techniques can be used to bridge the gap between natural language route instructions and a map of an environment built by a robot. Our approach uses training data to learn to translate from natural language instructions to an automatically-labeled map. The complexity of the translation process is controlled by taking advantage of physical constraints imposed by the map. As a result, our technique can efficiently handle uncertainty in both map labeling and parsing. Our experiments demonstrate the very promising capabilities achieved by our approach.

Toward Understanding Natural Language Directions

Thomas Kollar[1], Stefanie Tellex[2], Deb Roy[2], Nicholas Roy[1]
(1) MIT CSAIL, (2) MIT Media Lab

Speaking using unconstrained natural language is an intuitive and flexible way for humans to interact with robots. Understanding this kind of linguistic input is challenging because diverse words and phrases must be mapped into structures that the robot can understand, and elements in those structures must be grounded in an uncertain environment. In this paper, we present a system that follows natural language directions by extracting a sequence of spatial description clauses from the linguistic input and then finds the most probable path through the environment given only information about the environmental geometry and detected visible objects. We use a probabilistic graphical model over paths corresponding to a set of directions that factors into three key components. The first component grounds landmark phrases in the directions such as ``the computers" by exploiting co-occurrence statistics from Flickr. Second, a spatial reasoning component judges how well spatial relations such as ``past the computers" describe a path. Finally, verb phrases such as ``turn right" are modeled according to the amount of change in orientation in the path. Our system follows 60% of the directions in our corpus to within 15 meters of the true destination, significantly outperforming other approaches.

Robot-Directed Speech: Using language to assess First-Time users' conceptualizations of a Robot

Sarah Kriz[1], Gregory Anderson[2], J. Gregory Trafton[3]
(1) University of Washington, (2) George Mason University, (3) Naval Research Laboratory

It is expected that in the near-future people will have daily natural language interactions with robots. However, we know very little about how users feel they should talk to robots, especially users who have never before interacted with a robot. The present study evaluated first time users' expectations about a robot's cognitive and communicative capabilities by comparing robot-directed speech to the way in which participants talked to a human partner. The results indicate that participants spoke more loudly, raised their pitch, and hyperarticulated their messages when they spoke to the robot, suggesting that they viewed the robot as having low linguistic competence. However, utterances show that speakers often assumed that the robot had humanlike cognitive capabilities. The results suggest that while first time users were concerned with the fragility of the robot's speech recognition system, they believed that the robot had extremely strong information processing capabilities.

Robust Spoken Instruction Understanding for HRI

Rehj Cantrell, Matthias Scheutz, Paul Schermerhorn, Xuan Wu
Indiana University Bloomington

Natural human-robot interactions require novel computationally tractable models of language understanding on robots that operate incrementally, provide early backchannel feedback to human speakers, use pragmatic contexts in order to infer missing information, and can cope with the many different forms of disfluencies that mark spontaneous human speech. In this paper, we describe our attempts at developing an integrated natural language understanding architecture for HRI, and demonstrate its novel capabilities using challenging data collected in previous human-human interaction experiments.

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Friday, March 5

Keynote: Action understanding and gesture acquisition in the great apes — 10:00

Josep Call, *Max Planck Institute for Evolutionary Anthropology*

Abstract
A growing number of scholars have suggested that gestural communication may have been especially important in the early stages of language origins. Of special interest in this debate is the communication of other primates, especially those most closely related to humans, the great apes. The aim of this talk is to explore the interrelations between instrumental actions, action understanding and gesture generation in humans and other apes. In doing so, I will contrast the similarities and differences in the use and comprehension of gestures in humans and apes. Like humans, apes use gestures flexibly and they can even learn new gestures. Unlike humans, however, imitative learning does not seem to be the main mechanism underlying gesture acquisition in great apes. Instead apes seem to learn many of their gestures in social interaction with others via processes of ontogenetic ritualization by means of which instrumental actions are transformed into gestures. Like humans, apes can extract information about the goals contained in the actions of others but there is much less evidence that they also grasp some of the representational properties of certain kinds of gestures and the communicative intentions behind them.

