
CHICAGO
HRI 2018
MARCH 5TH
MARCH 8TH

13th Annual ACM/IEEE International Conference on Human Robot Interaction
HRI'18

Conference Booklet

Photo credits

Bastian. The Bean © 2012
Christopher. The Iconic View © 2013
David Gleason. Link Bridge Pano © 2009
Jovan J. Chicago Cultural Center © 2016
Shutter Runner. Lonely Lighthouse © 2013

All from Flickr

Design credits

Original InDesign work from HRI2015 (Portland)

Chairs' Welcome

It is our great pleasure to welcome you to the 13th Annual ACM/IEEE International Conference on Human Robot Interaction – HRI'18. The HRI Conference is a highly selective international meeting showcasing the best research in human-robot interaction (HRI), with broad participation from various communities of scholars, including robotics, human-computer interaction, artificial intelligence, engineering, social and behavioral sciences, and design.

The theme of this year's conference is "Robots for Social Good," considering two trends that have shaped HRI-related technologies in the past year. One is that after many years of research, social robots are being finally introduced 'en masse' as consumer devices. And the second is a worldwide recognition, increasingly appreciated in the consumer software sector, that developers of new technologies need to be cognizant of the societal consequences of psychologically impactful devices.

Balancing this societal and humanistic goal with the continuous evolution of technology, both in hardware and software, requires the multidisciplinary view that the HRI conference offers. To support this coming together of research areas, we solicited and reviewed papers under four submission themes: "Human-Robot Interaction User Studies," "Technical Advances in Human-Robot Interaction," "Human-Robot Interaction Design," and "Theory and Methods in Human-Robot Interaction." Each submission theme was overseen by a dedicated theme chair and reviewed by an expert group of program committee members, who worked together with the program chairs to define and apply review criteria appropriate to each of the four contribution types.

The conference attracted 206 submissions from contributors worldwide, including countries from Asia-Pacific, Europe, the Middle East, and North America. Each full paper was aligned with a theme-appropriate subcommittee, and subsequently reviewed through a double-blind process, which was followed by a rebuttal phase, and shepherding where found appropriate by the program committee. Following the review process, the program committee selected 49 (23.8%) of the submissions for presentation as full papers at the conference. As the conference is jointly sponsored by IEEE and ACM, papers are archived in both the ACM Digital Library and the IEEE Xplore.

This year, accommodating for the continued growth of the HRI conference, and with the goal of allowing for ample presentation, discussion, and informal meeting time, we have started to adopt a dual-track format for some of the full paper sessions. This also allowed us to plan for presenting papers from alternative tracks, such as alt.HRI, and experiment with new presentation formats, under the principle of reevaluating our methods and processes, as appropriate for a conference covering a rapidly evolving field.

Along with the full papers, the conference program and proceedings include Late Breaking Reports, Videos, Demos, and an alt.HRI section. Out of 137 total submissions, 123 (89.8%) Late Breaking Reports (LBRs) were accepted and will be presented as posters at the conference. A new peer-review process ensured that authors of LBR submissions received detailed feedback on their work. Fourteen short videos were accepted for presentation during a dedicated video session. The program also includes 9 demos of robot systems that participants will have an opportunity to interact with during the conference. We continue to include an alt. HRI session in this year's program, consisting of 5 papers (selected out of 14 submissions, 35.7%) that push the boundaries of thought and practice in the field. We are also continuing last year's reintroduction of the Student Design Competition event to encourage student participation in the conference and enrich the program with novel ideas and insights developed by student teams. The conference will also include 5 full-day and six half-day workshops on a wide array of topics.

Finally, we have the pleasure of presenting three inspiring keynote speakers from both academia and industry, who represent well the multidisciplinary nature of the HRI conference: Prof. Kerstin Dautenhahn, a researcher of Artificial Intelligence from the School of Computer Science at the University of Hertfordshire in the UK, Dr. Steve Cousins, Founder and CEO of the service robotics company Savioke, and Prof. David Mindell, a researcher of History of Engineering and Manufacturing, and Professor of Aeronautics and Astronautics at MIT.

HRI 2018 was made possible through the significant volunteer efforts of the organizing committee, program committee, reviewers, and the steering committee. We thank the keynote speakers, financial supporters, and international reviewers for their support and participation. The conference is sponsored by ACM SIGCHI, ACM SIGAI, IEEE Robotics and Automation Society, and is in cooperation with AAAI.

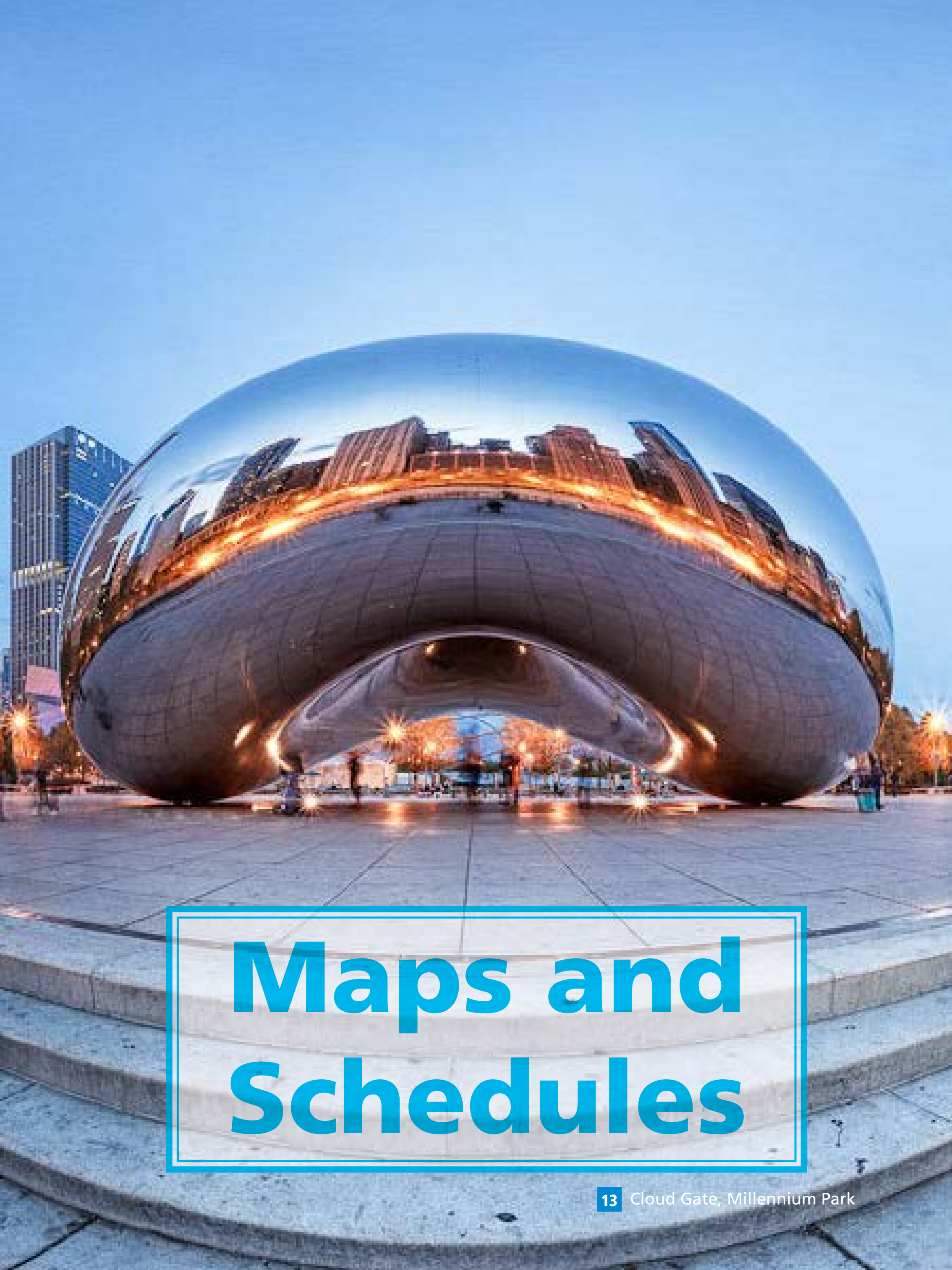
We are excited to welcome the authors who submitted papers, videos, and demos to HRI 2018, as well as all other conference participants. Your work and energy make the conference a success each year, and help to grow our community. We hope you will enjoy your time at HRI 2018 in Chicago!

Takayuki Kanda
HRI'18 General Co-Chair
ATR, Japan

Selma Šabanovic
HRI'18 General Co-Chair
Indiana University, USA

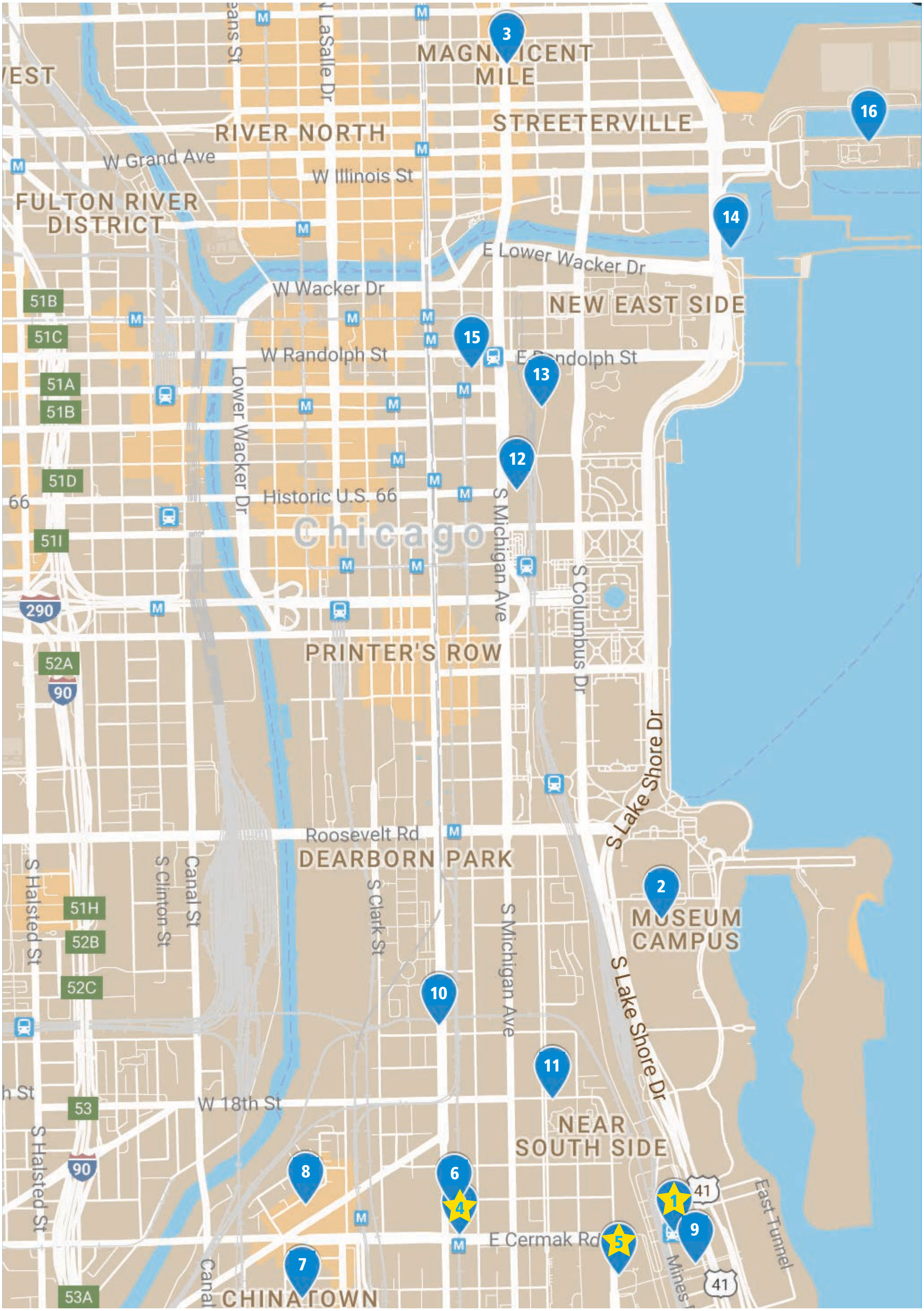
Guy Hoffman
HRI'18 Program Co-Chair
Cornell University, USA

Adriana Tapus
HRI'18 Program Co-Chair
ENSTA, ParisTech, France



Maps and Schedules

13 Cloud Gate, Millennium Park


MAGNIFICENT MILE
STREETERVILLE
RIVER NORTH
W Grand Ave
W Illinois St
FULTON RIVER DISTRICT
E Lower Wacker Dr
W Wacker Dr
NEW EAST SIDE
W Randolph St
E Randolph St
Lower Wacker Dr
Historic U.S. 66
Chicago
S Michigan Ave
S Columbus Dr
PRINTER'S ROW
S Lake Shore Dr
Roosevelt Rd
DEARBORN PARK
S Halsted St
S Clinton St
Canal St
S Clark St
MUSEUM CAMPUS
W 18th St
NEAR SOUTH SIDE
E Cermak Rd
CHINATOWN
East Tunnel
LaSalle Dr
51B
51C
51A
51D
51I
290
52A
90
51H
52B
52C
53
53A
66
41
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

HRI 2018 Chicago Area Map

1 **McCormick Place**
1401 Southwest Naito Parkway, Portland, OR 97201

2 **Museum Campus**
337 East Randolph St, Chicago, IL 60601; Tel: +1 312-742-7529

3 **Magnificent Mile**
Chicago, IL 60611

4 **Cermak-McCormick Place Green Line Station**
Train to magnificent mile or to orange line to get to Airport

5 **Bus to Magnificent Mile**

6 **Reggies Chicago**
2105 S State St, Chicago, IL 60616; Tel: +1 312-949-0120

7 **Chinatown**

8 **Joy Yee - Chinatown**
2139 S China Pl, Chicago, IL 60616; Tel: +1 312-328-0001

9 **Starbucks**
2301 S Lake Shore Dr, Chicago, IL 60616; Tel: +1 312-791-7229

10 **Overflow Coffee Bar**
1550 S State St, Chicago, IL 60605; Tel: +1 312-772-2356

11 **The Spoke & Bird (South Loop)**
205 E 18th St, Chicago, IL 60616; Tel: +1 929-263-2473

12 **The Art Institute of Chicago**
111 S Michigan Ave, Chicago, IL 60603; Tel: +1 312-443-3600

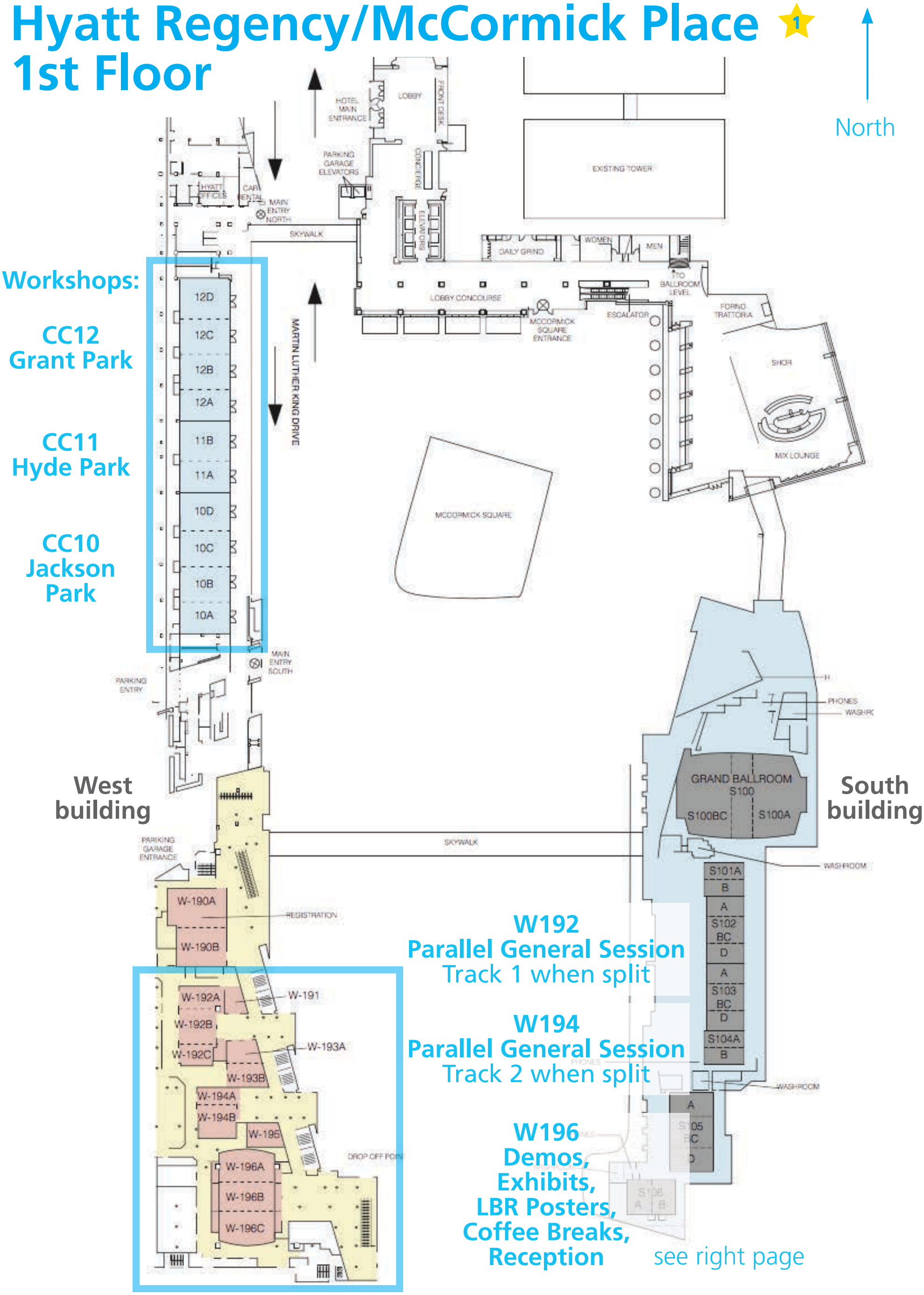
13 **Millennium Park**
201 E Randolph St, Chicago, IL 60602; Tel: +1 312-742-1168

14 **Outer Drive Link Bridge**
Lakefront Trail, Chicago, IL 60611

15 **Chicago Cultural Center**
78 E Washington St, Chicago, IL 60602; Tel: +1 312-744-6630

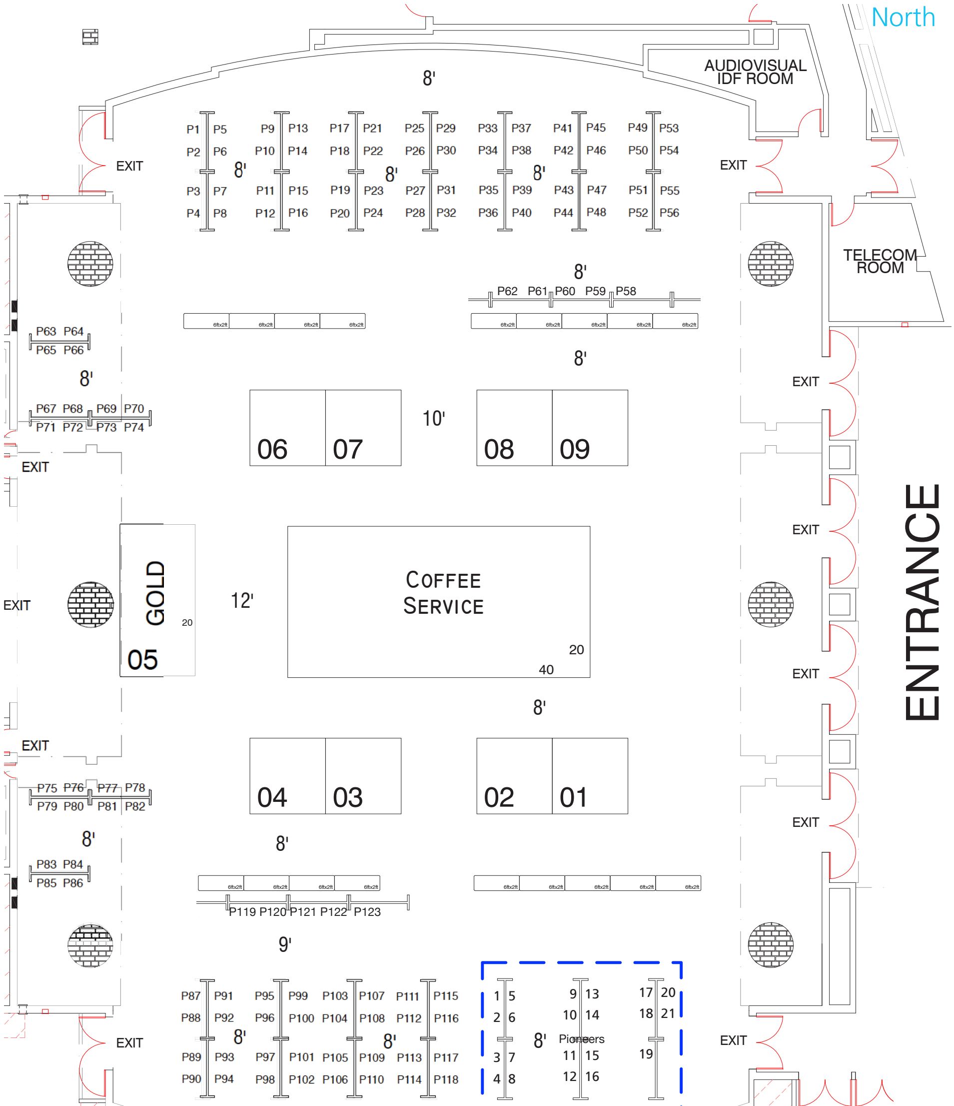
16 **Navy Pier**
600 E Grand Ave, Chicago, IL 60611; Tel: +1 312-595-7437

Hyatt Regency/McCormick Place 1st Floor



Poster Sessions - W196

- Late-Breaking Reports
- Student Design Competition
- HRI Pioneers
- Demos



LBR: P1-P123, see pages 34-39 for details

SDC and Demos: surrounding Exhibitor Booths, see pages 40 and 42-44

HRI Pioneers: 1-21, see page 41

Exhibitor Booths: large numbers, see pages 76-77

Monday March 5

Time	Event	Event
	MARCH 5 MORNING & FULL-DAY WORKSHOPS	
09:00	**Workshop on Longitudinal Human-Robot Teaming** – Grant Park D **Social Human-Robot Interaction of Human-Care Service Robots** – Grant Park B **Personal Robots for Exercising and Coaching** -Hyde Park B **Robots for Learning – R4L : Inclusive Learning** – Hyde Park A **Explainable Robot Behaviors** – Jackson Park D	**An Alternative HRI Methodology: The Use of Ethnography to Identify and Address Ethical, Legal, and Societal (ELS) issues** – Grant Park C **Social Robots in Therapy: Focusing on Autonomy and Ethical Challenges** - Grant Park A **Social Robots in the Wild** – Jackson Park C **Pioneers** – Jackson Park B
13:00	**Lunch**	
14:00	**MARCH 5 AFTERNOON WORKSHOPS**	
14:00	**Virtual, Augmented, and Mixed Reality for Human-Robot Interaction** – GrantPark D **Cognitive and Social Neuroscience Methods for HRI** – Grant Park B	**"What Could Go Wrong?!" Lessons Learned When Doing HRI User Studies with Off-the-Shelf Robots** – Grant Park C

