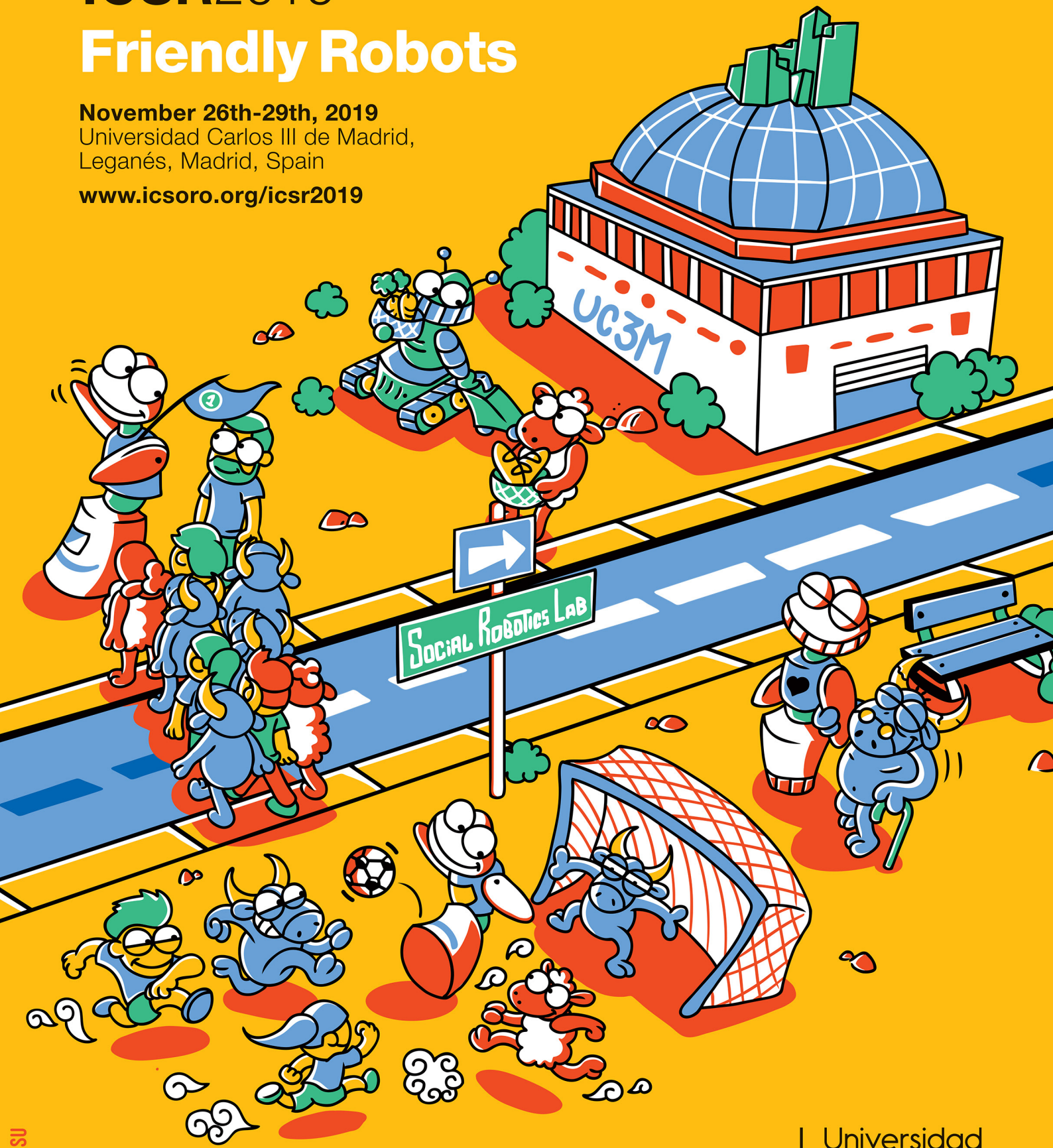
The Eleventh International Conference on **Social Robotics**

ICSR2019

Friendly Robots

November 26th-29th, 2019
Universidad Carlos III de Madrid,
Leganés, Madrid, Spain

www.icsoro.org/icsr2019



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INTRODUCTION

WELCOME

The 11th International Conference on Social Robotics (ICSR 2019) is held in Madrid, Spain in November 26 -29, 2019. This book gathers the proceedings of the conference, comprising 69 refereed papers, reviewed by the International Program Committee, and presented during the technical sessions of the conference. The International Conference on Social Robotics brings together researchers and practitioners working on the interaction between humans and robots and on the integration of robots into our society. Now on its eleventh year, the International Conference on Social Robotics conference is the leading international forum for researchers in social robotics. The International Conference on Social Robotics provides researchers and practitioners the opportunity to present and engage in dialogs on the latest progress in the field of social robotics.

The theme of the 2019 conference is “Friendly Robots”. Social robots are intended to coexist with humans and engage in relationships that lead them to a better quality of life. The success of these relationships relies on a positive perception of the robots that can be achieved by their behavior through AI, computational models, or robot embodiments. ICSR2019 aims to foster discussion on the development of innovative ideas, novel applications and relevant studies that contribute to the integration of social robots in our daily society. ICSR is the premier forum that looks into the potential of these technologies and gives insights to address the challenges and risks.

ICSR2019 received 92 submissions in total, 69 were accepted as full papers, yielding an overall acceptance rate of 75%. Accepted papers were arranged under the topics: perceptions and expectations of social robots; cognition and social values for social robots; verbal interaction with social robots; social cues and design of social robots; emotional and expressive interaction with social robots, collaborative SR and SR at the workplace; game approaches and applications to HRI; applications in heath domain; robots at home and at public spaces; robots in education; technical innovations in social robotics; and privacy and safety of social robots.