Bio
Josep Call is co-founder and director of the Wolfgang Köhler Primate Research Center (WKPRC) at the Max Planck Institute for Evolutionary Anthropology (MPI-EVA) in Leipzig, Germany, and a senior scientist at the department of Developmental and Comparative Psychology of the MPI-EVA. The WKPRC is the only center worldwide dedicated to the comparative study of the cognition of all four nonhuman great apes. He holds a Bachelors degree in Psychology from the Universitat Autonoma de Barcelona and Masters and Doctorate degrees from Emory University. Prior to joining the MPI-EVA, he was a lecturer at the School of Biological Sciences at the University of Liverpool. He has published two books and nearly two hundred articles and book chapters on the behavior and cognition of apes and other animals and

has presented his work on numerous occasions at international. He is currently the associate editor of the Journal of Comparative Psychology and a member of the editorial board of several other academic journals.

Paper Session 6: Nonverbal Interaction — 11:30

Session Chair: Sara Kiesler, *Carnegie Mellon University*

Reconfiguring Spatial Formation Arrangement by Robot Body Orientation

Hideaki Kuzuoka[1], Yuya Suzuki[1], Jun Yamashita[1], Keiichi Yamazaki[2]
(1) University of Tsukuba, (2) Saitama University

An information presentation robot is expected to establish appropriate spatial relationship with people. Drawing upon sociological studies of spatial relationships involving “F-formation” and “body torque,” we examined the effect of robot’s body rotation on the reconfiguration of the F-formation arrangement. The results showed that the robot can change the position of a visitor by rotating its body. We have also confirmed that in order to reconfigure the F-formation arrangement, it is more effective to rotate the whole body of the robot rather than rotating only its head.

Head Motions during Dialogue Speech and Nod Timing Control in Humanoid Robots

Carlos Ishi, Chaoran Liu, Hiroshi Ishiguro, Norihiro Hagita
ATR

Head motions naturally occur in synchrony with speech and may carry paralinguistic information, such as intentions, attitudes and emotions, in dialogue communication. With the aim of verifying the relationship between head motions and the dialogue acts carried by speech, analyses were conducted on motion-captured data of several speakers during natural dialogues. The analysis results firstly confirmed the trends of our previous work, showing that regardless the speaker, nods frequently occur during speech utterances, not only for expressing dialogue acts such as agreement and affirmation, but also appearing at the last syllable of the phrases, in strong phrase boundaries, especially when the speaker is confidently talking, or expressing interest to the interlocutor’s talk. Inter-speaker variability indicated that the frequency of head motions may vary according to the speaker’s age or status, while intra-speaker variability indicated that the frequency of head motions also differ depending on the inter-personal relationship with the interlocutor. A simple model for generating nods based on rules inferred from the analysis results was proposed and evaluated in two types of humanoid robot. Subjective scores showed that the proposed model could generate head motions with naturalness comparable to the original motions.

Pointing to Space: Modeling of Deictic Interaction Referring to Regions

Yasuhiko Hato[1,2], Satoru Satake[2], Takayuki Kanda[2], Michita Imai[2], Norihiro Hagita[2]
(1) Keio University, (2) ATR Intelligent Robotics and Communication Laboratories

In daily conversation, we sometimes observe a deictic interaction scene that refers to a region in a space, such as saying “please put it over there” with pointing. How can such an interaction be possible with a robot? Is it enough to simulate people’s behaviors, such as utterance and

pointing? Instead, we highlight the importance of simulating human cognition. In the first part of our study, we empirically demonstrate the importance of simulating human cognition of regions when a robot engages in a deictic interaction by referring to a region in a space. The experiments indicate that a robot with simulated cognition of regions improves efficiency of its deictic interaction. In the second part, we present a method for a robot to computationally simulate cognition of regions.