Note: Registration opens at 08:00 each day

Tuesday March 6

Time	Event - Room (Track 1, for Split Sessions)	Event - Room (Track 2, for Split Sessions)
09:00	**Chairs' Welcome** - W192	Takayuki Kanda, Selma Šabanovic, Guy Hoffman, Adriana Tapus
09:30	**Plenary Keynote** - W192	David Mindell: Autonomy in Human Environments
10:30	**Break** - W196	
10:50	**Teleoperation and Shared Manipulation – W192**	**Tutoring and Child-Robot Interaction – W194**
10:50	Eye-Hand Behavior in Human-Robot Shared Manipulation Reuben Aronson, Thiago Santini, Thomas Kübler, Enkelejda Kasneci, Siddhartha Srinivasa, Henny Admoni	Do Children Perceive Whether a Robotic Peer is Learning or Not? Shruti Chandra, Raul Paradeda, Hang Yin, Pierre Dillenbourg, Rui Prada, Ana Paiva
11:10	"Wait, Can You Move the Robot?": Examining Telepresence Robot Use in Collaborative Teams Brett Stoll, Samantha Reig, Lucy He, Ian Kaplan, Malte Jung, Susan Fussell	The Effect of a Robot's Gestures and Adaptive Tutoring on Children's Acquisition of Second Language Vocabularies Jan de Wit, Thorsten Schodde, Bram Willemsen, Kirsten Bergmann, Mirjam de Haas, Stefan Kopp, Emiel Krahmer, Paul Vogt
11:30	Shared Dynamic Curves: A Shared-Control Tele-manipulation Method for Motor Task Training Daniel Rakita, Bilge Mutlu, Michael Gleicher, Laura Hiatt	Thinking Aloud with a Tutoring Robot to Enhance Learning Aditi Ramachandran, Chien-Ming Huang, Edward Gartland, Brian Scassellati
11:50	It's All in Your Head: Using Priming to Shape an Operator's Perceptions and Behavior during Teleoperation Daniel Rea, James Young	"Stop. I See a Conflict Happening." A Robot Mediator for Young Children's Interpersonal Conflict Resolution Solace Shen, Petr Slovak, Malte Jung
12:10	**Lunch**	
13:40	**Late-Breaking Reports – W196** **Student Design Competition – W196**	**HRI Pioneers Posters – W196** **Demonstrations – W196**
15:40	**Break** - W196	
16:00	**Best Paper Nominees – W192**	
16:00	Improving Collocated Teleoperation with Augmented Reality Hooman Hedayati, Michael Walker, Daniel Szafir	
16:20	Expressing Robot Incapability Minae Kwon, Sandy Huang, Anca Dragan	
16:40	Characterizing the Design Space of Rendered Robot Faces Alisa Kalegina, Grace Schroeder, Aidan Allchin, Keara Berlin, Maya Cakmak	
17:00	What is Human-like?: Decomposing Robots' Human-like Appearance Using the Anthropomorphic roBOT (ABOT) Database Elizabeth Phillips, Xuan Zhao, Daniel Ullman, Bertram Malle	
17:20	Fribo: A Social Networking Robot for Increasing Social Connectedness through Sharing Daily Home Activities from Living Noise Data Kwangmin Jeong, Jihyun Sung, Hae-Sung Lee, Aram Kim, Hyemi Kim, Chan Mi Park, Yuin Jeong, JeeHang Lee, Jinwoo Kim	
17:40	**Distinguished Service Award** – W192	
18:00	**Reception** – W196	

Wednesday March 7

Time	Event - Room (Track 1, for Split Sessions)	Event - Room (Track 2, for Split Sessions)
09:00	**Announcements** - W192 Takayuki Kanda, Selma Šabanovic, Guy Hoffman, Adriana Tapus	
09:10	**Plenary Keynote** - W192 Kerstin Dautenhahn: Robots and Us — Useful Roles of Robots in Human Society	
10:10	**Break** - W196	
10:30	**Machine Learning for HRI – W192**	**Societal Issues: Abuse, Trust, Racism – W194**
10:30	Active Robot Learning for Temporal Task Models Mattia Racca, Ville Kyrki	Inducing Bystander Interventions During Robot Abuse With Social Mechanisms Xiang Zhi Tan, Marynel Vázquez, Elizabeth Carter, Cecilia Morales, Aaron Steinfeld
10:50	Learning from Richer Human Guidance: Augmenting Comparison-Based Learning with Feature Queries Chandrayee Basu, Mukesh Singhal, Anca Dragan	The Ripple Effects of Vulnerability: The Effects of a Robot's Vulnerable Behavior on Trust in Human-Robot Teams Sarah Strohkorb Sebo, Margaret Traeger, Malte Jung, Brian Scassellati
11:10	Learning from Physical Human Corrections, One Feature at a Time Andrea Bajcsy, Dylan Losey, Marcia O'Malley, Anca Dragan	Humans Conform to Robots: Disambiguating Trust, Truth, and Conformity Nicole Salomons, Michael van der Linden, Sarah Strohkorb Sebo, Brian Scassellati
11:30	DNN-HMM based Automatic Speech Recognition for HRI Scenarios José Novoa, Jorge Wuth, Juan Escudero, Josué Fredes, Rodrigo Mahu, Néstor Yoma	Robots and Racism Christoph Bartneck, Kumar Yogeeswaran, Qi Min Ser, Graeme Woodward, Robert Sparrow, Siheng Wang, Friederike Eyssel
11:50	Deep Reinforcement Learning of Abstract Reasoning from Demonstrations Madison Clark-Turner, Momotaz Begum	Mindless Robots get Bullied Merel Keijsers, Christoph Bartneck
12:10	**Lunch**	
13:40	**Designing Robots and Interactions – W192**	**Groups and Teams – W194**
13:40	User-Centered Robot Head Design: a Sensing Computing Interaction Platform for Research Robotics (SCIPRR) Anthony Harrison, Wendy Xu, J. Gregory Trafton	Human-Robot Similarity and Willingness to Work with Robotic Co-Worker Sangseok You, Lionel Robert Jr.
14:00	Bioluminescence-Inspired Human-Robot Interaction: Designing Expressive Lights that Affect Human's Willingness to Interact with a Robot Sichao Song, Seiji Yamada	Group-based Emotions in Teams of Humans and Robots Filipa Correia, Samuel Mascarenhas, Rui Prada, Francisco Melo, Ana Paiva
14:20	"Haru": Hardware Design of an Experimental Table top Robot Assistant Randy Gomez, Deborah Szapiro, Kerl Galindo, Keisuke Nakamura	Where Should Robots Talk?: Spatial Arrangement Study from a Participant Workload Perspective Takahiro Matsumoto, Mitsuhiro Goto, Ryo Ishii, Tomoki Watanabe, Tomohiro Yamada, Michita Imai
14:40	Iterative Design of an Upper Limb Rehabilitation Game with Tangible Robots Arzu Guneysu Ozgur, Maximilian Wessel, Wafa Johal, Kshitij Sharma, ... Pierre Dillenbourg	Friends or Foes? Socioemotional Support and Gaze Behaviors in Mixed Groups of Humans and Robots Raquel Oliveira, Patrícia Arriaga, Patrícia Alves-Oliveira, Filipa Correia, Sofia Petisca, Ana Paiva
15:00	**Break** - W196	
15:30	**Best Paper Nominees – W192**	
15:30	Social Robots for Engagement in Rehabilitative Therapies: Design Implications from a Study with Therapists Katie Winkle, Praminda Caleb-Solly, Ailie Turton, Paul Bremner	
15:50	"Thank You for Sharing that Interesting Fact!": Effects of Capability and Context on Indirect Speech Act Use in Task-Based Human-Robot Dialogue Tom Williams, Daria Thames, Julia Novakoff, Matthias Scheutz	
16:10	Planning with Trust for Human-Robot Collaboration Min Chen, Stefanos Nikolaidis, Harold Soh, David Hsu, Siddhartha Srinivasa	
16:30	Communicating Robot Motion Intent with Augmented Reality Michael Walker, Hooman Hedayati, Jennifer Lee, Daniel Szafir	
16:50	An Autonomous Dynamic Camera Method for Effective Remote Teleoperation Daniel Rakita, Bilge Mutlu, Michael Gleicher	
17:10	**Break** - W196	
17:30	**Videos** - W192	

Thursday March 8

Time	Event - Room (Track 1, for Split Sessions)	Event - Room (Track 2, for Split Sessions)
09:00	**Announcements** - W192 Takayuki Kanda, Selma Šabanovic, Guy Hoffman, Adriana Tapus	
09:10	**Plenary Keynote** - W192 Steve Cousins: Building a Service Robotics Business—Challenges from the Field	
10:10	**Break** - W196	
10:30	**Communicating with and without Speech – W192**	**Psychology and HRI – W194**
10:30	Multimodal Expression of Artificial Emotion in Social Robots Using Color, Motion and Sound Diana Löffler, Nina Schmidt, Robert Tscharn	alt-HRI – Social Psychology and Human-Robot Interaction: An Uneasy Marriage Bahar Irfan, James Kennedy, Séverin Lemaignan, Fotios Papadopoulos, Emmanuel Senft, Tony Belpaeme
10:50	Getting to Know Each Other: The Role of Social Dialogue in Recovery from Errors in Social Robots Gale Lucas, Jill Boberg, David Traum, Ron Artstein, Jonathan Gratch, Alesia Gainer, Emmanuel Johnson, Anton Leuski, Mikio Nakano	The Peculiarities of Robot Embodiment (EmCorp-Scale) Laura Hoffmann, Nikolai Bock, Astrid Rosenthal v.d. Pütten
11:10	alt.HRI – Agreeing to Interact: Understanding Interaction as Human-Robot Goal Conflicts Kazuhiro Sasabuchi, Katsushi Ikeuchi, Masayuki Inaba	Be More Transparent and Users Will Like You: A Robot Privacy and User Experience Design Experiment Jonathan Vitale, Meg Tonkin, Sarita Herse, Suman Ojha, Jesse Clark, Mary-Anne Williams, Xun Wang, William Judge
11:30	Observing Robot Touch in Context: How Does Touch and Attitude Affect Perceptions of a Robot's Social Qualities? Thomas Arnold, Matthias Scheutz	alt-HRI – Design Strategies for Representing the Divine in Robots Gabriele Trovato, Cesar Lucho, Alexander Huerta-Mercado, Francisco Cuellar
11:50	Social Momentum: A Framework for Legible Navigation in Dynamic Multi-Agent Environments Christoforos Mavrogiannis, Wil Thomason, Ross Knepper	Futuristic Autobiographies: Weaving Participant Narratives to Elicit Values around Robots EunJeong Cheon, Norman Su
12:10	**Lunch**	
13:40	**Rethinking Human-Robot Relationships – W192**	**Coordination in Time and Space – W194**
13:40	alt.HRI – Interacting with Anatomically Complete Robots – A Discussion about Human-robot Relationships Christoph Bartneck, Matthew McMullen	Compact Real-time Avoidance on a Humanoid Robot for Human-robot Interaction Dong Hai Phuong Nguyen, Matej Hoffmann, Alessandro Roncone, Ugo Pattacini, Giorgio Metta
14:00	Social Cobots: Anticipatory Decision-Making for Collaborative Robots Incorporating Unexpected Human Behaviors Orhan Can Görür, Benjamin Rosman, Fikret Sivrikaya, Sahin Albayrak	Detecting Contingency for HRI in Open-World Environments Elaine Short, Mai Lee Chang, Andrea Thomaz
14:20	alt.HRI – Crucial Answers about Humanoid Capital Brian Beaton	Effects of Robot Sound on Auditory Localization in Human-Robot Collaboration Elizabeth Cha, Naomi Fitter, Yunkyung Kim, Terry Fong, Maja Matarić
14:40	A Design Methodology for the UX of HRI: Example Case Study of a Social Robot at an Airport Meg Tonkin, Jonathan Vitale, Sarita Herse, Mary-Anne Williams, William Judge, Xun Wang	Evaluating Social Perception of Human-to-Robot Handovers using the Robot Social Attributes Scale (RoSAS) Matthew Pan, Elizabeth Croft, Günter Niemeyer
15:00	**Break** - W196	
15:30	**Transactions on HRI – W192**	
15:30	Closed-loop Global Motion Planning for Reactive Collision-free Execution of Learned Tasks Chris Bowen, Ron Alterovitz	
15:50	Adapting a General Purpose Social Robot for Paediatric Rehabilitation through In-situ Design Felip Marti Carillo, Joanna Butchart, Sarah Knight, Adam Scheinberg, Lisa Wise, Leon Sterling, Chris McCarthy	
16:10	Reframing Assistive Robots to Promote Successful Aging Hee Rin Lee, Laurel Riek	
16:30	**Closing & Award Ceremony** - W192	

Monday March 05

The Iconic View

Monday

Notes

Morning Workshops

Time	Place	Title	Contact Organizer
08:00		**Registration Open**	
09:00~13:00	Grant Park D	**Workshop on Longitudinal Human-Robot Teaming**	**Joachim de Greeff**
09:00~13:00	Grant Park C	**An alternative HRI methodology: The Use of Ethnography to Identify and Address Ethical, Legal, and Societal (ELS) issues**	**Jessica Sorenson**
09:00~13:00	Grant Park B	**Social Human-Robot Interaction of Human-Care Service Robots**	**Ho Seok AHN**

Afternoon Workshops

Time	Place	Title	Contact Organizer
14:00~18:00	Grant Park D	**Virtual, Augmented, and Mixed Reality for Human-Robot Interaction**	**Tom Williams**
14:00~18:00	Grant Park C	**"What Could Go Wrong?!" Lessons Learned When Doing HRI User Studies with Off-the-Shelf Robots**	**Mike Ligthart**
14:00~18:00	Grant Park B	**Cognitive and Social Neuroscience Methods for HRI**	**Agnieszka Wykowska**

Full-Day Workshops

Time	Place	Title	Contact Organizer
09:00~18:00	Grant Park A	**Social Robots in Therapy: Focusing on Autonomy and Ethical Challenges**	**Pablo Gomez Esteban**
09:00~18:00	Hyde Park B	**Personal Robots for Exercising and Coaching**	**Sebastian Schneider**
09:00~18:00	Hyde Park A	**Robots for Learning – R4L : Inclusive Learning**	**Wafa Johal**
09:00~18:00	Jackson Park D	**Explainable Robot Behaviors**	**Maartje de Graaf**
09:00~18:00	Jackson Park C	**Social Robots in the Wild**	**Ross Mead**
09:00~18:00	Jackson Park B	**HRI Pioneers**	**Austin Whitesell, Cristina Zaga**

Workshops

Monday March 5 (09:00~18:00)

Workshop lunch will be from 12:00~13:00.

Please see workshop website for break times.

Morning Workshop 1:

Workshop on Longitudinal Human-Robot Teaming

Place: Grant Park D

Joachim de Greeff
Bradley Hayes
Matthew Gombolay
Mark Neerincx
Jurriaan van Diggelen
Melissa Cefkin
Ivana Kruijff-Korbayová

As robots that share working and living environments with humans proliferate, human-robot teamwork (HRT) is becoming more relevant every day. By necessity, these HRT dynamics develop over time, as HRT can hardly happen only in the moment. What theories, algorithms, tools, computational models and design methodologies enable effective and safe longitudinal human-robot teaming? To address this question, we propose a half-day workshop on longitudinal human-robot teaming. This workshop seeks to bring together researchers from a wide array of disciplines with the focus of enabling humans and robots to better work together in real-life settings and over long-term. Sessions will consist of a mix of plenary talks by invited speakers and contributed papers/posters, and will encourage discussion and exchange of ideas amongst participants by having breakout groups and a panel discussion.

Morning Workshop 2:

An alternative HRI methodology: The Use of Ethnography to Identify and Address Ethical, Legal, and Societal (ELS) issues

Place: Grant Park C

Cathrine Hasse
Stine Trentemøller
Jessica Sorenson

As robotic technologies rapidly enter our everyday lives, we are compelled to consider the ethical, legal, and societal (ELS) challenges that arise in connection to these changes. In this workshop, we will present a novel methodological approach to HRI that will: help to identify ELS issues through ethnographic research methods, encourage interdisciplinary collaboration, and broaden the scope of existing HRI research while providing concrete tools for addressing these ELS challenges. We aim to introduce ethnographic methods and unfold the benefits and challenges of conducting ethnographic research. We will engage participants through speaker presentations, lightning talks, moderated group discussions, and a group-work session focused on integrating new methods into attendees' own research practices. Workshop topics will draw on the content of selected position papers, centered around how we can use ethnographic methods in HRI research so that we can: better understand users, workplaces, and robots; identify and address ELS issues; and ultimately ensure the design of more ethical, sustainable, and responsible robotics.

Morning Workshop 3:

Social Human-Robot Interaction of Human-care Service Robots

Place: Grant Park B

Ho Seok Ahn
JongSuk Choi
Hyungpil Moon
Yoonseob Lim

Service robots with social intelligence are starting to be integrated into our everyday lives. The robots are intended to help improve aspects of quality of life as well as improve efficiency. We are organizing an exciting workshop at HRI 2018 that is oriented towards sharing the ideas amongst participants with diverse backgrounds ranging from Human-Robot Interaction design, social intelligence, decision making, social psychology and aspects and robotic social skills. The purpose of this workshop is to explore how social robots can interact with humans socially and facilitate the integration of social robots. This workshop focuses on three social aspects of human-robot interaction: (1) technical implementation of social robots and products, (2) form, function and behavior, and (3) human behavior and expectations as a means to understand the social aspects of interacting with these robots and products. This workshop is supported by IEEE RAS Technical Committee on Robotic Hands, Grasping and Manipulation.

Full-Day Workshop 1:

Social Robots in Therapy: Focusing on Autonomy and Ethical Challenges

Place: Grant Park A

Pablo G. Esteban
Daniel Hernández García
Hee Rin Lee
Pauline Chevalier
Paul Baxter
Cindy Bethel

Robot-Assisted Therapy (RAT) has successfully been used in Human-Robot Interaction (HRI) research by including social robots in health-care interventions by virtue of their ability to engage human users in both social and emotional dimensions. Research projects on this topic exist all over the globe in the USA, Europe, and Asia. All of these projects have the overall ambitious goal of increasing the well-being of a vulnerable population. Typical, RAT is performed with the Wizard-of-Oz (WoZ) technique, where the robot is controlled, unbeknownst to the patient, by a human operator. However, WoZ has been demonstrated to not be a sustainable technique in the long-term. Providing the robots with autonomy (while remaining under the supervision of the therapist) has the potential to lighten the therapist's burden, not only in the therapeutic session itself but also in longer-term diagnostic tasks. Therefore, there is a need for exploring several degrees of autonomy in social robots used in therapy. Increasing the autonomy of robots might also bring about a new set of challenges. In particular, there will be a need to answer new ethical questions regarding the use of robots with a vulnerable population, as well as a need to ensure ethically-compliant robot behaviors. Therefore, in this workshop we want to gather findings and explore which degree of autonomy might help to improve health-care interventions and how we can overcome the ethical challenges inherent to it.

Full-Day Workshop 2:

Personal Robots for Exercising and Coaching

Place: Hyde Park B

Sebastian Schneider
Sascha S. Griffiths
Carlos Cifuentes
Britta Wrede
Stefan Wermter

Exercising is strongly recommended for prevention and treatment of pathologies with high prevalence such as cardiovascular diseases, cancer, and diabetes. The World Health Organization (WHO) states that insufficient physical activity is one of the leading risk factors for death worldwide. The decrease of physical activity in our society is not just an individual problem but it is influenced by a variety of environmental and social factors. Hence, it is important to target this issue from a multi-perspective and interdisciplinary point of view. This full-day workshop will offer a forum for researchers from a variety of backgrounds to discuss the potentials and limitations of using social robots to promote physical activity. Looking across disciplinary boundaries we hope to establish a common understanding of the needs of potential target groups. We invite participants to share their experiences on the requirements and challenges implementing and deploying robot coaches that could motivate people to start and adhere to a physical activity program.

Full-Day Workshop 3:

Robots for Learning – R4L : Inclusive Learning

Place: Hyde Park A

Wafa Johal
James Kennedy
Vicky Charisi
Hae Won Park
Ginevra Castellano
Pierre Dillenbourg

The Robots for Learning workshop series aims at advancing the research topics related to the use of social robots in educational contexts.

The full-day workshop follows on previous events in Human-Robot Interaction conferences focusing on efforts to design, develop and test new robotics systems that help learners.

This 4th edition of the workshop will be dealing in particular on the potential use of robots for inclusive learning.

Since the past few years, inclusive education have been a key policy in a number of countries, aiming to provide equal changes and common ground to all.

In this workshop, we aim to discuss strategies to design robotics system able to adapt to the learners' abilities, to provide assistance and to demonstrate long-term learning effects.

Full-Day Workshop 4:

Explainable Robot Behaviors

Place: Jackson Park D

Maartje M.A. de Graaf
Bertram F. Malle
Anca Dragan
Tom Ziemke

The increasing complexity of robotic systems are pressing the need for them to be transparent and trustworthy. When people interact with a robotic system, they will inevitably construct mental models to understand and predict its actions. However, people's mental models of robotic systems stem from their interactions with living beings, which induces the risk of establishing incorrect or inadequate mental models of robotic systems and may lead people to either under- and over-trust these systems. We need to understand the inferences that people make about robots from their behavior, and leverage this understanding to formulate and implement behaviors into robotic systems that support the formation of correct mental models of and fosters trust calibration. This way, people will be better able to predict the intentions of these systems, and thus more accurately estimate their capabilities, better understand their actions, and potentially correct their errors. The aim of this full-day workshop is to provide a forum for researchers and practitioners to share and learn about recent research on people's inferences of robot actions, as well as the implementation of transparent, predictable, and explainable behaviors into robotic systems.

Full-Day Workshop 5:

Social Robots in the Wild

Place: Jackson Park C

Ross Mead
Daniel H Grollman
Angelica Lim
Cynthia Yeung
Andrew Stout
W. Brad Knox

Commercially available social robots are finally here. Previously accessible only to companies or wealthy individuals, affordable, mass-produced autonomous robot companions are poised to take the global market by storm in 2018. It is an exciting time for social roboticists, as some of the theories and techniques developed and tested for years under controlled conditions are finally released to the general public. However, the social robots available to the public differ significantly from those currently used in labs and field studies due to commercial requirements such as affordability, reliability, and ability to function despite environmental variability.
This workshop focuses on the state of social robots in the market today---the lessons learned from mass-producing and distributing actual products, and the cutting-edge research that could be brought to bear on the many issues faced. Through presentations, panels, and hands-on interactions, participants from both academia and industry give each other feedback on what is working and what is not, and set goals for the near future.

Full-Day Workshop 6:

HRI2018 Pioneers Workshop

Place: Jackson Park B

Austin Whitesell
Cristina Zaga
Brittany Noah
Caitlyn Clabaugh
Felix Gervits

The 13th annual Human-Robot Interaction Pioneers Workshop will be held in Chicago, USA on Monday, March 5, 2018 in conjunction with the 2018 ACM/IEEE International Conference on Human-Robot Interaction.
Pioneers seeks to foster creativity and collaboration surrounding key challenges in human-robot interaction and empower students early in their academic careers. Each year, the workshop brings together a cohort of the world's top student researchers and provides the opportunity for students to present and discuss their work with distinguished student peers and senior scholars in the field.
Pioneers is a premiere forum for graduate students in HRI, thus we invite students at any stage of their academic career to consider applying. To facilitate attendance, we expect to provide financial support to accepted students to help mitigate the costs of the workshop and main conference

Afternoon Workshop 1:

Virtual, Augmented, and Mixed Reality for Human-Robot Interaction

Place: Grant Park D

Tom Williams
Daniel Szafir
Tathagata Chakraborti
Heni Ben Amor

The 1st International Workshop on Virtual, Augmented, and Mixed Reality for Human-Robot Interactions (VAM-HRI) will bring together HRI, Robotics, Artificial Intelligence, and Mixed Reality researchers to identify challenges in mixed reality interactions between humans and robots.

Topics relevant to the workshop include development of robots that can interact with humans in mixed reality, use of virtual reality for developing interactive robots, the design of new augmented reality interfaces that mediate communication between humans and robots, comparisons of the capabilities and perceptions of robots and virtual agents, and best practices for the design of such interactions. VAM-HRI is the first workshop of its kind at an academic AI or Robotics conference, and is intended to serve as a timely call to arms to the academic community in response to the growing promise of this emerging field.

Afternoon Workshop 2:

"What Could Go Wrong?!" Lessons Learned When Doing HRI User Studies with Off-the-Shelf Robots

Place: Grant Park C

An Jacobs
Mike Ligthart
Shirley A. Elprama
Koen Hindriks
Katie Winkle

Today, off-the-shelf social robots are used increasingly in the HRI community to research social interactions with different target user groups across a range of domains (e.g. healthcare, education, retail and other public spaces).

We invite everyone doing HRI studies with end users, in the lab or in the wild, to collect past experiences of methods and practices that had issues or did not turn out as expected. This could include but is not limited to experimental setup, unplanned interactions, or simply the difficulty in transferring theory to the real world.

In order to be able to generalize and compare differences across multiple HRI domains and create common solutions, we are focusing in this workshop on experiences with often used off-the-shelf social robots.

We are interested in identifying the underlying causes of the unexpected HRI results, e.g. the contextual, task, and user related factors that influence interaction with a robot platform. We will furthermore discuss and document (ad hoc) solutions and/or lessons learned such that they can be shared with the HRI community.