Paper Session 7: Evaluation of Interaction — 13:30

Session Chair: Rachid Alami, *LAAS*

When in Rome: The Role of Culture & Context in Adherence to Robot Recommendations

Lin Wang[1], Pei-Luen Patrick Rau[1], Vanessa Evers[2], Benjamin Krisper Robinson[3], Pamela Hinds[3]
(1) Tsinghua University, (2) University of Amsterdam, (3) Stanford University

In this study, we sought to clarify the effects of users' cultural background and cultural context on human–robot team collaboration by investigating attitudes toward and the extent to which people changed their decisions based on the recommendations of a robot collaborator. We report the results of a 2×2 experiment with nationality (Chinese vs. US) and communication style (implicit vs. explicit) as dimensions. The results confirm expectations that when robots behave in more culturally normative ways, subjects are more likely to heed their recommendations. Specifically, subjects with a Chinese vs. a US cultural background changed their decisions more when collaborating with robots that communicated implicitly vs. explicitly. We also found evidence that Chinese subjects were more negative in their attitude to robots and, as a result, relied less on the robot's advice. These findings suggest that cultural values affect responses to robots in collaborative situations and reinforce the importance of culturally sensitive design in HRI.

Lead Me by the Hand: Evaluation of a Direct Physical Interface for Nursing Assistant Robots

Tiffany Chen, Charles Kemp
Georgia Institute of Technology

When a user is in close proximity to a robot, physical contact becomes a potentially valuable channel for communication. People often use direct physical contact to guide a person to a desired location (e.g., leading a child by the hand) or to adjust a person's posture for a task (e.g., a dance instructor working with a dancer). Within this paper, we present an implementation and evaluation of a direct physical interface (DPI) for a human-scale anthropomorphic robot. Human-human interaction inspired our interface design, which enables a user to lead the robot by the hand. We evaluated this interface in the context of assisting nurses with patient lifting, which we expect to be a high-impact application area. Our evaluation consisted of a controlled laboratory experiment with 18 nurses from the Atlanta area. We found that the DPI significantly outperformed a comparable wireless gamepad interface in both quantitative and subjective measures, including number of collisions, time to complete the task, cognitive load (raw NASA TLX), and overall satisfaction. In contrast, we found no significant difference between the two interfaces with respect to the user's perception of personal safety, the robot's safety, or the speed of the robot.

Recognizing Engagement in Human-Robot Interaction
Charles Rich, Brett Ponsler, Aaron Holroyd, Candace Sidner
Worcester Polytechnic Institute

Based on a study of the engagement process between humans, we have developed and implemented an initial computational model for recognizing engagement between a human and a humanoid robot. Our model contains recognizers for four types of connection events involving gesture and speech: directed gaze, mutual facial gaze, conversational adjacency pairs and backchannels. To facilitate integrating and experimenting with our model in a broad range of robot architectures, we have packaged it as a node in the open-source Robot Operating System (ROS) framework. We demonstrate use of the engagement recognition node in a simple human-robot pointing game.

Video Session — 14:30

Session Co-chairs: Jacob Crandall, *Masdar Institute of Science and Technology* & Aaron Steinfeld, *Carnegie Mellon University*

As with prior Human Robot Interaction conferences, the 2010 conference hosted a video session. Submitted videos were peer reviewed on the importance of the lessons learned, novelty of the situation, and entertainment value. Out of the twenty-three submitted videos, twelve were accepted to this years' video session.

In addition to demonstrating the usefulness of effective human-robot interactions, this year's set of videos highlight many difficult challenges that designers of human-robot systems must continue to address. We were particularly pleased with the diverse set of topics and international representation. We hope these videos inform, entertain, and lead to additional scientific exploration and community discussion.

A Trial English Class with a Teaching Assistant Robot in Elementary School
Jeonghye Han[1], Seungmin Lee[1], Bokhyun Kang[2], Sungju Park[2], Jungkwan Kim[3], Myungsook Kim[3], Mihee Kim[4]
(1) Cheongju National University of Education, (2) Yujin Robot Co., Ltd., (3) Technical Exploration Research Department of Korea Telecommunication Corp., (4) Sujeong Elementary School

Sociable Trash Box
Yuta Yoshiike, Yuto Yamaji, Taisuke Miyake, P. Ravindra De Silva, and Michio Okada
Toyohashi University of Technology

Dona: Urban Donation Motivating Robot
Min Su Kim[1], Byung Keun Cha[2], Dong Min Park[1], Sae Mee Lee[3], Sonya Kwak[4], Min Kyung Lee[5]
(1) Hong Ik University, (2) LG Electronics, (3) YonSei University, (4) KAIST, (5) Carnegie Mellon University

Fusionbot: A Barista Robot—Fusionbot Serving Coffees to Visitors During Technology Exhibition Event
Dilip Kumar Limbu, Yeow Kee Tan, Lawrence TC Por
Institute for Infocomm Research