As well as sharing specific case studies documenting real world HRI experiences, we further hope to inspire the continued sharing of open and insightful reflections within the HRI community.

Afternoon Workshop 3:

Cognitive and Social Neuroscience Methods for HRI

Place: Grant Park B

Agnieszka Wykowska
Giorgio Metta
Cristina Becchio
Ruud Hortensius
Emily Cross

This workshop focuses on research in HRI using objective measures from social and cognitive neuroscience to provide guidelines for the design of robots well-tailored to the workings of the human brain. The aim is to present results from experimental studies in which human behavior and brain activity are measured during interactive protocols with robots. Discussion will focus on means to improve replicability and generalizability of experimental results in HRI.

Tuesday March 06

View from Outer Drive Link Bridge

Tuesday

Notes

Tuesday March 6

Time	Event - Room (Track 1, for Split Sessions)	Event - Room (Track 2, for Split Sessions)
09:00	**Chairs' Welcome** - W192 Takayuki Kanda, Selma Šabanovic, Guy Hoffman, Adriana Tapus	
09:30	**Plenary Keynote** - W192 David Mindell: Autonomy in Human Environments	
10:30	**Break** - W196	
10:50	**Teleoperation and Shared Manipulation – W192**	**Tutoring and Child-Robot Interaction – W194**
10:50	Eye-Hand Behavior in Human-Robot Shared Manipulation Reuben Aronson, Thiago Santini, Thomas Kübler, Enkelejda Kasneci, Siddhartha Srinivasa, Henny Admoni	Do Children Perceive Whether a Robotic Peer is Learning or Not? Shruti Chandra, Raul Paradeda, Hang Yin, Pierre Dillenbourg, Rui Prada, Ana Paiva
11:10	"Wait, Can You Move the Robot?": Examining Telepresence Robot Use in Collaborative Teams Brett Stoll, Samantha Reig, Lucy He, Ian Kaplan, Malte Jung, Susan Fussell	The Effect of a Robot's Gestures and Adaptive Tutoring on Children's Acquisition of Second Language Vocabularies Jan de Wit, Thorsten Schodde, Bram Willemsen, Kirsten Bergmann, Mirjam de Haas, Stefan Kopp, Emiel Krahmer, Paul Vogt
11:30	Shared Dynamic Curves: A Shared-Control Tele-manipulation Method for Motor Task Training Daniel Rakita, Bilge Mutlu, Michael Gleicher, Laura Hiatt	Thinking Aloud with a Tutoring Robot to Enhance Learning Aditi Ramachandran, Chien-Ming Huang, Edward Gartland, Brian Scassellati
11:50	It's All in Your Head: Using Priming to Shape an Operator's Perceptions and Behavior during Teleoperation Daniel Rea, James Young	"Stop. I See a Conflict Happening." A Robot Mediator for Young Children's Interpersonal Conflict Resolution Solace Shen, Petr Slovak, Malte Jung
12:10	**Lunch**	
13:40	**Late-Breaking Reports – W196** **Student Design Competition – W196**	**HRI Pioneers Posters – W196** **Demonstrations – W196**
15:40	**Break** - W196	
16:00	**Best Paper Nominees – W192**	
16:00	Improving Collocated Teleoperation with Augmented Reality Hooman Hedayati, Michael Walker, Daniel Szafir	
16:20	Expressing Robot Incapability Minae Kwon, Sandy Huang, Anca Dragan	
16:40	Characterizing the Design Space of Rendered Robot Faces Alisa Kalegina, Grace Schroeder, Aidan Allchin, Keara Berlin, Maya Cakmak	
17:00	What is Human-like?: Decomposing Robots' Human-like Appearance Using the Anthropomorphic roBOT (ABOT) Database Elizabeth Phillips, Xuan Zhao, Daniel Ullman, Bertram Malle	
17:20	Fribo: A Social Networking Robot for Increasing Social Connectedness through Sharing Daily Home Activities from Living Noise Data Kwangmin Jeong, Jihyun Sung, Hae-Sung Lee, Aram Kim, Hyemi Kim, Chan Mi Park, Yuin Jeong, JeeHang Lee, Jinwoo Kim	
17:40	**Distinguished Service Award** – W192	
18:00	**Reception** – W196	

Plenary Talk 1

Tue, March 6, W192 (09:30~10:30)

Autonomy in Human Environments

David Mindell

Abstract

As autonomous systems move out of the research laboratory into operational environments, they need ever deeper connections to their environments. Traditional notions of full autonomy—vehicles or robots working entirely on their own—are being augmented by precise, robust relationships with people and infrastructure. This situated autonomy appears in driverless cars' dependence on human-built infrastructure, the need for new systems of unmanned traffic management in the air, and the increasing importance of collaborative robotics in factories. This talk sketches a number of these emerging scenarios, introduces new technologies to address the problems they raise, and envisions a new approach to HRI that connects people, robots, and infrastructure at scale.

Biography

David Mindell, PhD, is Professor of Aeronautics and Astronautics, and Dibner Professor of the History of Engineering and Manufacturing at MIT. David has spent twenty-five years researching the myriad relationships between people and machines. He served as an MIT department head for five years, and has led or contributed to more than 25 oceanographic expeditions. David has developed and commercially licensed spread-spectrum sonar technologies for undersea navigation. He is the author of five books, including Our Robots, Ourselves: Robotics and the Myths of Autonomy (2015), Digital Apollo: Human and Machine in the First Six Lunar Landings (2008) and Between Human and Machine: Feedback, Control, and Computing Before Cybernetics (2000). David is an Associate Fellow of the American Institute of Aeronautics and Astronautics, and a Senior Member of the IEEE. He is co-founder of Humatics Corporation, which develops technologies for human-centered automation.

Full Papers Session

Tue, March 6

Full Papers Session 1, Track 1

Room W192 (10:50~12:10)

Teleoperation and Shared Manipulation

Session Chair: Henny Admoni (Carnegie Mellon University)

Eye-Hand Behavior in Human-Robot Shared Manipulation (10:50~11:10)

Reuben Aronson (Carnegie Mellon University), **Thiago Santini** (University of Tübingen), **Thomas Kübler** (University of Tübingen), **Enkelejda Kasneci** (University of Tübingen), **Siddhartha Srinivasa** (University of Washington), **Henny Admoni** (Carnegie Mellon University)

Shared autonomy systems enhance people's abilities to perform activities of daily living using robotic manipulators. Recent systems succeed by first identifying their operators' intentions, typically by analyzing the user's joystick input. To enhance this recognition, it is useful to characterize people's behavior while performing such a task. Furthermore, eye gaze is a rich source of information for understanding operator intention. The goal of this paper is to provide novel insights into the dynamics of control behavior and eye gaze in human-robot shared manipulation tasks. To achieve this goal, we conduct a data collection study that uses an eye tracker to record eye gaze during a human-robot shared manipulation activity, both with and without shared autonomy assistance. We process the gaze signals from the study to extract gaze features like saccades, fixations, smooth pursuits, and scan paths. We analyze those features to identify novel patterns of gaze behaviors and highlight where these patterns are similar to and different from previous findings about eye gaze in human-only manipulation tasks. The work described in this paper lays a foundation for a model of natural human eye gaze in human-robot shared manipulation.

"Wait, Can You Move the Robot?": Examining Telepresence Robot Use in Collaborative Teams (11:10~11:30)

Brett Stoll (Cornell University), **Samantha Reig** (Carnegie Mellon University), **Lucy He** (Cornell University), **Ian Kaplan** (Cornell University), **Malte Jung** (Cornell University), **Susan Fussell** (Cornell University)

Telepresence robots provide remote team members with embodied presence, but whether this improves remote teammate participation, remote users' perceptions of team collaboration, or collocated members' perceptions of remote teammates is an open question. We conducted an experiment in which teams of two collocated members and one telepresent (remote) member solved a word puzzle requiring a translation key. We varied who had access to the key to examine effects of resource accessibility in distributed groups: in the Robot Information condition, the remote pilot (RP) possessed the key; in the Shared Information condition, all team members possessed the key; in the Local Information condition, only collocated participants (CPs) possessed the key. Audio transcripts were analyzed for differences in the number of words spoken by each team member. RPs spoke significantly less than CPs, especially when they lacked the translation key. RPs perceived greater task difficulty and less ease of communication than CPs. CPs rated other CPs as more trust-worthy than RPs. This suggests an imbalance between collocated and remote collaborators that can negatively affect collaboration. We discuss implications for the design and use of telepresence robots in the workplace.

Shared Dynamic Curves: A Shared-Control Telemanipulation Method for Motor Task Training (11:30~11:50)

Daniel Rakita (University of Wisconsin-

Madison), **Bilge Mutlu** (University of Wisconsin-Madison), **Michael Gleicher** (University of Wisconsin-Madison), **Laura Hiatt** (Naval Research Laboratory)

In this paper, we present a novel shared-control telemanipulation method that is designed to incrementally improve a user's motor ability. Our method initially corrects for the user's suboptimal control trajectories, gradually giving the user more direct control over a series of training trials as he/she naturally gets more accustomed to the task. Our shared-control method, called *Shared Dynamic Curves*, blends suboptimal user translation and rotation control inputs with known translation and rotation paths needed to complete a task. Shared Dynamic Curves provide a translation and rotation path in space along which the user can easily guide the robot, and this curve can bend and flex in real-time as a dynamical system to pull the user's motion gracefully toward a goal. We show through a user study that Shared Dynamic Curves affords effective motor learning on certain tasks compared to alternative training methods. We discuss our findings in the context of shared control and speculate on how this method could be applied in real-world scenarios such as job training or stroke rehabilitation.

It's All in Your Head: Using Priming to Shape an Operator's Perceptions and Behavior during Teleoperation (11:50~12:10)

Daniel Rea (University of Manitoba), **James Young** (University of Manitoba)

Perceptions of a technology can shape the way the technology is used and adopted. Thus, in teleoperation, it is important to understand how a teleoperator's perceptions of a robot can be shaped, and whether those perceptions can impact how people drive robots. Priming, evoking activity in a person by exposing them to learned stimuli, is one way of shaping someone's perception. We investigate priming an operator's impression of a robot's physical capabilities in order to impact their perception of the robot and teleoperation behavior; that is, we examine if we can change operator driving behavior simply by making them believe that a robot is dangerous or safe, fast or slow, etc., without actually changing robot capability. Our results show that priming (with no change to robot behavior or capability) can impact operator perception of the robot, their teleoperation experience, and in some cases may impact teleoperation performance.

Full Papers Session 1, Track 2

Room W194 (10:50~12:10)

Tutoring and Child-Robot Interaction

Session Chair: Kerstin Dautenhahn
(University of Hertfordshire)

Do Children Perceive Whether a Robotic Peer is Learning or Not? (10:50~11:10)

Shruti Chandra (INESC-ID, Instituto Superior Tecnico, University of Lisbon & ÉPFL), **Raul Paradeda** (INESC-ID, Instituto Superior Tecnico, University of Lisbon & State University of Rio Grande do Norte), **Hang Yin** (INESC-ID, Instituto Superior Tecnico, University of Lisbon & ÉPFL), **Pierre Dillenbourg** (ÉPFL), **Rui Prada** (INESC-ID, Instituto Superior Técnico, Universidade de Lisbon), **Ana Paiva** (INESC-ID, Instituto Superior Técnico & University of Lisbon)

Social robots are being used to create better educational scenarios, thereby fostering children's learning. In the work presented here, we describe an autonomous social robot that was designed to enhance children's handwriting skills. Exploiting the benefits of the learning-by-teaching method, the system provides a scenario in which a child acts as a teacher and corrects the handwriting difficulties of the robotic agent. To explore the children's perception towards this social robot and the effect on their learning, we have conducted a multi-session study with children that compared two contrasting competencies in the robot: 'learning' vs 'non-learning' and presented as two conditions in the study. The results suggest that the children learned more in the learning condition compared with the non-learning condition and their learning gains seem to be affected by their perception of the robot. The results did not lead to any significant differences in the children's perception of the robot in the first two weeks of interaction. However, by the end of the 4th week, the results changed. The children in the learning condition gave significantly higher writing ability and overall performance scores to the robot compared with the non-learning condition. In addition, the change in the robot's learning capabilities did not show to affect their perceived intelligence, likability and friendliness towards it.

The Effect of a Robot's Gestures and Adaptive Tutoring on Children's Acquisition of Second Language Vocabularies (11:10~11:30)

Jan de Wit (Tilburg University), **Thorsten Schodde** (Bielefeld University), **Bram Willemsen** (Tilburg University), **Kirsten Bergmann** (Bielefeld University), **Mirjam de Haas** (Tilburg University), **Stefan Kopp** (Bielefeld University), **Emiel Krahmer** (Tilburg University), **Paul Vogt** (Tilburg University)

This paper presents a study in which children, four to six years old, were taught words in a second language by a robot tutor. The goal is to evaluate two ways for a robot to provide scaffolding for students: the use of iconic gestures, combined with adaptively choosing the next learning task based on the child's past performance. The results show a positive effect on long-term memorization of novel words, and an overall higher level of engagement during the learning activities when gestures are used. The adaptive tutoring strategy reduces the extent to which the level of engagement is diminishing during the later part of the interaction.

Thinking Aloud with a Tutoring Robot to Enhance Learning (11:30~11:50)

Aditi Ramachandran (Yale University), **Chien-Ming Huang** (Johns Hopkins University), **Edward Gartland** (Greens Farms Academy), **Brian Scassellati** (Yale University)

Thinking aloud, while requiring extra mental effort, is a metacognitive technique that helps students navigate through complex problem-solving tasks. Social robots, bearing embodied immediacy that fosters engaging and compliant interactions, are a unique platform to deliver problem-solving support such as thinking aloud to young learners. In this work, we explore the effects of a robot platform and the think-aloud strategy on learning outcomes in the context of a one-on-one tutoring interaction. Results from a 2x2 between-subjects study (n=52) indicate that both the robot platform and use of the think-aloud strategy promoted learning gains for children. In particular, the robot platform effectively enhanced immediate learning gains, measured right after the tutoring session, while the think-aloud strategy improved persistent gains as measured approximately one week after the interaction. Moreover, our results show that a social robot strengthened students' engagement and compliance with the think-aloud support while they performed cognitively demanding tasks. Our work indicates that robots can support metacognitive strategy use to effectively enhance learning and contributes to the growing body of research demonstrating the value of social robots in novel educational settings.

"Stop. I see a conflict happening." A Robot Mediator for Young Children's Interpersonal Conflict Resolution (11:50~12:10)

Solace Shen (Cornell University), **Petr Slovak** (University College London), **Malte Jung** (Cornell University)

The ability to constructively resolve interpersonal conflicts is a crucial set of social skills people need to effectively work and live well together. Is it possible to design social robots to support the early development of children's interpersonal conflict resolution skills? To investigate this question, 64 (32 pairs of) children ages 3-6 years engaged in a 50-minute play session consisting of 5 activities facilitated by the robot Keepon. Children were randomly assigned to 1 of 2 conditions. In the mediation condition, Keepon directed the play session flow by indicating when and which activity to switch to, and whenever possible, signaled the onset of object possession conflicts that occurred between the pair and offered prompts for constructive conflict resolution. In the control condition, Keepon only facilitated and directed the play session and did not intervene during children's conflicts. Results show that children were more likely to resolve conflicts constructively in the mediation condition than in the control condition, and that a key function for a robot mediator within the conflict process is to successfully flag the conflict onset. Drawing from these findings, we discuss design recommendation for a robot mediator.

Full Papers Session 2
Room W192 (16:00~17:40)

Best Paper Nominees

Session Chair: Fumihide Tanaka
(University of Tsukuba)

Improving Collocated Robot Teleoperation with Augmented Reality (16:00~16:20)

Hooman Hedayati (University of Colorado Boulder), **Michael Walker** (University of Colorado Boulder), **Daniel Szafir** (University of Colorado Boulder)

Robot teleoperation can be a challenging task, often requiring a great deal of user training and expertise, especially for platforms with high degrees-of-freedom (e.g., industrial manipulators and aerial robots). Users often struggle to synthesize information robots collect (e.g., a camera stream) with contextual knowledge of how the robot is moving in the environment. We explore how advances in augmented reality (AR) technologies are creating a new design space for mediating robot teleoperation by enabling novel forms of intuitive, visual feedback. We prototype several aerial robot teleoperation interfaces using AR, which we evaluate in a 48-participant user study where participants completed an environmental inspection task. Our new interface designs provided several objective and subjective performance benefits over existing systems, which often force users into an undesirable paradigm that divides user attention between monitoring the robot and monitoring the robot's camera feed(s).

Expressing Robot Incapability (16:20~16:40)

Minae Kwon (Cornell University), **Sandy Huang** (University of California Berkeley), **Anca Dragan** (University of California Berkeley)

Our goal is to enable robots to express their incapability, and to do so in a way that communicates both what they are trying to accomplish and why they are unable to accomplish it. We frame this as a trajectory optimization problem: maximize the similarity between the motion expressing incapability and what would amount to successful task execution, while obeying the physical limits of the robot. We introduce and evaluate candidate similarity measures, and show that one in particular generalizes to a range of tasks, while producing expressive motions that are tailored to each task. Our user study supports that our approach automatically generates motions expressing incapability that communicate both what and why to end-users, and improve their overall perception of the robot and willingness to collaborate with it in the future.

Characterizing the Design Space of Rendered Robot Faces (16:20~16:40)

Alisa Kalegina (University of Washington), **Grace Schroeder** (University of Washington), **Aidan Allchin** (Lakeside School), **Keara Berlin** (Macalester College), **Maya Cakmak** (University of Washington)

Faces are critical in establishing the agency of social robots; however, building expressive mechanical faces is costly and difficult. Instead, many robots built in recent years have faces that are rendered onto a screen. This gives great flexibility in what a robot's face can be and opens up a new design space with which to establish

a robot's character and perceived properties. Despite the prevalence of robots with rendered faces, there are no systematic explorations of this design space. Our work aims to fill that gap. We conducted a survey and identified 157 robots with rendered faces and coded them in terms of 76 properties. We present statistics, common patterns, and observations about this data set of faces. Next, we conducted two surveys to understand people's perceptions of rendered robot faces and identify the impact of different face features. Survey results indicate preferences for varying levels of realism and detail in robot faces based on context, and indicate how the presence or absence of specific features affects perception of the face and the types of jobs the face would be appropriate for.

What is Human-like?: Decomposing Robots' Human-like Appearance Using the Anthropomorphic roBOT (ABOT) Database (16:40~17:00)

Elizabeth Phillips (Brown University), **Xuan Zhao** (Brown University), **Daniel Ullman** (Brown University), **Bertram Malle** (Brown University)

Anthropomorphic robots, or robots with human-like appearance features such as eyes, hands, or faces, have drawn considerable attention in recent years. To date, what makes a robot appear human-like has been driven by designers' and researchers' intuitions, because a systematic understanding of the range, variety, and relationships among constituent features of anthropomorphic robots is lacking. To fill this gap, we introduce the ABOT (Anthropomorphic roBOT) Database—a collection of 200 images of real-world robots with one or more human-like appearance features (http://www.abotdatabase.info). Harnessing this database, Study 1 uncovered four distinct appearance dimensions (i.e., bundles of features) that characterize a wide spectrum of anthropomorphic robots and Study 2 identified the dimensions and specific features that were most predictive of robots' perceived human-likeness. With data from both studies, we then created an online estimation tool to help researchers predict how human-like a new robot will be perceived given the presence of various appearance features. The present research sheds new light on what makes a robot look human, and makes publicly accessible a powerful new tool for future research on robots' human-likeness.

Fribo: A Social Networking Robot for Increasing Social Connectedness through Sharing Daily Home Activities from Living Noise Data (17:00~17:20)

Kwangmin Jeong (Yonsei University), **Jihyun Sung** (Yonsei University), **Hae-Sung Lee** (Yonsei University), **Aram Kim** (Yonsei University), **Hyemi Kim** (Yonsei University), **Chan Mi Park** (Yonsei University), **Yuin Jeong** (Yonsei University), **JeeHang Lee** (KAIST), **Jinwoo Kim** (Yonsei University)

The rapid increase in the number of young adults living alone gives rise to a demand for the resolution of social isolation problems. Social robot technologies play a substantial role for this purpose. However, existing technologies try to solve the problem only through one-to-one interaction with robots, which in turn fails to utilize the real-world social relationships. Privacy concern is an additional issue since most social robots rely on the visual information for the interactions. To this end, we propose 'Fribo', auditory information centered social robot that recognizes user's activity by analyzing occupants' living noise and shares the activity information with close friends. A four-week field study with the first prototype of Fribo confirms that activity sharing through the use of anonymized living noise promises a virtual cohabiting experience that triggers more frequent real-world social interactions with less feeling of privacy intrusion. Based on this finding and the further qualitative analysis, we suggest a design principle of sound-based social networking robots and its associated new interactions, then present the second prototype of Fribo inspired by the implications from the field study.

Late-Breaking Reports - Posters

Tue, March 6, Room W196

Odd papers 13:40 - 14:40
Even papers 14:40 - 15:40

Late-Breaking Reports

01. Behavior Design of a Robot in a Public Place for Enriching Child-Robot Interaction in a Group
Kanae Kochigami, Kei Okada, Masayuki Inaba

02. Social Acceptance of Interactive Robots in Japan: Comparison of Children and Adults and Analysis of People's Opinion
Kanae Kochigami, Kei Okada, Masayuki Inaba

03. Methods for Providing Indications of Robot Intent in Collaborative Human-Robot Tasks
Gal Bejerano, Gregory LeMasurier, Holly Yanco)

04. Feedback Methods in HRI: Studying their effect on Real-Time Trust and Operator Workload
Siddharth Agrawal, Holly Yanco

05. Facilitating HRI by Mixed Reality Techniques
Patrick Renner, Florian Lier, Felix Friese, Thies Pfeiffer, Sven Wachsmuth

06. Towards an Open Simulation Environment for the Pepper Robot
Florian Lier, Sven Wachsmuth

07. Continuous Interaction Data Acquisition and Evaluation: A Process Applied within a Smart, Robot Inhabited Apartment
Viktor Richter, Franz Kummert

08. Fears of Intelligent Robots
Anna-Lisa Vollmer

09. Geographically Distributed Deployment of Reproducible HRI Experiments in an Interdisciplinary Research Context
Phillip Lücking, Florian Lier, Sven Wachsmuth, Selma Sabanovic

10. The Hesitating Robot - Implementation and First Impressions
Birte Carlmeyer, Simon Betz, Petra Wagner, Britta Wrede

11. User Study Results on Attitude Perception of a Mobile Robot
José Corujeira, José Luís Silva, Rodrigo Ventura

12. Resource-Based Modality Selection in Robot-Assisted Cognitive Training
Aleksandar Taranović, Aleksandar Jevtić, Joan Hernandez Farigola, Natalia Tantinyà, Carla Abdelnour, Carme Torras

13. Brain controlled humanoid pre-trained for interaction with people
Dana Tokmurzina, Batyrkhan Saduanov, Tohid Alizadeh, Berdakh Abibullaev

14. Exploring Child-Robot Proxemics
Anara Sandygulova

15. Towards Interpreting Robotic System for Fingerspelling Recognition in Real Time
Anara Sandygulova

16. Exploring Robot's Playing Strategy when Playing a Game with a Robot Companion
Anara Sandygulova

17. Exploring the Effects of Robot Gender on Child-Robot Interaction
Anara Sandygulova

18. Age-related Differences in Children's Associations and Preferences for a Robot's Gender
Anara Sandygulova

19. Exploring Cross-cultural Differences in Persuasive Robotics
Anara Sandygulova

20. At Arm's Length: Challenges in Building a Wearable Robotic Forearm for Human-Robot Collaboration
Vighnesh Vatsal, Guy Hoffman

21. Social interaction with drones using human emotion recognition
Eirini Malliaraki Malliaraki

22. Forecasting Hand Gestures for Human-Drone Interaction
Jangwon Lee, Haodan Tan, David Crandall, Selma Sabanovic

23. Attending and Observing Robot for Crutch Users

Naoaki Tsuda, Susumu Tarao, Yoshihiko Nomura, Norihiko Kato

24. The Use of Voice Input to Induce Human Communication with Banking Chatbots

Songhyun Kim, Junseok Goh, Soojin Jun

25. Developing a Vibrotactile Glove for Three-Dimensional Haptic Information Sensing

Yunjoo Kim, Jung Kim

26. Dilated Convolutional Neural Network for Predicting Driver's Activity

Banafsheh Rekabdar

27. Designing Shelly, a Robot Capable of Assessing and Restraining Children's Robot Abusing Behaviors

Hyunjin Ku, Jason Jangho Choi, Soomin Lee, Sunho Jang, Wonkyung Do

28. Evaluation of Posture Memory Retentivity using Coached Humanoid Robot

Ayami Kosaka, Taketo Katakura, Shigehiro Toyama, Fujio Ikeda

29. Toward Ethical Natural Language Generation for Human-Robot Interaction

Tom Williams

30. Coupled Indoor Navigation for People Who Are Blind

Amal Nanavati, Xiang Zhi Tan, Aaron Steinfeld

31. Social Haptic Interaction between Robot and Children with Disabilities

Álvaro Castro-González, Xiang Zhi Tan, Aaron Steinfeld, Elizabeth Jeanne Carter

32. Collaborative Robots in Surgical Research: A Low-Cost Adaptation

Natalia Sanchez-Tamayo, Juan Wachs

33. Dyadic Stance in Natural Language Communication with a Teachable Robot

Tricia Marie Chaffey, Hyeji Kim, Emilia Nobrega, Heather Pon-Barry

34. The Benefits of Teaching Robots using VR Demonstrations

Astrid G Jackson, Brandon D. Northcutt, Gita Sukthankar

35. Joint Surgeon Attributes Estimation in Robot-Assisted Surgery

Tian Zhou, Jackie S Cha, Glebys T Gonzalez Gonzalez, Juan Wachs, Chandru Sundaram, Denny Yu

36. A Diagnostic Human Workload Assessment Algorithm for Human-Robot Teams

Jamison Heard, Rachel Heald, Caroline Harriott, Julie A. Adams

37. Coherence in One-Shot Gesture Recognition for Human-Robot Interaction

Maria Eugenia Cabrera, Richard Voyles, Juan Wachs

38. Appeal and Perceived Naturalness of a Soft Robotic Tentacle

Jonas Jørgensen

39. Investigating the Effects of a Robot Peer on L2 Word Learning

Rianne van den Berghe, Sanne van der Ven, Josje Verhagen, Ora Oudgenoeg-Paz, Fotios Papadopoulos, Paul Leseman

40. Simulations and Self-Driving Cars: A Study of Trust and Consequences

Bjarke Kristian Maigaard Kjær Pedersen, Bente Charlotte Weigelin, Simon Köslich, Kamilla Egedal Andersen, Kati Kuusinen

41. Influence of Robophobia on Decision Making in a Court Scenario: A Preliminary Experimental Investigation Using a Simple Jury Task

Yugo Hayashi, Kosuke Wakabayashi

42. Robots in Diverse Contexts: Effects of Robots Tasks on Expected Personality

Seo-young Anne Lee, Soomin Kim, Gyuho Lee, Joonhwan Lee

43. ResQbot: A Mobile Rescue Robot for Casualty Extraction

Roni Permana Saputra, Petar Kormushev

44. What Does it Mean to Trust a Robot? Steps Toward a Multidimensional Measure of Trust

Daniel Ullman, Bertram F. Malle

45. Representation of Embodied Collaborative Behaviors in Cyber-Physical Human-Robot Interaction with Immersive User Interfaces

Jeffrey Too Chuan Tan, Yoshiaki Mizuchi, Yoshinobu Hagiwara, Tetsunari Inamura

Late-Breaking Reports

46. Simulating Human Explanations of Visual Scene Understanding
Leilani H Gilpin, Cagri Hakan Zaman, Danielle Marie Olson Olson, Ben Yuan

47. A Social Robot for Cognitive Assessment
Simone Varrasi, Santo Di Nuovo, Daniela Conti, Alessandro Di Nuovo

48. Keeping it Light: Perceptions of Humor Styles in Robot-Mediated Conflict
Brett Stoll, Malte F Jung, Susan R. Fussell

49. Robot Deathmatch: The Use of Robots to Model the System Engineering Process
Kerstin S Haring, Victor Finomore, Brian E Tidball

50. Personal Space Intrusion in Human-Robot Collaboration
Jessi Stark, Roberta Cabral Ramos Mota, Ehud Sharlin

51. Preliminary Interactions of Human-Robot Trust, Cognitive Load, and Robot Intelligence Levels in a Competitive Game
Michael Novitzky, Paul Robinette, Michael Benjamin, Danielle K Gleason

52. Behavioral Indoor Navigation With Natural Language Directions
Xiaoxue Zang, Marynel Vázquez, Alvaro Soto, Silvio Savarese

53. "Fight-or-Flight": Leveraging Instinctive Human Defensive Behaviors for Safe Human-Robot Interaction
Karthik Mahadevan, Sowmya Somanath, Ehud Sharlin

54. How a Little Robot Can Use Light, Sound and Movement to Get People's Attention in a Public Space
Kathrine Holtz, Søren Holmbjerg Schibler, Thea Kingo

55. A Pervasive Assistive Robot System Including Projection-Camera Technology for Older Adults
Seungho Chae, Hyocheol Ro, Yoonsik Yang, Tack-Don Han

56. Swarm Transparency
Julie A. Adams, Jessie Chen, Michael A Goodrich

57. Gendered Robot Voices and Their Influence on Trust
Sofie Ingeman Behrens, Michael Hansen, Anton Mikkonen Møllegård-Schroll, Anne Katrine Kongsgaard Egsvang

58. Double Pressure Presentation for Calligraphy Self-training
Ami Morikawa, Naoaki Tsuda, Yoshihiko Nomura, Norihiko Kato

59. Proof of Concept of a Social Robot for Patient Reported Outcome Measurements in Elderly Persons
Roel Boumans, Koen Hindriks, Fokke van Meulen, Mark Neerincx, Marcel Olde Rikkert

60. Who Do You Follow? Social Robots' Impact on Human Judgment.
Daniel Ullrich, Andreas Butz, Sarah Diefenbach

61. My Humorous Robot: Effects of a Robot Telling Jokes on Perceived Intelligence and Liking
I. Menne, Benjamin Lange, Dagmar C. Unz

62. Touch to Feel Me: Designing a Robot for Thermo-Emotional Communication
Denis Bryan Peña Pachamango, Fumihide Tanaka

63. Getting to Know You: Relationship Between Intergroup Contact and Willingness to Interact
Kathryn Wallisch, Marlena Fraune, Steven Sherrin, Selma Sabanovic, Eliot Smith

64. Month-long, In-home Case Study of a Socially Assistive Robot for Children with Autism Spectrum Disorder
Caitlyn Clabaugh, David Becerra, Eric Deng, Maja Mataric

65. Blossom: A Social Robot, Flexible Inside and Out
Michael Suguitan, Guy Hoffman

66. Individual Differences Predict Anthropomorphism of Robots along One of Two Dimensions
Miriam E. Armstrong, Keith S. Jones

67. Cost Functions based Dynamic Optimization for Robot Action Planning in Human-Robot Collaborative Tasks
Weitian Wang

68. **The Paths We Pick Together: A Behavioral Dynamics Algorithm for an HRI Pick-and-Place Task**
Maurice Lamb, Riley Mayr, Tamara Lorenz, Ali Minai, Michael J Richardson

69. **The Effects of the Physical Contact in the Functional Intimate Distance on User's Acceptance toward Robots**
Dahyun Kang, Sonya S. Kwak, SunKyoung Kim

70. **Predicting Human Intentions by Learning from Multi-modal Human Demonstrations in Human-Robot Hand-over Tasks**
Weitian Wang, Rui Li, Yi Chen, Yunyi Jia

71. **No data? No problem! Expert System Approach to Designing a POMDP Framework for Robot-assisted ASD Diagnostics**
Frano Petric, Zdenko Kovacic

72. **Bon Appetit! Robot Persuasion for Food Recommendation**
Sarita Herse, Jonathan Vitale, Daniel Ebrahimian, Meg Tonkin, Suman Ojha, Sidra Sidra, Benjamin Johnston, Sophie Phillips, Siva Leela Krishna Chand GUDI, Jesse Clark, William Judge, Mary-Anne Williams

73. **Evaluating the Effects of Personalization on Telepresence Robots for Education**
Naomi Fitter, Yasmin Chowdhury Chowdhury, Elizabeth Cha, Leila Takayama, Maja Mataric

74. **Cognitive Modeling of Remote-manual and Voice Controls for In-vehicle Human-automation Systems**
Heejin Jeong, Yili Liu

75. **The Way You Move: The Effect of a Robot Surrogate Movement in Remote Collaboration**
Martin Feick, Lora Oehlberg, Tony Tang, André Miede, Ehud Sharlin

76. **Human Trust in Robot Capabilities Across Tasks**
Shu Pan, Min Chen, Indu Bodala, Stefanos Nikolaidis, David Hsu, Harold Soh

77. **Designing an Affective Cognitive Architecture for Human-Humanoid Interaction**
Ana Tanevska, Rea Francesco, Giulio Sandini, Alessandra Sciutti

78. **Your Touch Leaves Me Cold, Robot.**
Nikolai Bock, Laura Hoffmann, Astrid M. Rosenthal von der Putten

79. **Teleoperation of a Robot through Audio-Visual Signal via Video Chat**
Hisato Fukuda, Yoshinori Kobayashi, Yoshinori Kuno

80. **If You Give Students a Social Robot... - World Robot Summit Pilot Study**
Amy Eguchi, Hiroyuki Okada

81. **Interaction Force Estimation for Quantitative Comfort Evaluation of an Eating Assistive Device**
Gustavo Alfonso Garcia Ricardez, Jorge Solis Alfaro, Jun Takamatsu, Tsukasa Ogasawara

82. **Excuse Me! Perception of Abrupt Direction Changes Using Body Cues and Paths on Mixed Reality Avatars**
Nicholas Katzakis, Frank Steinicke

83. **Designing Robot Receptionist for Overcoming Poor Infrastructure, Low Literacy and Low Rate of Female Interaction**
Muhammad Zubair Malik, Mohsen Ali, Talha Rehmani, Sabur Butt, Inam ur Rehman Baig

84. **How Robots Impact on Students Beliefs About Their Learning Skills**
Francesca Agatolio, Patrik Pluchino, Valeria Orso, Emanuele Menegatti, Luciano Gamberini

85. **Cognitive Implications of HMIs for Tele-operation and Supervisory Control of Robotic Ground Vehicles**
Anna Ma-Wyatt, Daniel Johnstone, Justin Fidock, Susan G Hill

86. **Evaluating Human Distraction and Disengagement for not Interactive Robot Tasks: a Pilot Study**
Silvia Rossi, Gabriella Santangelo, Martina Ruocco, Giovanni Ercolano, Luca Raggioli, Emanuele Savino

87. **Studying Table-Top Manipulation Tasks: A Robust Framework for Object Tracking in Collaboration**
Peter Lightbody, Marc Hanheide, Paul Baxter

Late-Breaking Reports

88. Differences Between Young and Old Users When Interacting with a Humanoid Robot: a Qualitative Usability Study

Ronit Feingold Polak, Avital Elishay, Yonat Shachar, Maayan Stein, Yael Edan, Shelly Levy Tzedek

89. Sensing Companions: Potential Clinical Uses of Robot Sensor Data for Home Care of Older Adults with Depression

Sawyer Collins, Selma Sabanovic, Marlena Fraune, Natasha Randall, Lori Eldridge, Jennifer Piatt, Casey Bennett, Shinichi Nagata

90. Decision-Making in Emotion Model

Chie Hieida, Takato Horii, Takayuki Nagai

91. Persistent Robot-Assisted Disaster Response

Joachim de Greeff, Tina Mioch, Willeke van Vught, Koen Hindriks, Mark Neerincx, Ivana Kruijff-Korbayová

92. Receiving Medical Treatment Plans from a Robot: Evaluations of Presence, Credibility, and Attraction

Chad Edwards, Autumn P. Edwards, Leah M. Omilion-Hodges

93. People's Judgments of Human and Robot Behaviors: A Robust Set of Behaviors and Some Discrepancies

Maartje M.A. de Graaf, Bertram F. Malle

94. Social Assistive Robot for Cardiac Rehabilitation: A Pilot Study with Patients with Angioplasty

Jonathan Casas, Bahar Irfan, Emmanuel Senft, Luisa Gutiérrez, Monica Rincon-Roncancio, Marcela Munera, Tony Belpaeme, Carlos Cifuentes

95. Robots Exhibit Human Characteristics: Theoretical and Practical Implications for Anthropomorphism Research

Keith S. Jones, Madeline K Niichel, Miriam E. Armstrong

96. Needs and Expectations for Fully Autonomous Vehicle Interfaces

Theocharis Amanatidis, Patrick Langdon, P. John Clarkson

97. Extending SCIPRR: Two Sensor Case-Studies

Pranav Avasarala, Anthony M. Harrison

98. Robot-Ergonomics: A Proposal for a Framework in HRI

Eduardo Benitez Sandoval, Ricardo Sosa, Miguel Montiel

99. Explanations and Expectations: Trust Building in Automated Vehicles

Jacob Haspiel, Na Du, Xi(Jessie) Yang, Dawn Tilbury, Anuj Pradhan, Lionel Peter Robert

100. Using of the Geneva Emotional Wheel as a Measurement Tool for the Perception of Affect on Robots

Conor McGinn, Kevin Kelly

101. A Robot Teaching Young Children a Second language: The Effect of Multiple Interactions on Engagement and Performance.

Emmy Rintjema, Rianne van den Berghe, Anne Kessels, Jan de Wit, Paul Vogt

102. Perception and Action in Remote and Virtual Environments

Sigal Berman, Tzvi Ganel

103. Explicit, Neutral, or Implicit: A Cross-Cultural Exploration of Communication-Style Preferences in Human Robot Interaction

Elaheh Sanoubari, James E. Young

104. Evaluating Robot Behavior in Response to Natural Language

Pooja Moolchandani, Cory Hayes, Matthew Marge

105. Contagious Yawning in Human-Robot Interaction

Hagen Lehmann, Frank Broz

106. Effects of a Delay Compensation Aid on Teleoperation of Unmanned Ground Vehicles

Shihan Lu, Meng Yuan Zhang, Tulga Ersal, Xi (Jessie) Yang

107. Asking for Help Effectively via Modeling of Human Beliefs

Taylor Kessler Faulkner, Scott Niekum, Andrea Thomaz

108. Teen-Robot Interaction: A Pilot Study of Engagement with a Low-Fidelity Prototype

Elin A. Björling, Emma Rose, Rachel Ren

109. **Humans Can Predict Where Their Partner Would Make a Handover**
Saki Kato, Natsuki Yamanobe, Gentiane Venture, Gowrishankar Ganesh

110. **Robots Providing Cognitive Assistance in Shared Workspaces**
Paul Baxter, Peter Lightbody, Marc Hanheide

111. **Attitudes, Prior Interaction, and Petitioner Credibility Predict Support for Considering the Rights of Robots**
Patric Spence, Autumn P Edwards, Chad Edwards

112. **Safe Human-Robot Interaction in Agriculture**
Paul Baxter, Grzegorz Cielniak, Marc Hanheide, Pal From

113. **Trust in AV: An Uncertainty Reduction Model of AV-Pedestrian Interactions**
Suresh Kumaar Jayaraman, Chandler Creech, Lionel Peter Robert, Dawn Tilbury, Xi(Jessie) Yang, Anuj Pradhan, Kate Tsui

114. **Using human reinforcement learning models to improve robots as teachers**
Sayanti Roy, Emily Kieson, Charles Abramson, Christopher Crick

115. **A Case Study of the Effects of Gender and Race in the Objectification of Humanlike Robots**
Ana Cecilia Sánchez Ramos, Virginia Contreras, Alejandra Santos, Cynthia Aguillon, Noemi Garcia, Jesus David Rodriguez, Ivan Amaya Vazquez, Megan Strait

116. **Adapting Robot-Assisted Therapy of Children with Autism and Different Levels of Intellectual Disability**
Daniela Conti, Alessandro Di Nuovo, Grazia Trubia, Serafino Buono, Santo Di Nuovo

117. **A Case Study on the Cybersecurity of Social Robots**
Justin Miller, Andrew B. Williams, Debbie Perouli

118. **Interpretation of (In-)Congruent Nonverbal Behavior and Non-Linguistic Utterances**
Astrid M Rosenthal von der Putten, Carolin Straßmann

119. **Strategies to Facilitate the Acceptance of a Social Robot by People with Dementia**
Dagoberto Cruz-Sandoval, Jesus Favela, Eduardo Benitez Sandoval

120. **Robot-Assisted Socio-Emotional Intervention Framework for Children with Autism Spectrum Disorder**
Hifza Javed, Myounghoon Jeon, Ayanna Howard, Chung Hyuk Park

121. **Acceptability of Tele-assistive Robotic Nurse for Human-Robot Collaboration in Medical Environment**
Wonhyong Lee, Jaebyong Park, Chung Hyuk Park

122. **Telepresence Group Leaders Receive Higher Ratings of Social Attractiveness and Leadership Quality**
Austin Beattie, Chad Edwards, Mallory Williams

123. **Inertial Human Motion Estimation for physical Human-Robot Interaction using an Interaction Velocity Update to reduce Drift**
Erik Kyrkjebø

Odd papers 13:40 - 14:40
Even papers 14:40 - 15:40

Student Design Competition

Tue, March 6 13:40, Room W196

01. 'We'- A Public and Community Robotic System Aimed at Maximizing Social Impact of Community Gardens
Swapna Joshi, Natasha Randall, Kostas Stavrianakis, Theodora Wattimena, Suraj Chiplunkar

02. Agreements and Financial, Robot-Human, Transactions Enabled by a Blockchain and Smart Contracts
Irvin Steve Cardenas, Jong Hoon Kim

03. RescueBot
Hammad Khan

04. The MAI: A Robot for/by Everyone
Kiran Jot Singh, Divneet Singh Kapoor, Balwinder Singh Sohi

05. Itchy, Scratchy: A Musical Robot for Low-Income Kid's Piano Practicing
Kyrie Jig, Chaolan Lin

06. YOLO - A Robot that Will Make Your Creativity BOOM
Patrícia Alves-Oliveira, Ankita Chandak, Ian Cloutier, Priyanka Kompella, Peter Moegenburg, André Elias Bastos Pires

07. MindScribe: Reflective Inquiry through Scaffolded Storytelling for Low-Income and Multilingual Early Childhood Communities
Layne Jackson Hubbard, Chen Hao Cheng, Boskin Erkocevic, Dylan Cassady, Andrea Chamorro

08. ParticiPod: Portable Telepresence for Immersive Activity Sharing
Sriraj Janakiram Aiyer, Heyi Wen, Stuart Alexander Arnott

09. Deeto the Drone
Yi-Chun Chen, Bryony Linden, Yun-sheng Su

10. LetterMoose: A Handwriting Tutor Robot
Fredrik Löfgren, Sofia Thunberg, Sam Thellman

11. Health-e-Eater: Dinnertime Companion Robot and Magic Plate for Improving Eating Habits in Children from Low-Income Families
Natasha Randall, Swapna Joshi, Xiaohang Liu

12. VOCOWA - VOice COntrolled Wheelchair Autonomous
Soujanya Madasu, Pranava Kumar Vemula

13. Buddy: A Speech Therapy Robot Companion for Children with Cleft Lip and Palate (CL/P) Disorder
Pavithra Ramamurthy, Kathy Li

14. GALEF
Marcela Gonzales Arias, Midori Sanchez Sanchez

15. BeachBot: Crowdsourcing Garbage Collection with Amphibious Robot Network
Abdullah Almosalami, Andrew Jones, Santipab Tipparach, Kade Leier, Randolph C Peterson

16. GeeBot: A Robotic Platform for Refugee Integration
Hugo Simão, João Avelino, Nuno Duarte, Rui Figueiredo

17. NEMSU
Midori Sanchez Sanchez, Marcela Gonzales Arias

18. EXGbuds: Universal Wearable Assistive Device for Disabled People to Interact with the Environment Seamlessly
Ker-Jiun Wang, Prakash C Thakur, Hsiao-Wei Tung, Zihang Huang, Zhi-Hong Mao

19. Shelly, a Tortoise-Like Robot for One-to-Many Interaction with Children
Hyunjin Ku, Jason Jangho Choi, Soomin Lee, Sunho Jang, Wonkyung Do

Pioneers Workshop Posters

Tue, March 6 13:40, Room W196

01. **Reducing Stress in Pediatric Oncology Care by Bonding with a Social Robot**
    Ligthart, Mike

02. **Emotionally Supporting Humans Through Robot Hugs**
    Block, Alexis

03. **Adaptive Robot Second Language Tutoring for Children**
    Schodde, Thorsten

04. **A Wearable Robotic Forearm for Human-Robot Collaboration**
    Vatsal, Vighnesh

05. **Robot Social Engineering: Attacking Human factors with Non-Human Actor**
    Postnikoff, Brittany

06. **Interfaces for Communicating Autonomous Vehicle Awareness and Intent to Pedestrians**
    Mahadevan, Karthik

07. **Assistive Device for Guiding Visually Impaired People With Mobility Disorders**
    Jimenez Hernandez, Mario Fernando

08. **Adaptable Multimodal Interaction Framework for Robot-Assistesd Cognitive Training**
    Taranovic, Aleksandar

09. **Designing Robot Personality Based on Fictional Sidekick Characters**
    Luria, Michal

10. **Setting Accurate Expectations of Robot Capabilities**
    Kwon, Minae

11. **Inferring and obeying norms in temporal logic**
    Kasenberg, Daniel

12. **A pilot Study: Advances in Robotic Hand Illusion and its Subjective Experience**
    Abrams, Anna

13. **Adaptive Behavior Generation for Child-Robot Interactions**
    Hemminghaus, Jacqueline

14. **Stress Factors that Impact Robot Operator Control in High-Stress Dynamic Scenarios**
    Hudson, Christopher

15. **Sound as Implicit Influence on Human-Robot interactions**
    Moore, Dylan

16. **Trust and Conformity when Interacting with a Group of Robots**
    Salomons, Nicole

17. **Human-Robot Trust: Understanding User Perceptions**
    Stuck, Rachel

18. **Efficient Human-Robot Interaction for Robust Autonomy in Task Execution**
    Banerjee, Siddhartha

19. **Contextual Collision: The Social Consequences of Touch and Collision in Human Robot Interaction**
    Shutterly, Alison

20. **End-User Programming of Manipulator Robots in Situated Tangible Programming Paradigm**
    Sefidgar, Yasaman

21. **Prediction and Production of Human Reaching Trajectories for Human-Robot Interaction**
    Sheikholeslami, Sara

Demo Session

Tue, March 6 13:40, Room W196

D1. Interaction with Soft Robotic Tentacles

Jonas Jørgensen

Soft robotics technology has been proposed for a number of applications that involve human-robot interaction. In this tabletop demonstration it is possible to interact with two soft robotic platforms that have been used in human-robot interaction experiments (also accepted to HRI'18 as a Late-Breaking Report and a Video).

D2. Buddy: A Companion Robot for the Whole Family

Gregoire Milliez

Buddy with its 60 centimeters and 4 degrees of freedom is a highly engaging social robot. Buddy deploys many assets for social interaction such as its appealing design, its anthropomorphic face able to display emotional reactions and its ability to be proactive to look for a user and propose activities. Buddy is developed by Blue Frog Robotics, a French start-up based in Paris, and aims to be the friendly companion for the whole family. With its intuitive SDK based on the famous UNITY game engine, Buddy is also designed to be a tool for research and education.

D3. Designing Exoskeletons for Children: Overcoming Challenge Associated with Weight-bearing and Risk of Injury

Manmeet Maggu, Rahul Udasi, Dina Nikitina

Research has shown that rehabilitation through repetitive automatic orthosis can be beneficial for children with cerebral palsy, however, it is expensive, requires a lot of room, and is rarely available in rehabilitation clinics. A different design approach was utilized to build an exoskeleton that can provide robot-assisted therapy while being mobile, weight-bearing, and safe. The Trexo device is fully powered, provides responsive support and allows data monitoring. Using this device, the goal is to provide affordable and accessible neurorehabilitation for children with disabilities.

D4. Designing Expressive Behaviors to Improve Human-Robot Relationships

Sahil Anand, John Luetke, Nikhil Venkatesh, Dorothy Wong

In this paper, we present a robot that communicates using nonverbal behaviors such as facial expressions and body movements to create a relatable character. We often see dissonance between human and machine because of differing interaction expectations and paradigms. In order to evolve these interactions, we created an expressive robot that can understand social cues and respond innately. The results of user tests emphasize the impact of expressive behaviors in both the perception of the robot and on the quality of the interaction. By creating an accessible robot model that puts the technology into more hands, we hope to move towards a deeper integration of robotics into everyday life.