The Step-on Interface (SOI) on a Mobile Platform (2) - Basic Functions
Takafumi Matsumaru, Yuichi Ito, and Wataru Saitou
Shizuoka University

The Step-on Interface (SOI) on a Mobile Platform (6) - Rehabilitation of the Physically Challenged
Takafumi Matsumaru, Yuichi Ito, and Wataru Saitou
Shizuoka University

Robot Rescue: An HRI engineering outreach activity
Jonathan T. Morgan, Sarah Kriz
University of Washington

Mysterious Machines
Billy Schonenberg, Christoph Bartneck
Eindhoven University of Technology

Olivia 2.0 @ TechFest 09: Receptionist Robot Impressed Visitors with Lively Interactions
Lawrence TC Por, Adrian Tay, Dilip Kumar Limbu
Institute for Infocomm Research

actDresses - interacting with robotic devices - fashion and comics
Rob Tieben[1], Ylva Fernaeus[2], Mattias Jacobsson[2]
(1) Eindhoven University of Technology, (2) Swedish Institute of Computer Science

Selecting and Commanding Individual Robots in a Vision-Based Multi-Robot System
Alex Couture-Beil, Richard T. Vaughan, Greg Mori
Simon Fraser University

The Articulated Head Pays Attention
Christian Kroos, Damith C. Herath, and Stelarc
MARCS Auditory Laboratories, University of Western Sydney

Paper Session 8: Social Learning — 15:40

Session Chair: Yukie Nagai, *Osaka University*

Investigating Multimodal Real-Time Patterns of Joint Attention in an HRI Word Learning Task
Chen Yu, Matthias Scheutz, Paul Schermerhorn
Indiana University

Joint attention — the idea that humans make inferences from observable behaviors of other humans by attending to the objects and events that these others humans attend to — has been recognized as a critical component in human-robot interactions. While various HRI studies showed that for robots to behave in ways that supports human recognition of joint attention leads to better behavioral outcomes on the human side, there are no studies that investigate the detailed time course of interactive joint attention processes.

In this paper, we present the results from an HRI study that investigates the exact time course of human multi-modal attentional processes during an HRI word learning task in an unprecedented way. Using novel data analysis techniques, we are able to demonstrate that the temporal details of human attentional behavior are critical for understanding human expectations of joint attention in HRI and that failing to do so can force humans into assuming unnatural behaviors.

Transparent Active Learning for Robots

Crystal Chao, Maya Cakmak, Andrea Thomaz
Georgia Institute of Technology

This research aims to build robots that learn from human teachers. Motivated by human social learning, we believe that a transparent learning process can help guide the human teacher to provide the most informative instruction. We believe active learning is an inherently transparent machine learning approach because it formulates queries to the oracle that reveal information about areas of uncertainty in the underlying model. In this work, we implement active learning on the Simon robot in the form of nonverbal gestures that query a human teacher about a demonstration within the context of a social dialog. Our preliminary data shows that transparency through active learning has the potential to improve the accuracy and efficiency of the teaching process. However, our data also seems to indicate possible undesirable effects from the human teacher's perspective. The results argue for a control strategy that balances leading and following during a social learning interaction.

From Manipulation to Communicative Gesture

Shichao Ou, Roderic Grupen
University of Massachusetts Amherst

Assisting humans in their daily lives requires robots to be proficient in manual tasks and in communicating states/intentions with human collaborators. This paper advocates an approach for learning communicative actions and manual skills in the same framework. We exploit a fundamental relationship between the structure of motor skills, intention, and communication. Manual behavior is used to convey intentions between robots and humans. Interactions with humans via communicative actions is learned in the same manner as the robot learns to interact with other objects in the environment. The learning framework and preliminary human-robot interaction experiments are presented, where a humanoid robot learns and refines communicative behavior incrementally by discovering the utility of manipulation behavior in the presence of humans. Results from interactions with 18 people provide support for the hypothesized benefits of this approach. Behavior reuse makes learning from relatively few interactions possible. This approach compliments other efforts in the field by grounding social behavior, and proposes a mechanism for negotiating a communicative vocabulary between humans and robots.