D5. Therabot™: A Robotic Support Companion

Sarah Darrow, Aaron Kimbrell, Nikhil Prakash Lokhande, Nicholas Dinep-Schneider, T.J. Ciufo, Brandon Odom, Zachary Henkel, Cindy L. Bethel

Therabot is a robotic therapy support system designed to supplement a therapist and to provide support to patients diagnosed with conditions associated with trauma and adverse events. The system takes on the form factor of a floppy-eared dog which fits in a person's lap and is designed for patients to provide support and encouragement for home therapy exercises and in counseling.

D6. Development of Seamless Telepresence Robot Control Methods to Interact with the Environment Using Physiological Signals

Ker-Jiun Wang, Kaiwen You, Fangyi Chen, Prakash Thakur, Michael Urich, Soumya Vhasure, Zhi-Hong Mao

Current assistive devices to help disabled people interact with the environment are complicated and cumbersome. Our approach aims to solve these problems by developing a compact and non-obtrusive wearable device to measure signals associated with human physiological gestures, and therefore generate useful commands to interact with the smart environment. Our innovation uses machine learning and non-invasive biosensors on top of the ears to identify eye movements and facial expressions. With these identified signals, users can control different applications, such as a cell phone, powered wheelchair, smart home, or other IoT (Internet of Things) devices with simple and easy operations. Combined with VR headset, the user can use our technology to control a camera-mounted telepresence robot to navigate around the environment in the first-person’s view (FPV) by eye movements and facial expressions. It enables a very intuitive way of interaction totally hands-free and touch-free.

D7. MiRo: Social Interaction and Cognition in an Animal-like Companion Robot

Tony J. Prescott, Ben Mitchinson, Sebastian Conran, Tom Power, George Bridges

Future companion and assistive robots will interact directly with end-users in their own homes over extended periods of time. To be useful, and remain engaging over the long-term, these technologies need to pass a new threshold in social robotics—to be aware of people, their identities, emotions and intentions and to adapt their behavior to different individuals. Our immediate goal is to match the social cognition ability of companion animals who recognize people and their intentions without linguistic communication. The MiRo robot is a pet-sized mobile platform, with a brain-based control system and an emotionally-engaging appearance, which is being developed for research on companion robotics, and for applications in education, assistive living and robot-assisted therapy. This paper describes new MiRo capabilities for animal-like perception and social cognition that support the adaptation of behavior towards people and other robots.

D8. Blossom: A Tensile Social Robot Design with a Handcrafted Shell

Michael Suguitan, Guy Hoffman

We describe the design and implementation of Blossom, a social robot that diverges from convention by being flexible both internally and externally. Internally, Blossom's actuation mechanism is a compliant tensile structure supporting a free-floating platform. This design enables organic and lifelike movements with a small number of motors and simple software control. Blossom's exterior is also flexible in that it is made of fabric and not rigidly attached to the mechanism, enabling it to freely shift and deform. The handcrafted nature of the shell allows Blossom to take on a variety of forms and appearances. Blossom is envisioned as an open platform for user-crafted human-robot interaction.

D9. Behaviours and States for Human-Swarm Interaction Studies

David St-Onge, Jing Yang Kwek, Giovanni Beltrame

This demonstration will present a software concept and architecture for the control robot swarms for user studies. Exploring user perception of a swarm's motion and the dynamics of its members is a topic of growing interest. However, at the time of writing, no structured methodology that ensures repeatable and scalable studies is available. We postulate that a swarm's motion can be controlled with three complementary aspects: its behaviour, its agents' state, and the task at hand. We developed a software solution that allows a researcher to quickly implement a new model for each of the aspects, and test it with users in a repeatable manner.

Wednesday March 07

Wednesday

Notes

Wednesday March 7

Time	Event - Room (Track 1, for Split Sessions)	Event - Room (Track 2, for Split Sessions)
09:00	**Announcements** - W192	Takayuki Kanda, Selma Šabanovic, Guy Hoffman, Adriana Tapus
09:10	**Plenary Keynote** - W192	Kerstin Dautenhahn: Robots and Us — Useful Roles of Robots in Human Society
10:10	**Break** - W196	
10:30	**Machine Learning for HRI – W192**	**Societal Issues: Abuse, Trust, Racism – W194**
10:30	Active Robot Learning for Temporal Task Models Mattia Racca, Ville Kyrki	Inducing Bystander Interventions During Robot Abuse With Social Mechanisms Xiang Zhi Tan, Marynel Vázquez, Elizabeth Carter, Cecilia Morales, Aaron Steinfeld
10:50	Learning from Richer Human Guidance: Augmenting Comparison-Based Learning with Feature Queries Chandrayee Basu, Mukesh Singhal, Anca Dragan	The Ripple Effects of Vulnerability: The Effects of a Robot's Vulnerable Behavior on Trust in Human-Robot Teams Sarah Strohkorb Sebo, Margaret Traeger, Malte Jung, Brian Scassellati
11:10	Learning from Physical Human Corrections, One Feature at a Time Andrea Bajcsy, Dylan Losey, Marcia O'Malley, Anca Dragan	Humans Conform to Robots: Disambiguating Trust, Truth, and Conformity Nicole Salomons, Michael van der Linden, Sarah Strohkorb Sebo, Brian Scassellati
11:30	DNN-HMM based Automatic Speech Recognition for HRI Scenarios José Novoa, Jorge Wuth, Juan Escudero, Josué Fredes, Rodrigo Mahu, Néstor Yoma	Robots and Racism Christoph Bartneck, Kumar Yogeeswaran, Qi Min Ser, Graeme Woodward, Robert Sparrow, Siheng Wang, Friederike Eyssel
11:50	Deep Reinforcement Learning of Abstract Reasoning from Demonstrations Madison Clark-Turner, Momotaz Begum	Mindless Robots get Bullied Merel Keijsers, Christoph Bartneck
12:10	**Lunch**	
13:40	**Designing Robots and Interactions – W192**	**Groups and Teams – W194**
13:40	User-Centered Robot Head Design: a Sensing Computing Interaction Platform for Research Robotics (SCIPRR) Anthony Harrison, Wendy Xu, J. Gregory Trafton	Human-Robot Similarity and Willingness to Work with Robotic Co-Worker Sangseok You, Lionel Robert Jr.
14:00	Bioluminescence-Inspired Human-Robot Interaction: Designing Expressive Lights that Affect Human's Willingness to Interact with a Robot Sichao Song, Seiji Yamada	Group-based Emotions in Teams of Humans and Robots Filipa Correia, Samuel Mascarenhas, Rui Prada, Francisco Melo, Ana Paiva
14:20	"Haru": Hardware Design of an Experimental Table top Robot Assistant Randy Gomez, Deborah Szapiro, Kerl Galindo, Keisuke Nakamura	Where Should Robots Talk?: Spatial Arrangement Study from a Participant Workload Perspective Takahiro Matsumoto, Mitsuhiro Goto, Ryo Ishii, Tomoki Watanabe, Tomohiro Yamada, Michita Imai
14:40	Iterative Design of an Upper Limb Rehabilitation Game with Tangible Robots Arzu Guneysu Ozgur, Maximilian Wessel, Wafa Johal, Kshitij Sharma, ... Pierre Dillenbourg	Friends or Foes? Socioemotional Support and Gaze Behaviors in Mixed Groups of Humans and Robots Raquel Oliveira, Patrícia Arriaga, Patrícia Alves-Oliveira, Filipa Correia, Sofia Petisca, Ana Paiva
15:00	**Break** - W196	
15:30	**Best Paper Nominees – W192**	
15:30	Social Robots for Engagement in Rehabilitative Therapies: Design Implications from a Study with Therapists Katie Winkle, Praminda Caleb-Solly, Ailie Turton, Paul Bremner	
15:50	"Thank You for Sharing that Interesting Fact!": Effects of Capability and Context on Indirect Speech Act Use in Task-Based Human-Robot Dialogue Tom Williams, Daria Thames, Julia Novakoff, Matthias Scheutz	
16:10	Planning with Trust for Human-Robot Collaboration Min Chen, Stefanos Nikolaidis, Harold Soh, David Hsu, Siddhartha Srinivasa	
16:30	Communicating Robot Motion Intent with Augmented Reality Michael Walker, Hooman Hedayati, Jennifer Lee, Daniel Szafir	
16:50	An Autonomous Dynamic Camera Method for Effective Remote Teleoperation Daniel Rakita, Bilge Mutlu, Michael Gleicher	
17:10	**Break** - W196	
17:30	**Videos** - W192	

Plenary Talk 2

Wed, March 7, W192 (09:10~10:10)

Robots and Us – Useful Roles for Robots in Human Society

Kerstin Dautenhahn

Abstract

My talk will highlight some of the developments over the past 15 years in human-robot interaction and social robots. I have been fascinated by this area since it requires us to tackle hard problems on many dimensions, including robot design and functionalities, robot cognition and intelligence, and last but not least, the human dimension of how people perceive robots and relate to them. I will make a few points on what robots are, and what they are not, and emphasise useful roles they can play in human society. I will illustrate those points with examples of research projects I have been involved in, and highlight lessons that we have learned over the years in our quest to develop robot companions that provide useful assistance and are socially acceptable.

Biography

Kerstin Dautenhahn, Senior Member IEEE, is Professor of AI in the School of Computer Science at University of Hertfordshire in U.K. where she coordinates the Adaptive Systems Research Group. She has published more than 300 research articles on topics related to social robotics and human-robot interaction. She is interested in both the technical aspects of robot development for HRI as well as the human aspects of how people relate to and interact with robots. In addition to basic research she is interested in assistive applications of interactive, social robots. Since 1998 she has been exploring the use of robots for therapy and education of children with autism. More recently she became interested in home companion robots. She has edited several books and frequently gives invited keynote lectures. She has been Principal Investigator of her research team in several European, nationally and internationally funded projects.Kerstin has several editorial roles: is Founding Editor in Chief of the journal Interaction Studies: Social Behaviour and Communication in Biological and Artificial Systems, as well as Associate Editor of Adaptive Behaviour, the International Journal of Social Robotics, IEEE Transactions on Affective Computing and the IEEE Transactions on Cognitive and Developmental Systems. She is co-coordinator of the euRobotics Topic Group "Natural Interaction with Social Robots"

Full Papers Session

Wed, March 7

Full Papers Session 3, Track 1

Room W192 (10:30~12:10)

Machine Learning for HRI

Session Chair: Ross Knepper (Cornell University)

Active Robot Learning for Temporal Task Models (10:30~10:50)

Mattia Racca (Aalto University), **Ville Kyrki** (Aalto University)

With the goal of having robots learn new skills after deployment, we propose an active learning framework for modelling user preferences about task execution. The proposed approach interactively gathers information by asking questions expressed in natural language. We study the validity and the learning performance of the proposed approach and two of its variants compared to a passive learning strategy. We further investigate the human-robot-interaction nature of the framework conducting a usability study with 18 subjects. The results show that active strategies are applicable for learning preferences in temporal tasks from non-expert users. Furthermore, the results provide insights in the interaction design of active learning robots.

Learning from Richer Human Guidance: Augmenting Comparison-Based Learning with Feature Queries (10:50~11:10)

Chandrayee Basu (University of California Merced), **Mukesh Singhal** (University of California Merced), **Anca Dragan** (University of California Berkeley)

We focus on learning the desired objective function for a robot. Although trajectory demonstrations can be very informative of the desired objective, they can also be difficult for users to provide. Answers to comparison queries, asking which of two trajectories is preferable, are much easier for users, and have emerged as an effective alternative. Unfortunately, comparisons are far less informative.
We propose that there is much richer information that users can easily provide and that robots ought to leverage. We focus on augmenting comparisons with feature queries, and introduce a unified formalism for treating all answers as observations about the true desired reward. We derive an active query selection algorithm, and test these queries in simulation and on real users. We find that richer, feature-augmented queries can extract more information faster, leading to robots that better match user preferences in their behavior.

Learning from Physical Human Corrections, One Feature at a Time (11:10~11:30)

Andrea Bajcsy (University of California Berkeley), **Dylan Losey** (Rice University), **Marcia O'Malley** (Rice University), **Anca Dragan** (University of California Berkeley)

We focus on learning robot objective functions from human guidance: specifically, from physical corrections provided by the person while the robot is acting. Objective functions are typically parametrized in terms of *features*, which capture aspects of the task that might be important. When the person intervenes to correct the robot's behavior, the robot should update its understanding of which features matter, how much, and in what way. Unfortunately, real users do not provide optimal corrections that isolate exactly what the robot was doing wrong. Thus, when receiving a correction, it is difficult for the robot to determine which features the person meant to correct, and which features were changed unintentionally. In this paper, we propose to improve the efficiency of robot learning during physical interactions by reducing *unintended* learning. Our approach allows the human-robot team to focus on learning *one feature at a time*, unlike state-of-the-art techniques that update all

features at once. We derive an online method for identifying the single feature which the human is trying to change during physical interaction, and experimentally compare this one-at-a-time approach to the all-at-once baseline in a user study. Our results suggest that users teaching one-at-a-time perform better, especially in tasks that require changing multiple features.

DNN-HMM based Automatic Speech Recognition for HRI Scenarios (11:30~11:50)

José Novoa (University of Chile), **Jorge Wuth** (University of Chile), **Juan Escudero** (University of Chile), **Josué Fredes** (University of Chile), **Rodrigo Mahu** (University of Chile), **Néstor Yoma** (University of Chile)

In this paper, we propose to replace the classical black box integration of automatic speech recognition technology in HRI applications with the incorporation of the HRI environment representation and modeling, and the robot and user states and contexts. Accordingly, this paper focuses on the environment representation and modeling by training a deep neural network-hidden Markov model based automatic speech recognition engine combining clean utterances with the acoustic-channel responses and noise that were obtained from an HRI testbed built with a PR2 mobile manipulation robot. This method avoids recording a training database in all the possible acoustic environments given an HRI scenario. Moreover, different speech recognition testing conditions were produced by recording two types of acoustics sources, i.e. a loudspeaker and human speakers, using a Microsoft Kinect mounted on top of the PR2 robot, while performing head rotations and movements towards and away from the fixed sources. In this generic HRI scenario, the resulting automatic speech recognition engine provided a word error rate that is at least 26% and 38% lower than publicly available speech recognition APIs with the playback (i.e. loudspeaker) and human testing databases, respectively, with a limited amount of training data.

Deep Reinforcement Learning of Abstract Reasoning from Demonstrations (11:50~12:10)

Madison Clark-Turner (University of New Hampshire), **Momotaz Begum** (University of New Hampshire)

Extracting a set of generalizable rules that govern the dynamics of complex, high-level interactions between humans based only on observations is a high-level cognitive ability. Mastery of this skill marks a significant milestone in the human developmental process. A key challenge in designing such an ability in autonomous robots is discovering the relationships among discriminatory features. Identifying features in natural scenes that are representative of a particular event or interaction (i.e. 'discriminatory features') and then discovering the relationships (e.g., temporal/spatial/spatio-temporal/causal) among those features in the form of generalized rules are non-trivial problems. They often appear as a 'chicken-and-egg' dilemma. This paper proposes an end-to-end learning framework to tackle these two problems in the context of learning generalized, high-level rules of human interactions from structured demonstrations. We employed our proposed deep reinforcement learning framework to learn a set of rules that govern a behavioral intervention session between two agents based on observations of several instances of the session. We also tested the accuracy of our framework with human subjects in diverse situations.

Full Papers Session 3, Track 2

Room W194 (10:30~12:10)

Societal Issues: Abuse, Trust, Racism

Session Chair: Cindy Bethel
(Mississippi University)

Inducing Bystander Interventions During Robot Abuse with Social Mechanisms (10:30~10:50)

Xiang Zhi Tan (Carnegie Mellon University), **Marynel Vázquez** (Stanford University),

Elizabeth Carter (Carnegie Mellon University), **Cecilia Morales** (Carnegie Mellon University), **Aaron Steinfeld** (Carnegie Mellon University)

We explored whether a robot can leverage social influences to motivate nearby bystanders to intervene and defend them from human abuse. We designed a between-subjects study where 48 participants took part in a memorization task and observed a confederate mistreating a robot both verbally and physically. The robot was either empathetic towards the participant's performance in the task or indifferent. When the robot was mistreated, it ignored the abuse, shut down in response to it, or reacted emotionally. We found that the majority of the participants intervened to help the robot after it was abused. Interventions happened for a wide range of reasons. Interestingly, the empathetic robot increased the proportion of participants that self-reported intervening in comparison to the indifferent robot, but more participants moved the robot as a response to abuse in the latter case. The participants also perceived the robot being verbally mistreated more and reported higher levels of personal distress when the robot briefly shut down after abuse in comparison to when it reacted emotionally or did not react at all.

The Ripple Effects of Vulnerability: The Effects of a Robot's Vulnerable Behavior on Trust in Human-Robot Teams (10:50~11:10)

Sarah Strohkorb Sebo (Yale University), **Margaret Traeger** (Yale University), **Malte Jung** (Cornell University), **Brian Scassellati** (Yale University)

Successful teams are characterized by high levels of trust between team members, allowing the team to learn from mistakes, take risks, and entertain diverse ideas. We investigated a robot's potential to shape trust within a team through the robot's expressions of vulnerability. We conducted a between-subjects experiment (N=35 teams, 105 participants) comparing the behavior of three human teammates collaborating with either a social robot making vulnerable statements or with a social robot making neutral statements. We found that, in a group with a robot making vulnerable statements, participants responded more to the robot's comments and directed more of their gaze to the robot, displaying a higher level of engagement with the robot. Additionally, we discovered that during times of tension, human teammates in a group with a robot making vulnerable statements were more likely to explain their failure to the group, console team members who had made mistakes, and laugh together, all actions that reduce the amount of tension experienced by the team. These results suggest that a robot's vulnerable behavior can have 'ripple effects' on their human team members' expressions of trust-related behavior.

Humans Conform to Robots: Disambiguating Trust, Truth, and Conformity (11:10~11:30)

Nicole Salomons (Yale University), **Michael van der Linden** (Yale University), **Sarah Strohkorb Sebo** (Yale University), **Brian Scassellati** (Yale University)

Asch's conformity experiment has shown that people are prone to adjusting their view to match those of group members even when they believe the answer of the group to be wrong. Previous studies have attempted to replicate Asch's experiment with a group of robots but have failed to observe conformity. One explanation can be made using Hodges and Geyers work, in which they propose that people consider distinct criteria (truth, trust, and social solidarity) when deciding whether to conform to others. In order to study how trust and truth affect conformity, we propose an experiment in which participants play a game with three robots, in which there are no objective answers. We measured how many times participants changed their preliminary answers to match the group of robots' in their final answer. We conducted a between-subjects study (N = 30) in which there were two conditions: one in which participants saw the group of robots' preliminary answer before deciding their final answer, and a control condition in which they did not know the robots' preliminary answer. Participants in the experimental condition conformed significantly more (29%) than participants in the control condition (6%). Therefore we have shown that groups of robots can cause people to conform to them. Additionally trust plays a role in conformity:

initially, participants conformed to robots at a similar rate to Asch's participants, however, many participants stop conforming later in the game when trust is lost due to the robots choosing an incorrect answer.

Robots and Racism (11:30~11:50)

Christoph Bartneck (University of Canterbury), **Kumar Yogeeswaran** (University of Canterbury), **Qi Min Ser** (University of Canterbury), **Graeme Woodward** (University of Canterbury), **Robert Sparrow** (Monash University), **Siheng Wang** (Guizhou University of Engineering Science), **Friederike Eyssel** (University of Bielefeld)

Most robots currently being sold or developed are either stylized with white material or have a metallic appearance. In this research we used the shooter bias paradigm and several questionnaires to investigate if people automatically identify robots as being racialized, such that we might say that some robots are 'White' while others are 'Asian', or 'Black'. To do so, we conducted an extended replication of the classic social psychological shooter bias paradigm using robot stimuli to explore whether effects known from human-human intergroup experiments would generalize to robots that were racialized as Black and White. Reaction-time based measures revealed that participants demonstrated 'shooter-bias' toward both Black people and robot racialized as Black. Participants were also willing to attribute a race to the robots depending on their racialization and demonstrated a high degree of inter-subject agreement when it came to these attributions.

Mindless Robots get Bullied (11:50~12:10)

Merel Keijsers (University of Canterbury), **Christoph Bartneck** (University of Canterbury)

Humans recognise and respond to robots as social agents, to such extent that they occasionally attempt to bully a robot. The current paper investigates whether aggressive behaviour directed towards robots is influenced by the same social processes that guide human bullying behaviour. More specifically, it measured the effects of dehumanisation primes and anthropomorphic qualities of the robot on participants' verbal abuse of a virtual robotic agents.

Contrary to previous findings in human-human interaction, priming participants with power did not result in less mind attribution. However, evidence for dehumanisation was still found, as the less mind participants attributed to the robot, the more aggressive responses they gave. In the main study this effect was moderated by the manipulations of power and robot anthropomorphism; the low anthropomorphic robot in the power prime condition endured significantly less abuse, and mind attribution remained a significant predictor for verbal aggression in all conditions save the low anthropomorphic robot with no prime.

It is concluded that dehumanisation occurs in human-robot interaction and that like in human-human interaction, it is linked to aggressive behaviour. Moreover, it is argued that this dehumanisation is different from anthropomorphism as well as human-human dehumanisation, since anthropomorphism itself did not predict aggressive behaviour and dehumanisation of robots was not influenced by primes that have been established in human-human dehumanisation research.

Full Papers Session 4, Track 1

Room W192 (13:40~15:00)

Designing Robots and Interactions

Session Chair: Maya Cakmak
(University of Washington)

User-Centered Robot Head Design: a Sensing Computing Interaction Platform for Research Robotics (SCIPRR) (13:40~14:00)

Anthony Harrison (Naval Research Laboratory), **Wendy Xu** (Oregon State University), **J. Gregory Trafton** (Naval Research Laboratory)

We developed and evaluated a novel humanoid head, SCIPRR (Sensing, Computing, Interacting Platform for Robotics Research). SCIPRR is a head shell that was iteratively created with additive manufacturing. SCIPRR contains internal scaffolding that allows sensors, small form computers, and a back-projection system to display an animated face on a front-facing screen. SCIPRR was developed using User Centered Design principles and evaluated using three different methods. First, we created multiple, small-scale prototypes through additive manufacturing and performed polling and refinement of the overall head shape. Second, we performed usability evaluations of expert HRI mechanics as they swapped sensors and computers within the the SCIPRR head. Finally, we ran and analyzed an experiment to evaluate how much novices would like a robot with our head design to perform different social and traditional robot tasks. We made both major and minor changes after each evaluation and iteration. Overall, expert users liked the SCIPRR head and novices wanted a robot with the SCIPRR head to perform more tasks (including social tasks) than a more traditional robot.

Bioluminescence-Inspired Human-Robot Interaction: Designing Expressive Lights that Affect Human's Willingness to Interact with a Robot (14:00~14:20)

Sichao Song (The Graduate University for Advanced Studies, SOKENDAI), **Seiji Yamada** (National Institute of Informatics & The Graduate University for Advanced Studies, SOKENDAI)

Bioluminescence is the production and emission of light by a living organism. It, as a means of communication, is of importance for the survival of various creatures. Inspired by bioluminescent light behaviors, we explore the design of expressive lights and evaluate the effect of such expressions on a human's perception of and attitude toward an appearance-constrained robot. Such robots are in urgent need of finding effective ways to present themselves and communicate their intentions due to a lack of social expressivity. We particularly focus on the expression of attractiveness and hostility because a robot would need to be able to attract or keep away human users in practical human-robot interaction (HRI) scenarios. In this work, we installed an LED lighting system on a Roomba robot and conducted a series of two experiments. We first worked through a structured approach to determine the best light expression designs for the robot to show attractiveness and hostility. This resulted in four recommended light expressions. Further, we performed a verification study to examine the effectiveness of such light expressions in a typical HRI context. On the basis of the findings, we offer design guidelines for expressive lights that HRI researchers and practitioners could readily employ.

"Haru": Hardware Design of an Experimental Table top Robot Assistant (14:20~14:40)

Randy Gomez (Honda Research Institute Japan), **Deborah Szapiro** (University of Technology Sydney), **Kerl Galindo** (University of Technology Sydney), **Keisuke Nakamura** (Honda Research Institute Japan)

This paper discusses the design and development of an experimental tabletop robot called 'Haru' based on design thinking methodology. Right from the very beginning of the design process, we have brought an interdisciplinary team that includes animators, performers and sketch artists to help create the first iteration of a distinctive anthropomorphic robot design based on a concept that leverages form factor with functionality. Its unassuming physical affordance is intended to keep human expectation grounded while its actual interactive potential stokes human interest. The meticulous combination of both subtle and pronounced mechanical movements together with its stunning visual displays, highlight its affective affordance. As a result, we have developed the first iteration of our tabletop robot rich in affective potential for use in different research fields involving long-term human-robot interaction.

Iterative Design of an Upper Limb Rehabilitation Game with Tangible Robots (14:40~15:00)

Arzu Guneysu Ozgur (ÉPFL), **Maximilian Wessel** (ÉPFL), **Wafa Johal** (ÉPFL), **Kshitij Sharma** (NTNU), **Ayberk Özgür** (ÉPFL), **Philippe Vuadens** (Clinique Romande de Réadaptation), **Francesco Mondada** (ÉPFL), **Friedhelm Hummel** (ÉPFL & Clinique Romande de Réadaptation), **Pierre Dillenbourg** (ÉPFL)

Rehabilitation aims to ameliorate deficits in motor control via intensive practice with the affected limb. Current strategies, such as one-on-one therapy done in rehabilitation centers, have limitations such as treatment frequency and intensity, cost and requirement of mobility. Thus, a promising strategy is home-based therapy that includes task specific exercises. However, traditional rehabilitation tasks may frustrate the patient due to their repetitive nature and may result in lack of motivation and poor rehabilitation. In this article, we propose the design and verification of an effective upper extremity rehabilitation game with a tangible robotic platform named Cellulo as a novel solution to these issues. We first describe the process of determining the design rationales to tune speed, accuracy and challenge. Then we detail our iterative participatory design process and test sessions conducted with the help of stroke, brachial plexus and cerebral palsy patients (18 in total) and 7 therapists in 4 different therapy centers. We present the initial quantitative results, which support several aspects of our design rationales and conclude with our future study plans.

Full Papers Session 4, Track 2
Room W194 (13:40~15:00)

Groups and Teams

Session Chair: Adriana Tapus
(ENSTA, ParisTech)

Human-Robot Similarity and Willingness to Work with Robotic Co-Worker (13:40~14:00)

Sangseok You (Syracuse University), **Lionel Robert Jr.** (University of Michigan)

Organizations now face a new challenge of encouraging their employees to work alongside robots. In this paper, we address this problem by investigating the impacts of human-robot similarity, trust in a robot, and the risk of physical danger on individuals' willingness to work with a robot and their willingness to work with a robot over a human co-worker. We report the results from an online experimental study involving 200 participants. Results showed that human-robot similarity promoted trust in a robot, which led to willingness to work with robots and ultimately willingness to work with a robot over a human co-worker. However, the risk of danger moderated not only the positive link between the surface-level similarity and trust in a robot, but also the link between intention to work with the robot and willingness to work with a robot over a human co-worker. We discuss several implications for the theory of human-robot interaction and design of robots.

Group-based Emotions in Teams of Humans and Robots (14:00~14:20)

Filipa Correia (INESC-ID & Instituto Superior Técnico, Universidade de Lisboa), **Samuel Mascarenhas** (INESC-ID & Instituto Superior Técnico, Universidade de Lisboa), **Rui Prada** (INESC-ID & Instituto Superior Técnico, Universidade de Lisboa), **Francisco Melo** (INESC-ID & Instituto Superior Técnico, Universidade de Lisboa), **Ana Paiva** (INESC-ID & Instituto Superior Técnico, Universidade de Lisboa)

Providing social robots an internal model of emotions can help them guide their behaviour in a more humane manner by simulating the ability to feel empathy towards others. Furthermore, the growing interest in creating robots that are capable of collaborating with other humans in team settings provides an opportunity to explore another side of human emotion, namely, group-based emotions.

This paper contributes with the first model on group-based emotions in social robotic partners. We defined a model of group-based emotions for social robots that allowed us to create two distinct robotic characters that express either individual or group-based emotions. This paper also contributes with a user study where two autonomous robots embedded the previous characters, and formed two human-robot teams to play a competitive game. Our results showed that participants perceived the robot that expresses group-based emotions as more likeable and attributed higher levels of group identification and group trust towards their teams, when compared to the robotic partner that expresses individual-based emotions.

Where Should Robots Talk?: Spatial Arrangement Study from a Participant Workload Perspective (14:20~14:40)

Takahiro Matsumoto (Keio University), **Mitsuhiro Goto** (NTT Service Evolution Laboratories), **Ryo Ishii** (NTT Media Intelligence Laboratories), **Tomoki Watanabe** (NTT Service Evolution Laboratories), **Tomohiro Yamada** (NTT Service Evolution Laboratories), **Michita Imai** (Keio University)

Several benefits obtained using multiple robots in conversation have been reported in the human-robot interaction field.This paper first presents pre-trial results by which elderly people assigned a lower rating to a conversation with two robots than to one with a single robot. Observations of the trial suggest the hypothesis that an inappropriate spatial arrangement between robots and humans increases the workload in a conversation. Reducing the workload is important, especially when robots are used by elderly people. Therefore, we specifically examine the workload that is influenced by the spatial arrangement in group conversation. To verify the hypothesis, we use a NASA-TLX and a dual-task method to evaluate the workload and to conduct a comparative experiment in which the participant talks with two robots in two spatial arrangements. We also conduct a case study for elderly people in the same conversational conditions. From these experiments, we demonstrate that the spatial arrangement in which people cannot see both robots simultaneously increases their conversational workload and decreases their evaluation of the dialogue compared to a spatial arrangement by which people can see both robots simultaneously. We also show that the primary cause of the workload by positioning is not physical but mental.

Friends or Foes? Socioemotional Support and Gaze Behaviors in Mixed Groups of Humans and Robots (14:40~15:00)

Raquel Oliveira (Instituto Universitário de Lisboa ISCTE-IUL, CIS-IUL), **Patrícia Arriaga** (Instituto Universitário de Lisboa ISCTE-IUL, CIS-IUL), **Patrícia Alves-Oliveira** (Instituto Universitário de Lisboa ISCTE-IUL, CIS-IUL & INESC-ID), **Filipa Correia** (Instituto Superior Técnico, Universidade de Lisboa & INESC-ID), **Sofia Petisca** (Instituto Universitário de Lisboa ISCTE-IUL, CIS-IUL & INESC-ID), **Ana Paiva** (Instituto Superior Técnico, Universidade de Lisboa & INESC-ID)

This study investigated non-verbal behavior and socioemotional interactions in small-groups of humans and robots. Sixty-participants were involved in a group setting in which they were required to play a card game with another human and two robots (playing as partners or as opponents). The two robots displayed different goal orientations: a competitive robot (named Emys-) and a relationship-driven cooperative robot (named Glin+). Video recordings of the interactions were analyzed in three game play sessions. Eye gaze and socioemotional support behaviors were coded based on Bales' Interaction Process Analysis. Results indicated that gaze behavior towards partners was more frequently displayed to the relationship-driven robot than to the competitive robot and the human partners. In contrast, gaze towards opponents occurred more often towards the competitive robot than to the relationship-driven robot and the human opponents. Socioemotional support occurred more frequently towards partners than opponents, and was also displayed more often towards humans than towards robots. Moreover, in the sessions where the robots were opponents, participants provided more support to the competitive robot. This investigation in small groups of humans and

robots provided evidence of different interaction patterns towards robots displaying distinct orientation goals, which can be useful in guiding the successful design of social robots.

Full Papers Session 5

Room W192 (15:30~17:10)

Best Paper Nominees

Five 20-Minute Presentations
(5 full papers)

Social Robots for Engagement in Rehabilitative Therapies: Design Implications from a Study with Therapists (15:30~15:50)

Katie Winkle (Bristol Robotics Laboratory), **Praminda Caleb-Solly** (Bristol Robotics Laboratory), **Ailie Turton** (Bristol Robotics Laboratory), **Paul Bremner** (Bristol Robotics Laboratory)

In this paper we present the results of a qualitative study with therapists to inform social robotics and human robot interaction (HRI) for engagement in rehabilitative therapies. Our results add to growing evidence that socially assistive robots (SARs) could play a role in addressing patients' low engagement with self-directed exercise programmes. Specifically, we propose how SARs might augment or offer more pro-active assistance over existing technologies such as smartphone applications, computer software and fitness trackers also designed to tackle this issue. In addition, we present a series of design implications for such SARs based on therapists' expert knowledge and best practices extracted from our results. This includes an initial set of SAR requirements and key considerations concerning personalised and adaptive interaction strategies.

"Thank You for Sharing that Interesting Fact!": Effects of Capability and Context on Indirect Speech Act Use in Task-Based Human-Robot Dialogue (15:50~16:10)

Tom Williams (Colorado School of Mines), **Daria Thames** (Tufts University), **Julia Novakoff** (Tufts University), **Matthias Scheutz** (Tufts University)

Naturally interacting robots must be able to understand natural human speech. As such, recent work has sought to allow robots to infer the intentions behind commonly used non-literal utterances such as indirect speech acts (ISAs). However, it is still unclear to what extent ISAs will actually be used in task-based human-robot dialogue, and to what extent robots could function without the ability to understand ISAs. In this paper, we present the results of a Wizard-of-Oz experiment that examined human ISA use in scenarios that did or did not have conventionalized social norms, and analyzed both ISA use and perceptions of robots when robots were or were not capable of understanding ISAs. Our results suggest that (1) ISAs are commonly used in task-based human-robot dialogues, even when robots show themselves unable to understand ISAs; (2) ISA use is more common in contexts with conventionalized social norms; and (3) a robot's inability to understand ISAs harms both the robot's task performance and human perception of the robot.tegies.

Planning with Trust for Human-Robot Collaboration (16:10~16:30)

Min Chen (National University of Singapore), **Stefanos Nikolaidis** (Carnegie Mellon University), **Harold Soh** (National University of Singapore), **David Hsu** (National University of Singapore), **Siddhartha Srinivasa** (University of Washington)

Trust is essential for human-robot collaboration and user adoption of autonomous systems, such as robot assistants. This paper introduces a computational model which integrates trust into robot decision-making. Specifically, we learn from data a partially observable Markov decision process (POMDP) with human trust as a latent

variable. The trust-POMDP model provides a principled approach for the robot to (i) infer the trust of a human teammate through interaction, (ii) reason about the effect of its own actions on human behaviors, and (iii) choose actions that maximize team performance over the long term. We validated the model through human subject experiments on a table-clearing task in simulation (201 participants) and with a real robot (20 participants). The results show that the trust-POMDP improves human-robot team performance in this task. They further suggest that maximizing trust in itself may not improve team performance.

Communicating Robot Motion Intent with Augmented Reality (16:30~16:50)

Michael Walker (University of Colorado Boulder), **Hooman Hedayati** (University of Colorado Boulder), **Jennifer Lee** (University of Colorado Boulder), **Daniel Szafir** (University of Colorado Boulder)

Humans coordinate teamwork by conveying intent through social cues, such as gestures and gaze behaviors. However, these methods may not be possible for appearance-constrained robots that lack anthropomorphic or zoomorphic features, such as aerial robots. We explore a new design space for communicating robot motion intent by investigating how augmented reality (AR) might mediate human-robot interactions. We develop a series of explicit and implicit designs for visually signaling robot motion intent using AR, which we evaluate in a user study. We found that several of our AR designs significantly improved objective task efficiency over a baseline in which users only received physically-embodied orientation cues. In addition, our designs offer several trade-offs in terms of intent clarity and user perceptions of the robot as a teammate.

An Autonomous Dynamic Camera Method for Effective Remote Teleoperation (16:50~17:10)

Daniel Rakita (University of Wisconsin-Madison), **Bilge Mutlu** (University of Wisconsin-Madison), **Michael Gleicher** (University of Wisconsin-Madison)

In this paper, we present a method that improves the ability of remote users to teleoperate a \textit{manipulation} robot arm by continuously providing them with an effective viewpoint using a second *camera-in-hand* robot arm. The user controls the manipulation robot using *any* teleoperation interface, and the camera-in-hand robot automatically servos to provide a view of the remote environment that is estimated to best support effective manipulations. Our method avoids occlusions with the manipulation arm to improve visibility, provides context and detailed views of the environment by varying the camera-target distance, utilizes motion prediction to cover the space of the user's next manipulation actions, and actively corrects views to avoid disorienting the user as the camera moves. Through two user studies, we show that our method improves teleoperation performance over alternative methods of providing visual support for teleoperation. We discuss the implications of our findings for real-world teleoperation and for future research.

Video Session

Wed, March 7 17:30
Room W192

FirstHand

Kristine O'Brien, Daniel Garcia

1. Robots that are engineered and programmed to help in residential and/or hospital settings can encourage or discourage the acceptance of help by the look of its character design.
2. We interact with robotic technology in varying ways based on our perception.
3. Human/Robot interaction is essentially Human/Human interaction with the robot as a facilitator

Social Proxemics of Human-Drone Interaction: Flying Altitude and Size

Jeonghye Han, Ilhan Bae

To what extent do humans comfortably approach to hovering drones? In human-robot interaction, social proxemics is somewhat known. Han & Bae showed that students usually stand as far apart as the height of tele-robot teacher. As commercial drone markets rise, the social proximity in human-drone interaction becomes an important issue. Researches on measuring the social proximity of interacting with drones are still in early stages. Jane showed that Chinese participants approach flying drone closer than American participants. Abtahi experimented with an unsafe and a safe-to-touch drone, to check whether participants instinctively use touch for interacting with the safe-to-touch drones.
We aimed the first research on how people respond to the order to approach hovering drones which differs in size and flying altitudes under the conditions that a safety issue was secured enough. Two types of drones: small and big sized ones were prepared. Each drone flew 1.6m of eye level or 2.6m of overhead high. Total 32 participants with an average age of 22.64 were individually to stand 11.5 Feet away from hovering drones in 2x2 conditions: two sizes and two flying altitudes. Only one of participants experienced operating drones. A transparent safety panel was installed between hovering drone and participants. Each participant was technically allowed to move from the standing point 6.5 Feet away from a safety panel.
A remote drone operator who controlled a hovering drone made a short conversation with a participant who stood behind a safety panel via a loud speaker system connected to a cellular phone in the experiment spot. After a participant recognized the drone as the extension of a remote operator, the participant was asked to move forward to hear a remote operator better.
The experiment results showed that participants approached further when interacting with eye leveled drones compared with overhead drones. Flight altitude matters in social proximity of human-drone interaction with a significant level=0.2. Females moved closer to a big and eye-level drone. 31 participants entered into social space to interact with drones, and only one approached less than two Feet to be still in public space from drones. Gender and size of drone did not make significant differences in social proximity of human-drone interaction.

Social Interaction with Drones using Human Emotion Recognition

Eirini Malliaraki

The proposed demonstration suggests a mapping function for human interpretable drone motions corresponding to the five human emotional states (i.e anger, happiness, sadness, surprise, and fear), using the personal drone's movements (i.e, changing speed or rotations) instead of anthropomorphizing it.

cARe-bot: Portable Projection-based AR Robot for Elderly

Yoonsik Yang, Yoon Jung Park, Hyocheol Ro, Seungho Chae, Tack-Don Han

An estimated 20 percent of the world's population experience difficulties with physical, cognitive and mental health. Senior citizens experience many inconveniences due to less memory and mobility as a function of the aging process. To solve this, the cARe-bot system was designed to dynamically provide optimal information in the actual environment at any time or place. It is also designed to increase an elder person's ability to live in a house or in senior homes with daily support, thus establishing the convenience and comfort they knew throughout their lives. The hardware of this system is a 360-degree controllable projection system. It is made with a pan-tilt system, projector, and a depth-recognition camera. Arduino is attached in order to control two sets of servo-motors, and is connected to a PC, which controls the entire process.

Do You Have Pain? A Robot who Cares

Roel Boumans, Koen Hindriks, Fokke van Meulen, Mark Neerincx, Marcel Olde Rikkert

Patient Reported Outcome Measures (PROMs) are a means of collecting information on the effectiveness of care delivered to patients as perceived by the patients themselves. A patient's pain level is a typical parameter only a patient him/herself can describe. It is an important measure for a person's quality of life. When a patient stays in a Dutch hospital, nursing staff needs to ask a patient for its pain level at least three times a day. Due to their work pressure, this requirement is regularly not met. A social robot available as a bed side companion for a patient during his hospital stay, might be able to ask the patient's pain level regularly. The video shows that this innovation in PROM data acquisition is feasible in older persons.

Video: Landing a Drone with Pointing Gestures

Boris Gromov, Luca M. Gambardella, Alessandro Giusti

We demonstrate an intuitive gesture-based interface for manually guiding a drone to land on a precise spot. Using unobtrusive wearable sensors, an operator can quickly and accurately maneuver and land the drone after very little training; a preliminary user study on 5 subjects shows that the system compares favorably with a traditional joystick interface.

Social Relationship Development between Human and Robot through Real-time Face Identification and Emotional Interaction

WonHyong Lee, Jong-Hwan Kim

We developed an interactive humanoid robotic platform with a real-time face learning algorithm for user identification and an emotional episodic memory to combine emotional experiences with users so that the robot can differentiate its reactions to users according to the emotional history. In this video, it is demonstrated how a robot can develop a social relationship with humans through the face identification and emotional interaction.

Perceptions of a Soft Robotic Tentacle in Interaction

Jonas Jørgensen

Soft robotics technology has been proposed for a number of applications that involve human-robot interaction. This video documents a platform created to explore human perceptions of soft robots in interaction. The video presents select footage from an interaction experiment conducted with the platform and the initial findings obtained (also accepted to HRI'18 as a Late-Breaking Report).

WYSIWICD: What You See is What I Can Do - Facilitating HRI by Mixed Reality Techniques

Patrick Renner, Florian Lier, Felix Friese, Thies Pfeiffer, Sven Wachsmuth

Mobile robots start to appear in everyday life, e.g., in shopping malls or nursing homes. Often, they are operated by staff with no prior experience in robotics. False expectations regarding the capabilities of robots, however, may lead to disappointments and reservations when it comes to accepting robots in ones personal space.

We make use of state-of-the-art Mixed Reality (MR) technology by integrating a Microsoft HoloLens into the robot's operating space to facilitate acceptance and interaction. The MR device is used to increase situation awareness by (a) externalizing the robot's behavior-state and sensor data and (b) projecting planned behavior. In addition to that, MR technology is (c) used as satellite sensing and display device for human-robot-communication.

Roboterfabrik: A Pilot to Link and Unify German Robotics Education to Match Industrial and Societal Demands

Sami Haddadin, Lars Johannsmeier, Marvin Becker, Moritz Schappler, Torsten Lilge, Simon Haddadin, Johannes Schmid, Tobias Ende, Sven Parusel

In this video we introduce a unifying concept for robotics education that is already partially implemented as a pilot project in the German education system. We propose a network that connects various types of schools, universities and companies and introduces them to and trains them in state-of-the-art robotic platforms. Students, apprentices, technicians and engineers can profit from lectures covering the broad theory of robotics while being supported by a strong practical component. In the video we outline our goals as well as first results that underline the validity of the proposed approach.

Humanoid Robot Pepper at a Belgian Chocolate Shop

Laurens De Gauquier, Hoang-Long Cao, Pablo Gomez Esteban, Albert De Beir, Stephanie van de Sanden, Kim Willems, Malaika Brengman, Bram Vanderborght

Humanoid robots hold potential to offer customer experience for bricks-and-mortar stores. Participants took part in a quiz on the topic chocolate in an experimental field study at `The Belgian Chocolate House' in Brussels airport in which a tablet kiosk and a Pepper robot were compared. The experiments showed that offering the quiz on a humanoid robot provided better results in terms of shopper impressions and behavior.

Blossom: A Tensile Social Robot Design with a Handcrafted Shell

Michael Suguitan, Guy Hoffman

We describe the design and implementation of Blossom, a social robot that diverges from convention by being flexible both internally and externally. Internally, Blossom's actuation mechanism is a compliant tensile structure supporting a free-floating platform. This design enables organic and lifelike movements with a small number of motors and simple software control. Blossom's exterior is also flexible in that it is made of fabric and not rigidly attached to the mechanism, enabling it to freely shift and deform. The handcrafted nature of the shell allows Blossom to take on a variety of forms and appearances. Blossom is envisioned as an open platform for user-crafted human-robot interaction.

Towards Sign Language Interpreting Robotic System

Nazerke Kalidolda, Anara Sandygulova

Hearing-impaired communities around the world communicate via a sign language. The focus of this work is to develop an interpreting human-robot interaction system that could act as a sign language interpreter in public places. To this end, we utilize a number of technologies including depth cameras (a leap motion sensor and Microsoft Kinect), humanoid robots NAO and Pepper, and deep learning approaches for classification.

Deep Reinforcement Learning of Abstract Reasoning from Demonstrations

Madison Clark-Turner, Momotaz Begum

We designed a Deep Q-Network (DQN) that learns to perform high-level reasoning in a Learning from Demonstration (LfD) domain involving the analysis of human responses. We test our system by having a NAO humanoid robot automatically deliver a behavioral intervention designed to teach social skills to individuals with Autism Spectrum Disorder (ASD). Our model extracts relevant features from the multi-modal input of tele-operated demonstrations in order to deliver the intervention correctly to novel participants.

Thursday March 08

Thursday

Notes

Thursday March 8

Time	Event - Room (Track 1, for Split Sessions)	Event - Room (Track 2, for Split Sessions)
09:00	**Announcements** - W192 Takayuki Kanda, Selma Šabanovic, Guy Hoffman, Adriana Tapus	
09:10	**Plenary Keynote** - W192 Steve Cousins: Building a Service Robotics Business—Challenges from the Field	
10:10	**Break** - W196	
10:30	**Communicating with and without Speech – W192**	**Psychology and HRI – W194**
10:30	Multimodal Expression of Artificial Emotion in Social Robots Using Color, Motion and Sound Diana Löffler, Nina Schmidt, Robert Tscharn	alt-HRI – Social Psychology and Human-Robot Interaction: An Uneasy Marriage Bahar Irfan, James Kennedy, Séverin Lemaignan, Fotios Papadopoulos, Emmanuel Senft, Tony Belpaeme
10:50	Getting to Know Each Other: The Role of Social Dialogue in Recovery from Errors in Social Robots Gale Lucas, Jill Boberg, David Traum, Ron Artstein, Jonathan Gratch, Alesia Gainer, Emmanuel Johnson, Anton Leuski, Mikio Nakano	The Peculiarities of Robot Embodiment (EmCorp-Scale) Laura Hoffmann, Nikolai Bock, Astrid Rosenthal v.d. Pütten
11:10	alt.HRI – Agreeing to Interact: Understanding Interaction as Human-Robot Goal Conflicts Kazuhiro Sasabuchi, Katsushi Ikeuchi, Masayuki Inaba	Be More Transparent and Users Will Like You: A Robot Privacy and User Experience Design Experiment Jonathan Vitale, Meg Tonkin, Sarita Herse, Suman Ojha, Jesse Clark, Mary-Anne Williams, Xun Wang, William Judge
11:30	Observing Robot Touch in Context: How Does Touch and Attitude Affect Perceptions of a Robot's Social Qualities? Thomas Arnold, Matthias Scheutz	alt-HRI – Design Strategies for Representing the Divine in Robots Gabriele Trovato, Cesar Lucho, Alexander Huerta-Mercado, Francisco Cuellar
11:50	Social Momentum: A Framework for Legible Navigation in Dynamic Multi-Agent Environments Christoforos Mavrogiannis, Wil Thomason, Ross Knepper	Futuristic Autobiographies: Weaving Participant Narratives to Elicit Values around Robots EunJeong Cheon, Norman Su
12:10	**Lunch**	
13:40	**Rethinking Human-Robot Relationships – W192**	**Coordination in Time and Space – W194**
13:40	alt.HRI – Interacting with Anatomically Complete Robots – A Discussion about Human-robot Relationships Christoph Bartneck, Matthew McMullen	Compact Real-time Avoidance on a Humanoid Robot for Human-robot Interaction Dong Hai Phuong Nguyen, Matej Hoffmann, Alessandro Roncone, Ugo Pattacini, Giorgio Metta
14:00	Social Cobots: Anticipatory Decision-Making for Collaborative Robots Incorporating Unexpected Human Behaviors Orhan Can Görür, Benjamin Rosman, Fikret Sivrikaya, Sahin Albayrak	Detecting Contingency for HRI in Open-World Environments Elaine Short, Mai Lee Chang, Andrea Thomaz
14:20	alt.HRI – Crucial Answers about Humanoid Capital Brian Beaton	Effects of Robot Sound on Auditory Localization in Human-Robot Collaboration Elizabeth Cha, Naomi Fitter, Yunkyung Kim, Terry Fong, Maja Matarić
14:40	A Design Methodology for the UX of HRI: Example Case Study of a Social Robot at an Airport Meg Tonkin, Jonathan Vitale, Sarita Herse, Mary-Anne Williams, William Judge, Xun Wang	Evaluating Social Perception of Human-to-Robot Handovers using the Robot Social Attributes Scale (RoSAS) Matthew Pan, Elizabeth Croft, Günter Niemeyer
15:00	**Break** - W196	
15:30	**Transactions on HRI – W192**	
15:30	Closed-loop Global Motion Planning for Reactive Collision-free Execution of Learned Tasks Chris Bowen, Ron Alterovitz	
15:50	Adapting a General Purpose Social Robot for Paediatric Rehabilitation through In-situ Design Felip Marti Carillo, Joanna Butchart, Sarah Knight, Adam Scheinberg, Lisa Wise, Leon Sterling, Chris McCarthy	
16:10	Reframing Assistive Robots to Promote Successful Aging Hee Rin Lee, Laurel Riek	
16:30	**Closing & Award Ceremony** - W192	

Plenary Talk 3

Thu, March 8, W192 (09:10~10:10)

Building a Service Robotics Business: Challenges from the Field

Steve Cousins

Abstract

Over the years of prototyping home, service, and assistive robots at Willow Garage and more recent years of deploying real service robots at Savioke, we have identified and begun surmounting many challenges in the road ahead toward a future of human-robot interaction. In this talk, I will share more than few of the stories and lessons learned from our experiences. First, these robots need a purpose; they need to provide value to specific people in concrete ways. Beware of novelty effects. Second, especially in the domain of service and consumer robotics, the social skills of the robots are inherently critical aspects of the robots' ability to function. Socially inappropriate robots get shoved aside, abandoned, and hijacked. Third, building a truly interdisciplinary team has been an incredibly powerful way forward to designing, deploying, and iteratively improving upon building robotic products and services that people actually want to use. Respecting and leveraging the diverse skills on real product teams makes all the difference. Getting robots out of factory cages and into the hands of real end-users takes much more than just a single company. It takes a community. The human-robot interaction community is critical to the success of inventing this future of robotics that supports real human needs, enabling everyday people to benefit from the advances in robotics.