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Conference Goals & the Peer-Review Process

The Human-Robot Interaction (HRI) Conference is a highly selective, single track conference that each year showcases the best research in human-robot interaction. HRI brings together researchers from many domains, emphasizes interdisciplinary work, and is co-sponsored by ACM and IEEE. Because we aim for as much transparency as possible about how the conference is organized and the peer-review process, we provide further information here:

Excellence — HRI is designed to be the top-tier conference in human-robot interaction. To achieve this goal, the conference is highly selective. This year, the acceptance rate was 20.9%.

Fairness and Rigor in the Peer-Review Process — Great efforts were made on maintaining fairness and rigor in the review process. Each submission was assigned to one of about 20 Program Committee (PC) members from the international community, who handled the paper as the meta-reviewer. The meta-reviewer than collected three or more high-quality anonymous, peer reviews. Next, the meta-reviewer provided a meta-review of the paper that aimed to synthesize the major issues from the peer-reviews as well as articulate his or her own thoughts about the merits of the paper. All these reviews were then released early to authors, who had the option to provide a rebuttal to correct errors of fact and misunderstandings by reviewers. Next, as needed, reviewers engaged in online discussion about the author's rebuttal, and revised their initial scores and reviews. At this junction, based on scores, a decision was made on which papers would be discussed at the in-person Program Committee meeting. The criteria was that either the paper had to have an average score of 3 or higher (on a 1-5 point scale) or the PC member handling the paper had to have rated the paper with a score of 4 or higher. Each paper that met this criteria was then assigned to a secondary PC member who provided a second meta-review. At this junction, the international Program Committee convened in person and individually discussed this subset of submissions. Discussions focused on each paper's contribution and impact to the field of HRI, regardless of whether the author was well-known to the community or a newcomer, a senior scientist or a first-year graduate student. During the discussion, we recognized that different methods provide different ways of generating important knowledge in HRI. Thus we sought to treat all methods as valid a priori and evaluate each of them based on the contribution that they make to HRI.

Thus based on 3 or more peer reviews, 2 meta-reviews, and substantive in-person discussion, the top papers were selected for acceptance. This year we also accepted several papers conditionally upon satisfactory revisions.

International Community — HRI is international in scope, and actively solicits submissions and participation from researchers worldwide. HRI 2008 took place in the Netherlands. HRI 2009 took place in the United States. HRI 2010 is taking place in Japan. And HRI 2011 will take place in Switzerland.

Multidisciplinary — HRI is a multi-disciplinary field. It includes researchers and scholars with roots in robotics, psychology, artificial intelligence, design, HCI, human factors, organizational behavior, simulation, anthropology, cognitive science, engineering, and many other fields. Thus, the selection of the Program Committee and reviewers included individuals who represent a broad range of disciplines, some of whom perform inter-disciplinary research, and all of whom are motivated to evaluate work from different disciplines by the standards of those disciplines.

Affordable — In order to help the HRI community to grow, HRI aims to keep costs low. Location, facilities, and registration fees are chosen in order to minimize costs as much as possible. For this reason, HRI does not meet in places that are excessively time-consuming or difficult to reach, nor select conference sites that are expensive. We believe that affordability is especially essential to enable students to participate.

Interactive and Inclusive — To promote community-wide discussion and learning, HRI is a single-track conference. Oral presentations are given sufficient time for detailed questions. Poster sessions are arranged so that people can spend significant time with authors. Panels emphasize debate and discussion. Keynote speakers are chosen based on their ability to engage and spark interest.

Sustainable — HRI is structured to be sustainable over the long-term. The steering committee is composed of a small group of standing members, plus the general chairs and program chairs from the past year, the current year, and the upcoming year. This framework allows the organization to maintain some continuity yet also to evolve quickly and to ensure the continuous infusion of new talent into the conference and organizational structure. In addition, we work very closely with both ACM and IEEE to guarantee that banking, insurance, publication, and promotion are handled efficiently and professionally.

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Maps of the Area

(A) marks the Business innovation Center Osaka (conference site). The bottom left pin indicates the station, "Sakaisujihonmachi." The top right pin marks the hotel, "City Plaza Osaka."

The park of Osakajo (castle) is a 20-minute walk from the Business Innovation Center.