Biography

Steve Cousins is founder and CEO of Savioke, the leader in developing and deploying autonomous robots that work in human environments to improve people's lives. Before founding Savioke, Steve was President and CEO of robotics incubator Willow Garage, where he oversaw the creation of the robot operating system (ROS), an open source software suite that has become the standard tool among robotics researchers. Also at Willow Garage, Steve launched the industry's first personal robots including the PR2 and the TurtleBot. Prior to that, Steve was a member of executive teams at IBM's Almaden Research Center and Xerox PARC. He's active in the Robots for Humanity project and holds a PhD from Stanford University, BS and MS degrees in computer science from Washington University, and earned a micro-MBA while at IBM.

Full Papers Session

Thu, March 8

Full Papers Session 6, Track 1

Room W192 (10:30~12:10)

Communicating with and Without Speech

Session Chair: Kerstin Fischer (University of Southern Denmark)

Multimodal Expression of Artificial Emotion in Social Robots Using Color, Motion and Sound (10:30~10:50)

Diana Löffler (University of Würzburg), **Nina Schmidt** (University of Würzburg), **Robert Tscharn** (University of Würzburg)

Artificial emotion display is a key feature of social robots to communicate internal states and behaviors in familiar human terms. While humanoid robots can draw on signals such as facial expressions or voice, emotions in appearance-constrained robots can only be conveyed through less-anthropomorphic output channels. While previous work focused on identifying specific expressional designs to convey a particular emotion, little work has been done to quantify the information content of different modalities and how they become effective in combination. Based on emotion metaphors that capture mental models of emotions, we systematically designed and validated a set of 28 different uni- and multimodal expressions for the basic emotions joy, sadness, fear and anger using the most common output modalities color, motion and sound. Classification accuracy and users' confidence of emotion assignment were evaluated in an empirical study with 33 participants and a robot probe. The findings are distilled into a set of recommendations about which modalities are most effective in communicating basic artificial emotion. Combining color with planar motion offered the overall best cost/benefit ratio by making use of redundant multimodal coding. Furthermore, modalities differed in their degree of effectiveness to communicate single emotions. Joy was best conveyed via color and motion, sadness via sound, fear via motion and anger via color. robotics.

Getting to Know Each Other: The Role of Social Dialogue in Recovery from Errors in Social Robots (10:50~11:10)

Gale Lucas (University of Southern California), **Jill Boberg** (University of Southern California), **David Traum** (University of Southern California), **Ron Artstein** (University of Southern California), **Jonathan Gratch** (University of Southern California), **Alesia Gainer** (University of Southern California), **Emmanuel Johnson** (University of Southern California), **Anton Leuski** (University of Southern California), **Mikio Nakano** (Honda Research Institute Japan)

This work explores the extent to which social dialogue can mitigate (or exacerbate) the loss of trust caused when robots make conversational errors. Our study uses a NAO robot programmed to persuade users to agree with its rankings on two tasks. We perform two manipulations: (1) The timing of conversational errors—the robot exhibited errors either in the first task, the second task, or neither; (2) The presence of social dialogue—between the two tasks, users either engaged in a social dialogue with the robot or completed a control task. We found that the timing of the errors matters: replicating previous research, conversational errors reduce the robot's influence in the second task, but not on the first task. Social dialogue interacts with the timing of errors, acting as an intensifier: social dialogue helps the robot recover from prior errors, and actually boosts subsequent influence; but social dialogue backfires if it is followed by errors, because it extends the period of good performance, creating a stronger contrast effect with the subsequent errors. The design of social robots should therefore be more careful to avoid errors after periods of good performance than early on in a dialogue.

alt.HRI - Agreeing to Interact: Understanding Interaction as Human-Robot Goal Conflicts (11:10~11:30)

Kazuhiro Sasabuchi (University of Tokyo), **Katsushi Ikeuchi** (Microsoft), **Masayuki Inaba** (University of Tokyo)

In human-robot interaction (HRI) people have studied user preferable robot actions in various social situations. The role of the robot is often designed, and situations are assumed that the robot will interact with the human. However, there are also situations where either the human or robot may not be willing to interact. In such situations, the human and robot are under a goal conflict and must first agree to begin an interaction. In this paper, we re-explore interaction beginnings and endings as a confliction and agreement between human and robot goals—the willingness of whether to interact or not. Through our discussion, we categorize conflict/agreement interactions into nine situations. Using a probabilistic analysis approach and 93 HRI recordings, we evaluate the different human behaviors in different interaction situations. We further question whether learning from typical existing HRI would benefit other scenarios when a robot has physical task capabilities.We conclude that the benefits of understanding different agreement situations would largely depend on a robot's task capability as well as the human's expectation toward these capabilities; however, conflict and agreement should not be neglected when applying interaction capability to physical-task-capable robots. Our research also suggests the probabilistic drawbacks of robot speech in situations where both the human and robot are not willing to interact.

Observing Robot Touch in Context: How Does Touch and Attitude Affect Perceptions of a Robot's Social Qualities? (11:30~11:50)

Thomas Arnold (Tufts University), **Matthias Scheutz** (Tufts University)

The complex role of touch is an increasingly appreciated horizon for HRI research. The explicit and implicit registers of touch, both human-to-robot and robot-to-human, have opened up pressing questions in design and HRI ethics about embodiment, communication, care, and human affection. In this paper we present results of an MTurk survey about robot-initiated touch in a social context. We examine how a positive or negative attitude from the robot, a well as whether the robot touches an interactant, affects how a robot is judged as a worker and teammate. Our findings confirm previous empirical support for the idea of touch as enhancing social appraisals of a robot, though the extent of that positive tactile role was complicated and tempered by the survey responses' gender effects.

Social Momentum: A Framework for Legible Navigation in Dynamic Multi-Agent Environments (11:50~12:10)

Christoforos Mavrogiannis (Cornell University), **Wil Thomason** (Cornell University), **Ross Knepper** (Cornell University)

Intent-expressive robot motion has been shown to result in increased efficiency and reduced planning efforts for copresent humans. Existing frameworks for generating intent-expressive robot behaviors have typically focused on applications in static or structured environments. Under such settings, emphasis is placed towards communicating the robot's intended final configuration to other agents. However, in dynamic, unstructured and multi-agent domains, such as pedestrian environments, knowledge of the robot's final configuration is not sufficiently informative as it completely ignores the complex dynamics of interaction among agents. To address this problem, we design a planning framework that aims at generating motion that clearly communicates an agent's intended collision avoidance strategy rather than its destination. Our framework estimates the most likely intended avoidance protocols of others based on their past behaviors, superimposes them, and generates an expressive and socially compliant robot action that reinforces the expectations of others regarding these avoidance protocols. This action facilitates inference and decision making for everyone, as illustrated in the simplified topological pattern of agents' trajectories. Extensive simulations demonstrate that our framework consistently achieves significantly lower topological complexity, compared against common benchmark approaches in multi-agent collision avoidance. The significance of this result for real world applications is demonstrated by a user study that reveals statistical evidence suggesting that multi-agent trajectories of lower topological complexity tend to facilitate inference for observers.

Full Papers Session 6, Track 2
Room W194 (10:30~12:10)

Psychology and HRI

Session Chair: Christoph Bartneck (University of Canterbury)

alt.HRI - Social Psychology and Human-Robot Interaction: An Uneasy Marriage (10:30~10:50)

Bahar Irfan (University of Plymouth), **James Kennedy** (University of Plymouth), **Séverin Lemaignan** (University of Plymouth), **Fotios Papadopoulos** (University of Plymouth), **Emmanuel Senft** (University of Plymouth), **Tony Belpaeme** (University of Plymouth)

The field of Human-Robot Interaction (HRI) lies at the intersection of several disciplines, and is rightfully perceived as a prime interface between engineering and the social sciences. In particular, our field entertains close ties with social and cognitive psychology, and there are many HRI studies which build upon commonly accepted results from psychology to explore the novel relation between humans and machines. Key to this endeavour is the trust we, as a field, put in the methodologies and results from psychology, and it is exactly this trust that is now being questioned across psychology and, by extension, should be questioned in HRI.
The starting point of this paper are a number of failed attempts by the authors to replicate old and established results on social facilitation, which leads us to discuss our arguable over-reliance and over-acceptance of methods and results from psychology. We highlight the recent 'replication crisis' in psychology, which directly impacts the HRI community and argue that our field should not shy away from developing its own reference tasks.

The Peculiarities of Robot Embodiment (EmCorp-Scale): Development, Validation and Initial Test of the Embodiment and Corporeality of Artificial Agents Scale (10:50~11:10)

Laura Hoffmann (Bielefeld University), **Nikolai Bock** (University of Duisburg-Essen), **Astrid Rosenthal v.d. Pütten** (RWTH Aachen University)

We propose a new theoretical framework assuming that embodiment effects in HAI and HRI are mediated by users' perceptions of an artificial entity's body-related capabilities. To enable the application of our framework to foster more theoretical-driven research, we developed a new self-report measurement that assesses bodilyrelated perceptions of the embodiment and corporeality—which we reveal as not being a binary characteristic of artificial entities. For the development and validation of the new scale we conducted two surveys and one video-based experiment. Exploratory factor analysis reveal a four-factorial solution with good reliability (Study 2, n=442), which was confirmed via confirmatory factor analysis (Study 3, n=260). In addition, we present first insights into the explanatory power of the scale: We reveal that humans' perceptions of an artificial entity's capabilities vary between virtual and physical embodiments, and that the evaluation of the artificial counterpart can be explained through the perceived capabilities. Practical applications and future research lines are discussed.

Be More Transparent and Users Will Like You: A Robot Privacy and User Experience Design Experiment (11:10~11:30)

Jonathan Vitale (University of Technology Sydney), **Meg Tonkin** (University of Technology Sydney), **Sarita Herse** (University of Technology Sydney), **Suman Ojha** (University of Technology Sydney), **Jesse Clark** (University of Technology Sydney), **Mary-Anne Williams** (University of Technology

Sydney), **Xun Wang** (Commonwealth Bank of Australia), **William Judge** (Commonwealth Bank of Australia)

Robots interacting with humans in public spaces often need to collect users' private information in order to provide the required services. Current privacy legislation in major jurisdictions requires organisations to disclose information about their data collection process and obtain user's consent prior to collecting privacy sensitive information. In this study, we consider a privacy-sensitive design of a data collection system for face identification. We deployed a face enrolment system on a humanoid robot with human-like gesturing and speech. We compared it with an equivalent system, in terms of capability and interactive process, on a screen-based interactive kiosk.
In our previous contribution, we investigated the effects that embodiment has on users' privacy considerations. We found that an embodied humanoid robot is capable of collecting more private information from users in comparison to a disembodied interactive kiosk. However, this effect was statistically significant only when the two compared systems were using a transparent interface, i.e. an interface communicating to users the privacy policies for data processing and storage. Thus, in this work, we aim to further investigate the effects of transparency on users' privacy considerations and their experience with robot applications.
We found that when comparing a non-transparent vs. transparent interface within the same system (i.e. on an embodied robot or on a disembodied kiosk) transparency does not lead to significant effects on users' privacy considerations. However, we found that transparency leads to a significantly better user experience for both systems.
Therefore, our overall analyses suggest that both the interactive robot and the interactive kiosk are capable of enhancing the user experience by providing transparent information to users, which is required by privacy legislation. However, an interactive kiosk providing transparent information elicits significantly more privacy concerns in users as compared to the robot supplying the very same transparent information.
This exploratory study provides conclusions that provide valuable insights for designing robot applications dealing with users privacy and it discusses the related legal implications, concluding with recommendations for privacy policymakers.

alt.HRI - Design Strategies for Representing the Divine in Robots (11:30~11:50)

Gabriele Trovato (Waseda University), **Cesar Lucho** (Pontificia Universidad Católica del Perú), **Alexander Huerta-Mercado** (Pontificia Universidad Católica del Perú), **Francisco Cuellar** (Pontificia Universidad Católica del Perú)

Robot appearance morphology can be divided in anthropomorphic, zoomorphic and functional. In previous recent work, a new category was introduced, called 'theomorphic robots', in which robots carry the shape and the identity of a supernatural creature or object within a religion. This approach can bring some advantages for certain categories of users such as children and elders. This paper is an exploratory discussion over practical design strategies for representing the divine in robots, based on theoretical insights on the historical intertwinements between sacred art and robotics. The illustrated concepts will be followed in the realisation of the prototypes of the first theomorphic robots.

Futuristic Autobiographies: Weaving Participant Narratives to Elicit Values around Robots (11:50~12:10)

EunJeong Cheon (Indiana University), **Norman Su** (Indiana University)

In this paper, we motivate and introduce Futuristic Autobiographies, a method inspired by design fiction for eliciting values and perspectives on the future of technologies from participants such as users, designers, and researchers. Futuristic autobiographies are the creative work of the researchers and participants. Grounded in empirical and background work, researchers pose several stories involving the participant as a character about a future state with robots. Participants are then asked to weave fictional autobiographies to explain what led to this future state. Via a case study in which futuristic autobiographies were used with 23 roboticists, we detail the process involved in developing and implementing this method. When futuristic autobiographies are employed and carefully crafted from background research, they allow informants to speak for themselves on how their practices and values are intertwined now and in the future. We highlight both the benefits and challenges of futuristic autobiographies as a way to elicit rich stories about values. We argue that futuristic autobiographies are a promising addition to the current qualitative methods toolkit used in HRI.

Full Papers Session 7, Track 1
Room W192 (13:40~15:00)

Rethinking Human-Robot Relationships

Session Chair: Alan Wagner
(Penn State University)

alt.HRI - Interacting with Anatomically Complete Robots - A Discussion about Human-robot Relationships (13:40~14:00)

Christoph Bartneck (University of Canterbury), **Matthew McMullen** (Abyss Creations LLC)

Abyss Creations LLC is selling highly realistic and anatomically complete dolls for decades. The interaction that customers have with the dolls has been subject to many controversial discussions. David Levy already showed that humanity has been rather inventive when it comes to machines that useful for sexual purposes. Abyss Creations recently revealed its Harmony platform that consists of a robotic head that is attached to their doll bodies. This paper present an interview with Matthew McMullen, CEO and Creative director of Abyss Creations about the Harmony platform and its implications on human-robot relationships.

Social Cobots: Anticipatory Decision-Making for Collaborative Robots Incorporating Unexpected Human Behaviors (14:00~14:20)

Orhan Can Görür (Technische Universität Berlin), **Benjamin Rosman** (CSIR & University of Witwatersrand), **Fikret Sivrikaya** (GT-ARC gemeinnützige GmbH), **Sahin Albayrak** (Technische Universität Berlin)

We propose an architecture as a robot's decision-making mechanism to anticipate a human's state of mind, and so plan accordingly during a human-robot collaboration task. At the core of the architecture lies a novel stochastic decision-making mechanism that implements a partially observable Markov decision process anticipating a human's state of mind in two-stages. In the first stage it anticipates the human's task related availability, intent (motivation), and capability during the collaboration. In the second, it further reasons about these states to anticipate the human's true need for help. Our contribution lies in the ability of our model to handle these unexpected conditions: 1) when the human's intention is estimated to be irrelevant to the assigned task and may be unknown to the robot, e.g., motivation is lost, another assignment is received, onset of tiredness, and 2) when the human's intention is relevant but the human doesn't want the robot's assistance in the given context, e.g., because of the human's changing emotional states or the human's task-relevant distrust for the robot. Our results show that integrating this model into a robot's decision-making process increases the efficiency and naturalness of the collaboration.

alt.HRI - Crucial Answers about Humanoid Capital (14:20~14:40)

Brian Beaton (California Polytechnic State University)

Inside AI research and engineering communities, explainable artificial intelligence (XAI) is one of the most provocative and promising lines of AI research and development today. XAI has the potential to make expressible the context and domain-specific benefits of particular AI applications to a diverse and inclusive array of stakeholders and audiences. In addition, XAI has the potential to make AI benefit claims more deeply evidenced. Outside AI research and engineering communities, one of the most provocative and promising lines of research happening today is the work on 'humanoid capital' at the edges of the social, behavioral, and economic sciences. Humanoid capital theorists renovate older discussions of 'human capital' as part of trying to make calculable and provable the domain-specific capital value, value-adding potential, or relative worth (i.e., advantages and benefits) of different humanoid models over time. Bringing these two exciting streams of research into direct conversation for the first time is the larger goal of this landmark paper. The primary research contribution of the paper is to detail some of the key requirements for making humanoid robots explainable in capital terms using XAI approaches. In this regard, the paper not only brings two streams of provocative research into much-needed conversation but also advances both streams.

A Design Methodology for the UX of HRI: Example Case Study of a Social Robot at an Airport (14:40~15:00)

Meg Tonkin (University of Technology Sydney), **Jonathan Vitale** (University of Technology Sydney), **Sarita Herse** (University of Technology Sydney), **Mary-Anne Williams** (University of Technology Sydney), **William Judge** (Commonwealth Bank of Australia), **Xun Wang** (Commonwealth Bank of Australia)

Research in robotics and human-robot interaction is becoming more and more mature. Additionally, more affordable social robots are being released commercially. Thus, industry is currently demanding ideas for viable commercial applications to situate social robots in public spaces and enhance customers experience. However, present literature in human-robot interaction does not provide a clear set of guidelines and a methodology to (i) identify commercial applications for robotic platforms able to position the users' needs at the centre of the discussion and (ii) ensure the creation of a positive user experience. With this paper we propose to fill this gap by providing a methodology for the design of robotic applications including these desired features, suitable for integration by researchers, industry, business and government organisations. As we will show in this paper, we successfully employed this methodology for an exploratory field study involving the trial implementation of a commercially available, social humanoid robot at an airport.

Full Papers Session 7, Track 2

Room W194 (13:40~15:00)

Coordination in Time and Space

Session Chair: Greg Trafton
(Naval Research Lab)

Compact Real-time Avoidance on a Humanoid Robot for Human-robot Interaction (13:40~14:00)

Dong Hai Phuong Nguyen (Istituto Italiano di Tecnologia), **Matej Hoffmann** (Czech Technical University Prague & Istituto Italiano di Tecnologia), **Alessandro Roncone** (Yale University), **Ugo Pattacini** (Istituto Italiano di Tecnologia), **Giorgio Metta** (Istituto Italiano di Tecnologia)

With robots leaving factories and entering less controlled domains, possibly sharing the space with humans, safety is paramount and multimodal awareness of the body surface and the surrounding environment is fundamental. Taking inspiration from peripersonal space representations in humans, we present a framework on a humanoid robot that dynamically maintains such a protective safety zone, composed of the following main components: (i) a human 2D keypoints estimation pipeline employing a deep learning based algorithm, extended here into 3D using disparity; (ii) a distributed peripersonal space representation around the robot's body parts; (iii) a reaching controller that incorporates all obstacles entering the robot's safety zone on the fly into the task. Pilot experiments demonstrate that an effective safety margin between the robot's and the human's body parts is kept. The proposed

solution is flexible and versatile since the safety zone around individual robot and human body parts can be selectively modulated—here we demonstrate stronger avoidance of the human head compared to rest of the body. Our system works in real time and is self-contained, with no external sensory equipment and use of onboard cameras only.

Detecting Contingency for HRI in Open-World Environments (14:00~14:20)

Elaine Short (University of Texas Austin), **Mai Lee Chang** (University of Texas Austin), **Andrea Thomaz** (University of Texas Austin)

This paper presents a novel algorithm for detecting contingent reactions to robot behavior in noisy real-world environments with naive users. Prior work has established that one way to detect contingency is by calculating a difference metric between sensor data before and after a robot probe of the environment. Our algorithm, CIRCLE (Contingency for Interactive Real-time CLassification of Engagement) provides a new approach to calculating this difference and detecting contingency, improving the running time for the difference calculation from 2.5 seconds to approximately 0.001 seconds on an 1100-sample vector, and effectively enabling real-time detection of contingent events. We show accuracy comparable to the best offline results for detecting contingency in this way (89.5% vs 91% in prior work), and demonstrate the utility of the real-time contingency detection in a field study of a survey-administering robot in a noisy open-world environment with naive users, showing that the robot can decrease the number of requests it makes (from 38 to 13) while more efficiently collecting survey responses (30% response rate rather than 26.3%).

Effects of Robot Sound on Auditory Localization in Human-Robot Collaboration (14:20~14:40)

Elizabeth Cha (University of Southern California), **Naomi Fitter** (University of Southern California), **Yunkyung Kim** (NASA Ames Research Center), **Terry Fong** (NASA Ames Research Center), **Maja Mataric** (University of Southern California)

Auditory cues facilitate situational awareness by enabling humans to infer what is happening in the nearby environment. Unlike humans, many robots do not continuously produce perceivable state-expressive sounds. In this work, we propose the use of iconic auditory signals that mimic the sounds produced by a robot's operations. In contrast to artificial sounds (e.g., beeps and whistles), these signals are primarily functional, providing information about the robot's actions and state. We analyze the effects of two variations of robot sound, tonal and broadband, on auditory localization during a human-robot collaboration task. Results from 24 participants show that both signals significantly improve auditory localization, but the broadband variation is preferred by participants. We then present a computational formulation for auditory signaling and apply it to the problem of auditory localization using a human-subjects data collection with 18 participants to learn optimal signaling policies.

Evaluating Social Perception of Human-to-Robot Handovers using the Robot Social Attributes Scale (RoSAS) (14:40~15:00)

Matthew Pan (University of British Columbia), **Elizabeth Croft** (Monash University), **Günter Niemeyer** (Disney Research)

This work explores social perceptions of robots within the domain of human-to-robot handovers. Using the Robotic Social Attributes Scale (RoSAS), we explore how users socially judge robot receivers as three factors are varied: initial position of the robot arm prior to handover, grasp method employed by the robot when receiving a handover object trading off perceived object safety for time efficiency, and retraction speed of the arm following handover. Our results show that over multiple handover interactions with the robot, users gradually perceive the robot receiver as being less discomforting and having more emotional warmth. Additionally, we have found that by varying grasp method and retraction speed, users may hold significantly different judgments of robot competence and discomfort. With these results, we recognize empirically that users are able to develop social perceptions of robots which can change through modification of robot receiving behaviour and through repeated interaction with the robot. More widely, this work suggests that measurement of user social perceptions should play a larger role in the design and evaluation of human-robot interactions and that the RoSAS can serve as a standardized tool in this regard.

Full Papers Session 8

Room W192 (15:30~16:30)

Transactions on HRI

Session Chair: Guy Hoffman
(Cornell University)

Closed-loop Global Motion Planning for Reactive Collision-free Execution of Learned Tasks (15:30~15:50)

Chris Bowen (University of North Carolina Chapel Hill), **Ron Alterovitz** (University of North Carolina Chapel Hill)

We present a motion planning approach for performing a learned task while reacting to the movement of obstacles and task-relevant objects. We employ a closed-loop sampling-based motion planner operating multiple times a second that senses obstacles and task-relevant objects and generates collision-free motion plans based on a learned task model. The task model is learned from expert demonstrations prior to task execution and is represented as a hidden Markov model. During task execution, our motion planner quickly searches in the Cartesian product of the task model and a probabilistic roadmap for a collision-free plan with features most similar to the demonstrations given the current locations of the task-relevant objects. We accelerate replanning using a fast bidirectional search and by biasing the sampling distribution using information from the learned task model. We show the efficacy of our approach with the Baxter robot performing two tasks.

Adapting a General Purpose Social Robot for Paediatric Rehabilitation through In-situ Design (15:50~16:10)

Felip Marti Carillo (Swinburne University of Technology), **Joanna Butchart** (Royal Children's Hospital Melbourne, Murdoch Children's Research Institute), **Sarah Knight** (Murdoch Children's Research Institute, Royal Children's Hospital Melbourne), **Adam Scheinberg** (Royal Children's Hospital Melbourne, Murdoch Children's Research Institute), **Lisa Wise** (Swinburne University of Technology), **Leon Sterling** (Swinburne University of Technology), **Chris McCarthy** (Swinburne University of Technology)

Socially Assistive Robots (SARs) offer great promise for improving outcomes in paediatric rehabilitation. However, the design of software and interactive capabilities for SARs must be carefully considered in the context of their intended clinical use. While previous work has explored specific roles and functionalities to support paediatric rehabilitation, few have considered the design of such capabilities in the context of ongoing clinical deployment. In this paper we present a two-phase In-situ design process for SARs in health care, emphasising stakeholder engagement and on-site development. We explore this in the context of developing the humanoid social robot NAO as a socially assistive rehabilitation aid for children with cerebral palsy. We present and evaluate our design process, outcomes achieved, and preliminary results from ongoing clinical testing with 9 patients and 5 therapists over 14 sessions. We argue that our in-situ Design methodology has been central to the rapid and successful deployment of our system.

Reframing Assistive Robots to Promote Successful Aging (16:10~16:30)

Hee Rin Lee, Laurel Riek (UC San Diego)

We are living in an exciting time, as people are living longer, active lives. This is reshaping how we think about aging. Rather than viewing aging as a problem to be fixed (i.e., a deficit model of aging), many aging researchers are viewing aging as a developmental stage of life to be celebrated and supported, e.g., 'Successful Aging'. In this paper, we embrace this new approach and consider it in the context of assistive robot design, in an aim to steer the conversation away from deficit models that have limited robot design possibilities. To explore an alternative design approach to the study of aging in HRI, we invited five aging researchers including geriatricians and nine older adults to our research process. In the study, participants illustrated their interpretations of aging and suggested potential assistive robots. We found that while all participants perceived disabilities due to aging as important to understand it, they considered disabilities as only one aspect of the experience of aging. Based on the findings, we suggest a social model of disability as an alternative approach to reframe assistive robots and we call for 'robots for successful aging.'

Sponsors

Sponsors

SIGCHI

acm SIGAI

IEEE Robotics & Automation Society

In Cooperation With

aaai

Supporters

Gold Supporter

KINOVA

Silver Supporters

Disney Research

LuxAI

Bronze Supporters

Furhat Robotics

ROBOTIS

Google

HRI Honda Research Institute JP

beam suitabletech.com

savioke

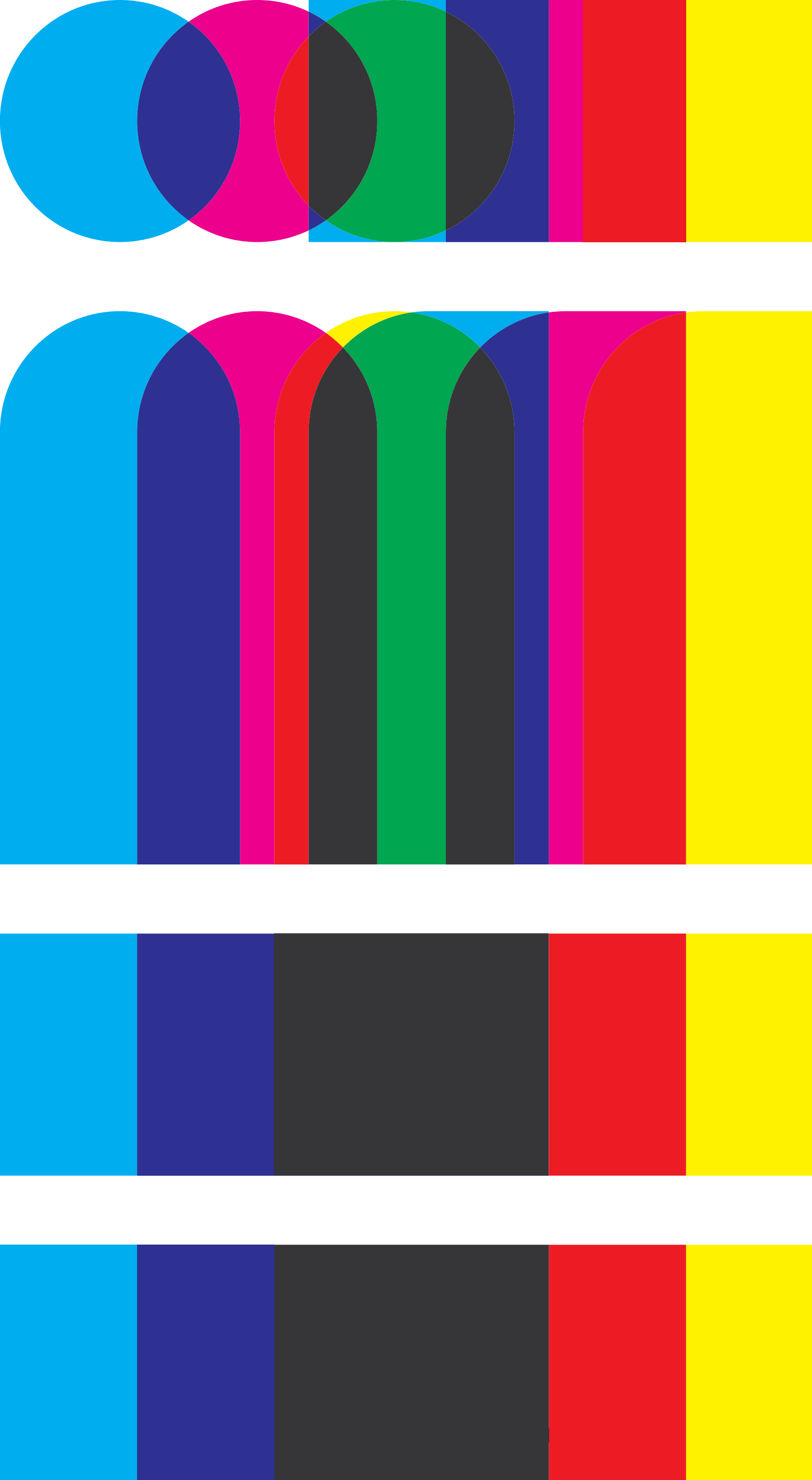
YUJIN ROBOT

Misty Robotics

HEBI ROBOTICS

DE-ENIGMA Playfully Empowering Autistic Children

haption



The 14th ACM/IEEE
International Conference on
Human-Robot Interaction

HRI 2019

DAEGU/KOREA

March 11-14, 2019

EXCO, Daegu Exhibition
& Convention Center, Korea

Important dates (tentative)

Submission of full papers:
3 October 2018

Submission of late-breaking reports:
7 December 2018

General chairs
Jung Kim, KAIST, Korea (jungkim@kaist.ac.kr)
Adriana Tapus, ENSTA-ParisTech, France

Program chairs
Sonya S. Kwak, Ewha Womans University, Korea
Malte Jung, Cornell University, USA
David Sirkin, Stanford University, USA

Local arrangements chairs
Jin Woong An, DGIST, Korea
Soon Yong Park, Kyungpook National University, Korea

Financial chairs
Jongsuk Choi, KIST, Korea
Cindy Bethel, Mississippi State University, USA

http://humanrobotinteraction.org/2019

Organizers

Organizing Committee:

General Co-Chairs
Takayuki Kanda (ATR), Japan
Selma Sabanovic (Indiana University), USA

Program Co-Chairs
Guy Hoffman (Cornell University), USA
Adriana Tapus (ENSTA-ParisTech), France

Finance Co-Chairs
Cindy Bethel (Mississippi State University), USA
Angelika Peer (University of Bristol), UK

Local Arrangement Co-Chairs
Michael Ryoo (Indiana University), USA
Carlotta Berry (Rose-Hulman Institute of Technology), USA
Amanda Lazar (Northwestern University), USA

Design Co-Chairs
Jamy Li (University of Twente), Netherlands
David Sirkin (Stanford University), USA

Publication Chair
Dražen Bršcic (University of Rijeka), Croatia

Workshop and Tutorials Co-Chairs
Laurel Riek (University of California San Diego), USA
Elizabeth Broadbent (University of Aukland), New Zealand

Alt.HRI Co-Chairs
Christoph Bartneck (University of Canterbury), New Zealand
Fumihide Tanaka (University of Tsukuba), Japan

Late-Breaking Reports Co-Chairs
Friederike Eyssel (Bielefeld University), Germany
François Ferland (Université de Sherbrooke), Canada
Kate Tsui (Toyota Research Institute), USA

Video Session Co-Chairs
Hideyuki Nakanishi (Osaka University), Japan
Bram Vanderborght (Vrije Universiteit Brussels), Belgium

Demo Session Co-Chairs
Heather Knight (Oregon State University), USA
Iolanda Leite (KTH), Sweden

Student Design Competition Co-Chairs
Malte Jung (Cornell University), USA
Sonya S. Kwak (Ewha Womans University), Korea
Hirotaka Osawa (University of Tsukuba), Japan

Industrial Relations and Fundraising Co-Chairs
Daisuke Sakamoto (Hokkaido University), Japan
Aaron Steinfeld (Carnegie Mellon University), USA
Astrid Weiss (Vienna University of Technology), Austria

Registration Co-Chairs
Chung-Hyuk Park (George Washington University), USA
Chien-Ming Huang (Johns Hopkins University), USA

Publicity Co-Chairs
Dong-Soo Kwon (KAIST), Korea
Ayanna Howard (Georgia Institute of Technology), USA
Vanessa Evers (University of Twente), Netherlands
Yimin Zhang (Intel Labs China), China

Student Volunteer Co-Chairs
Henny Admoni (Carnegie Mellon University), USA
Megan Strait (University of Texas Rio Grande Valley), USA

Telepresence Co-Chairs
Maya Cakmak (University of Washington), USA
Jenay Beer (University of South Carolina), USA

Communications Chair
Daniel Rea (University of Manitoba), Canada

Conference Administrative Assistant
Marlena Fraune (Indiana University), USA

HRI Steering Committee:

Co-Chairs

Jeonghye Han (Cheongju National University of Education), **Korea**
Gerhard Sagerer (Bielefeld University), **Germany**

Members (in alphabetical order)

Cindy Bethel (Mississippi State University), **USA**
Jongsuk Choi (KIST), **Korea**
David Feil-Seifer (University of Nevada), **USA**
Kerstin Fischer (University of Southern Denmark), **Denmark**
Guy Hoffman (Cornell University), **USA**
Odest Jenkins (University of Michigan), **USA**
Malte Jung (Cornell University), **USA**
Wendy Ju (Cornell Tech), **USA**
Takayuki Kanda (ATR), **Japan**
Sara Kiesler (Carnegie Mellon University), **USA**
Jung Kim (KAIST), **Korea**
Sonya Kwak (Ewha Womans University), **Korea**
Bilge Mutlu (University of Wisconsin–Madison), **USA**
Hirotaka Osawa (University of Tsukuba), **Japan**
Angelika Peer (Free University of Bozen-Bolzano), **Italy**
Laurel Riek (University of California San Diego), **USA**
Selma Sabanovic (Indiana University), **USA**
David Sirkin (Stanford University), **USA**
Adriana Tapus (ENSTA-ParisTech), **France**
Manfred Tscheligi (University of Salzburg), **Austria**
Astrid Weiss (Vienna University of Technology), **Austria**
James Young (University of Manitoba), **Canada**

Past Chairs

Vanessa Evers (University of Twente), **Netherlands**
Holly Yanco (University of Massachusetts-Lowell), **USA**

Program Committee:

Chairs

Guy Hoffman (Cornell University), **USA**
Adriana Tapus (ENSTA-ParisTech), **France**

Theme Chairs

Maha Salem (Google), **USA**
Iolana Leite (KTH Royal Institute of Technology), **Sweden**
HRI User Studies

Andrea Tomaz (University of Texas Austin), **USA**
Technical Advances in HRI

Malte Jung (Cornell University), **USA**
HRI Design

Paul Baxter (University of Lincoln), **UK**
Theory and Methods in HRI

Subcommittees:

HRI User Studies

Co-Chairs: Maha Salem (Google)
Iolanda Leite(KTH Royal Institute of Technology)

Henny Admoni (Carnegie Mellon University)
Sean Andrist (Microsoft Research AI)
Frank Broz (Heriot-Watt University)
Vicky Charisi (University of Twente)
Maartje de Graaf (Brown University)
Friederike Eyssel (Yale University)
David Feil-Seifer (University of Nevada)
Jeonghye Han (Cheongju National University of Education)
Chien-Ming Huang (Johns Hopkins University)
Heather Knight (Oregon State University)
Lilia Moshkina (Soar Technology)
Astrid Rosenthal von der Putten (University of Duisburg-Essen)
Brian Scassellati (Yale University)
Aaron Steinfeld (Carnegie Mellon University)
Greg Trafton (Naval Research Laboratory)
Marynel Vasquez (Stanford University)
Alan Wagner (Penn State University)
Holly Yanco (University of Massachusetts Lowell)

HRI Design

Chair: Malte Jung (Cornell University)

Jodi Forlizzi (Carnegie Mellon University)
Wafa Johal (EPFL)
Wendy Ju (Cornell Tech)
Mohammad Obaid (Uppsala University)
Hirotaka Osawa (University of Tsukuba)
Hae Won Park (MIT)
Dan Szafir (University of Colorado Boulder)

Technical Advances in HRI

Chair: Andrea Tomaz (University of Texas Austin)

Rachid Alami (LAAS-CNRS)
Maya Cakmak (University of Washington)
Brittany Duncan (University of Nebraska-Lincoln)
François Ferland (Universite de Sherbrooke)
Marc Hanheide (University of Lincoln)
Bradley Hayes (University of Colorado Boulder)
Jung Kim (KAIST)
Ross Knepper (Cornell University)
Severin Lemaignan (University of Plymouth)
Yukie Nagai (National Inst. of Information and Communications Tech.)
Laurel Riek (University of California San Diego)
Masahiro Shiomi (ATR-IRC)

Theory and Methods in HRI

Chair: Paul Baxter (University of Lincoln)

Gerard Bailly (GIPSA-LAB, INPG)
Kerstin Fischer (University of Southern Denmark)
Solace Shen (Cornell University)
Candy Sidner (Worcester Polytechnic Institute)
Megan Strait (University of Texas Rio Grande Valley)
Elin Anna Topp (Lund University)

Reviewers

Parastoo Abtahi
Maher Abujelala
Urja Acharya
Julie A. Adams
Abhijeet Agnihotri
Roxana Agrigoroaie
Ahmed Nisar Ahmed
Hoseok Ahn
Baris Akgun
Alyssa Alcorn
Jason Alexander
Patricia Alves-Oliveira
Jinung An
Elisabeth Andre
Marvin Andujar
Margherita Antona
Brenna Argall
Thomas Arnold
Reuben Aronson
Thibault Asselborn
Ruth Aylett
Rafae Aziz

Byung-Chull Bae
Ilhan Bae
Markus Bajones
Christian Balkenius
Tadas Baltrusaitis
Siddhartha Banerjee
Santosh Balajee Banisetty
Jaime Banks
Jimmy Baraglia
Wolmet Barendregt
Matt Beane
Jenay Beer
Momotaz Begum
Nicola Bellotto
Tony Belpaeme
Allouch Somaya Ben
Amor Heni Ben
Jasmin Bernotat
Dario Bertero
Cindy Bethel
Tapomayukh Bhattacharjee
Timothy Bickmore
Erik Billing
Joydeep Biswas
Lasse Blond
Dan Bohus
Jake Brawer
Paul Bremner
Gordon Briggs
Drazen Brscic
Alberto Brunete
Kalesha Bullard

Elizabeth Carter
Liz Carter
Ginevra Castellano
Álvaro Castro-González
Elizabeth Cha
Darren Chan
Adeline Chanseau
Debaleena Chattopadhyay
Jessie Chen
Yu Fan (Steven) Chen
Mohamed Chetouani
Pauline Chevalier
Seungmoon Choi
Vivian Chu
Carlos Cifuentes
Caitlyn Clabaugh
Aurelie Clodic
Jacob Crandall
Chris Crawford
Christopher Crick
Elizabeth Croft
Nigel Crook
Raymond Cuijpers
Gabriel Culbertson
Heather Culbertson
Rebecca Currano

Luisa Damiano
Angeli Antonella de
Visser Ewart de
Virginie Demulier
Nicholas DePalma
Dominic DiFranzo
Malcolm Doering
Lorin Dole
Christian Dondrup
Anca Dragan

Jane E
Autumn Edwards
Sabrina Eimler
Frederic Elisei
Colleen Emmenegger
Hadas Erel
Zackory Erickson
Vanessa Evers

Sean Fanello
Karen Feigh
David Filliat
Naomi Fitter
Tesca Fitzgerald
Villaronga Eduard Fosch
Mary Ellen Foster
Marlena Fraune
Susan Fussell

Denise Geiskkovitch
Felix Gervits
Mehdi Ghayoumi
Manuel Giuliani
Dylan Glas
Michael Gleicher
Matthew Gombolay
Goren Gordon
Pamela Greenwood
Sascha Griffiths
Elena Corina Grigore
Daniel Grollman
Horst-Michael Gross
Darren Guinness
Hatice Gunes
Reymundo Gutierrez
Andrea Guzman
Gahgene Gweon

Per Krogh Hansen
Happee Riender Happee
Kerstin Haring
Justin Hart
Komei Hasegawa
Cory Hayes
Laura Herlant
Daniel Hernandez
Roberto Pinillos Herrero
Laura Hiatt
Chie Hieida
Hiremath Shivayogi Hiremath
Masakazu Hirokawa
Laura Hoffmann
Rachel Holladay
Ayanna Howard
Thomas Howard
Justin Huang
Sandy Huang
Helge Huettenrauch
Ke Huo

Takamasa Iio
Michita Imai
Tariq Iqbal
Bahar Irfan
Hisashi Ishihara

Alexis Jacq
Mihai Jalobeanu
Hifza Javed
Sooyeon Jeong
Zhenhua Jia
Celine Jost

Takayuki Kanda
Shaun Kane
Daphne Karreman
Enkelejda Kasneci
Peter Kazanzides
James Kennedy
Soheil Keshmiri
Harmish Khambhaita
Mohamed Khamis
Minkyu Kim
Yunkyung Kim
Mitsuhiko Kimoto
Hedvig Kjellström
Naoya Koizumi
Elly Konjin
Stefan Kopp
Westlund Jacqueline Kory
Emiel Krahmer
Dieta Kuchenbrandt
Johannes Kulick
Sonya Kwak
Marta Kwiatkowska

Kiuk Kyung

Diana Löffler
Przemyslaw (Pem) Lasota
Hee Rin Lee
Jaeryoung Lee
Min Hun Lee
Min Kyung Lee
Wonhyong Lee
Jill Lehman
Hagen Lehmann
Jamy Li
Shen Li
Ying Siu Liang
Achim Lilienthal
Angelica Lim
Timm Linder
Phoebe Liu
Katrin Lohan
Tamara Lorenz
Amy Loutfi
Nichola Lubold
Michal Luria

Maxim Makatchev
Olivier Mangin
Michail Maniadakis
Julie Marble
Matthew Marge
Nik Martelaro
Eric Martinson
Justin Matejka
Kory Mathewson
Tetsuya Matsui
Cynthia Matuszek
Christoforos Mavrogiannis
Derek McColl
Peter McKenna
Ross Mead
Francisco Melo
Luis Merino
Joseph Michaelis
François Michaud
Mark Micire
Isabelle Milleville-Pennel
Grégoire Milliez
Gregory Mills
Takashi Minato
Nicole Mirnig
Brian Mok
Dylan Moore
Maryam Moosaei
Omar Mubin
Katharina Muelling
Nagisa Munekata
Bilge Mutlu

Yutaka Nakamura
Hideyuki Nakanishi
Junya Nakanishi
Daniele Nardi
Mollik Nayyar
Chrystopher L. Nehaniv
Benjamin Newman
Oliver Niebuhr
Stefanos Nikolaidis
Tomoyuki Noda
Tatsuya Nomura

Adam Norton
Jekaterina Novikova
Michael Novitzky
Christopher Nowakowski

Ioana Ocnarescu
Catharine Oertel
Kohei Ogawa
Masaki Ogino
Yuya Onishi

Claudia Pérez D'Arpino
Maike Paetzel
Amit Kumar Pandey
Ioannis Papaioannou
Chung Hyuk Park
Leah Perlmutter
Ron Petrick
Ingrid Pettersson
Elizabeth Phillips
Roel Pieters
Tony Prescott
Fentanes Jaime Pulido

Meiying Qin
Shi Qiu

Mattia Racca
Irene Rae
Daniel Rakita
Aditi Ramachandran
Photchara Ratsamee
Paula Raymond
Daniel Rea
Natalia Reich-Stiebert
Samantha Reig
Tiago Ribeiro
Mike Roberts
Paul Robinette
Andrzej Romanowski
Alessandro Roncone
Raquel Ros
Stephanie Rosenthal
Silvia Rossi
Matthew Rueben

Dorsa Sadigh
Daisuke Sakamoto
Majd Sakr
Nicole Salomons
Eduardo Sandoval
Anara Sandygulova
Yuko Sasa
Satoru Satake
Allison Sauppe
Marcus Scheunemann
Lars Schillingmann
Alessandra Sciutti
Johanna Seibt
Emmanuel Senft
Luis Sentis
Stela Seo
Ankit Shah
Meher Shaikh
Kshitij Sharma
Mahni Shayganfar
Dongjun Shin
Elaine Short

Alison Shutterly
Reid Simmons
Jivko Sinapov
David Sirkin
Gabriel Skantze
Bill Smart
Christian Smith
Harold Soh
Marco Spadafora
Samuel Spaulding
Brett Stoll
David St-Onge
Sebo Sarah Strohkorb
Hidenobu Sumioka
S. Shyam Sundar
Vidullan Surendran
Jessica Szczuka

Leila Takayama
Xiang Zhi Tan
Angelique Taylor
Glenn Taylor
Hamish Tennent
Konstantinos Theofilis
Serge Thill
Peter Trautman
Kate Tsui

Miki Ueno
Daniel Ullman
Vaibhav Unhelkar

Ioana Vasilescu
Dominique Vaufreydaz
Paul Verschure

Erin Walker
Aaron Walsman
Sophie Wang
Weitian Wang
Astrid Weiss
Tom Williams
Wrede Sebastian Wrede
Britta Wrede
Ricarda Wullenkord

Seiji Yamada
Yamane Katsu Yamane
Yoichi Yamazaki
Hang Yin
Yuichiro Yoshikawa
James E. Young
Zhou Yu

Cristina Zaga
Karolina Zawieska
Xuan Zhao
Tian Zhou
John Zimmerman
Lan Ziqnan
Kevin Zish
Jakub Zlotowski
Igor Zubrycki
Oren Zuckerman

13th ACM/IEEE International Conference on Human-Robot Interaction (HRI 2018)
March 05–08, 2018, Chicago Ilinois, USA
http://humanrobotinteraction.org/2018/