In addition to the technical sessions, ICSR 2019 included six workshops: (i) The Communication Challenges in Joint Action for Human-Robot Interaction, (ii) Perspectives on Human-Aware Navigation, (iii) Self-coaching Tools for Conducting Responsible Research and Innovation with Social Robots, (iv) Quality of Interaction in Socially Assistive Robots, (v) Experimental and Integrative Approaches to Robo-ethics, and (vi) Robots in the Wild: from the Lab, Field and Showrooms to Real-world Experiences in Social Robotics,.

ICSR 2019 included three distinguished researchers in social robotics as keynote speakers: Dr. Katsu Yamane, Senior Scientist at Honda Research Institute, USA; Francesco Ferro, CEO and co-founder of PAL Robotics, Spain; and Lola Cañamero, Head of the Embodied Emotion, Cognition and (Inter-)Action Lab in the School of Computer Science at the University of Hertfordshire, UK.

We would like to express our appreciation to the organizing committee for putting together an excellent program, to the International Program Committee for their rigorous review of the papers, and most importantly to the authors and participants who enhanced the quality and effectiveness of the conference through their papers, presentations, and conversations.

We are hopeful that this conference will generate many future collaborations and research endeavors, resulting in enhancing human lives through the utilization of social robots and artificial intelligence.

Fall 2019

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CONFERENCE INFORMATION

INSTRUCTIONS FOR AUTHORS

Instructions for oral presentations:

Each presenter will be allocated a total of 15 minutes for their talk (questions included). Authors can bring their own laptop and any adapter they require. HDMI and VGA connections will be available for their computer. On the other hand, they can also bring their presentation on a USB stick and use the Windows computer that is available in the room. It supports PowerPoint and PDF files.

The authors must arrive at their session room a few minutes before the session begins. They must communicate the session chairs they are there.

Poster guidelines for interactive sessions:

For interactive session presentations, authors will present their posters in a 45-minute block of scheduled interaction with the participants. All posters are required to be A0 size in Portrait Orientation (0.84 x 1.19 m). Failure to follow this requirement will mean that the poster will not fit on the allotted board.

IMPORTANT NOTICES

- Please, wear the identification badge during the conference.
- No smoking.
- Please, for assisting to the social events: welcome reception and banquet, the tickets given at registration are required.
- The Casino de Madrid, where the banquet takes place, requires a “business casual” dress code. i.e. jeans are not allowed, and jackets are required for men.

CONFERENCE VENUE

ICSR2019 is held at **Carlos III University of Madrid, Leganés**, a city at the outskirts of Madrid. Getting to the campus from Madrid city center, the airport and main train stations is easy and convenient using the public transport.

GETTING TO THE VENUE

Leganés Campus Address
Avda. Universidad, 30
28911 Leganés, Madrid

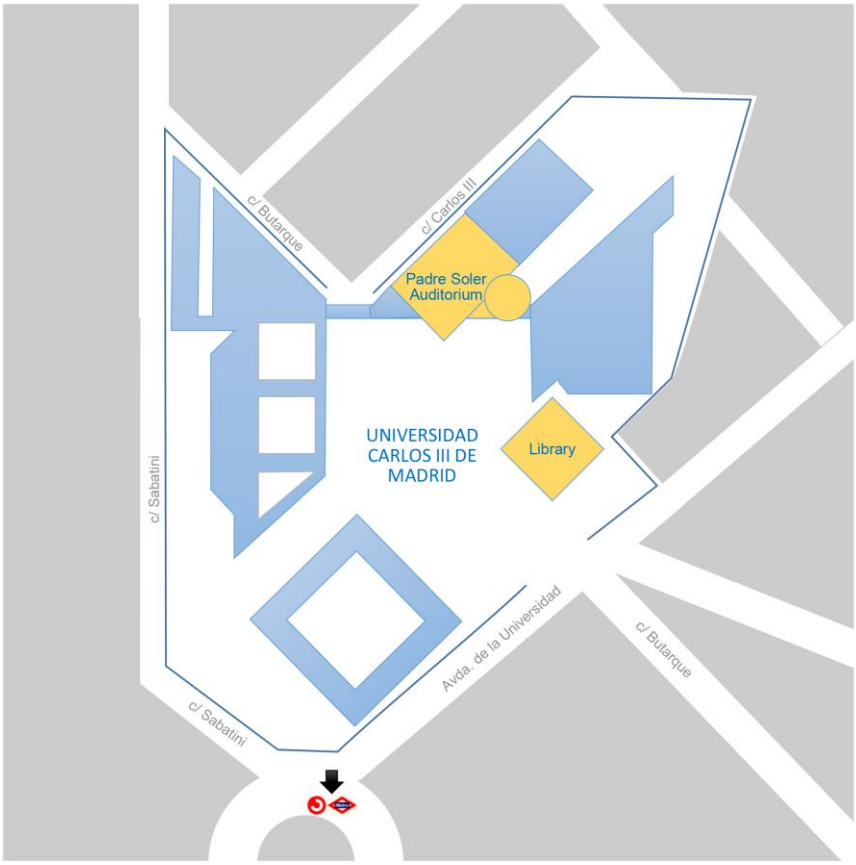
Public transportation in Madrid makes it easy to get to the conference venue. Here are some directions of how to get to Leganés from Madrid and the airport.

- **From the airport:** a commuting train (Cercanias, line C1 or C10) departs from Terminal 4, getting to Madrid main train station, Atocha. There, take line C5 in the direction of Humanes and get off at Leganés Central (it takes 18 minutes). Upon leaving the train station from the main exit, turn left and walk straight on for 5 minutes until you reach the University. If you are arriving at Terminals 1, 2, or 3, take the free airport internal shuttle to Terminal 4.

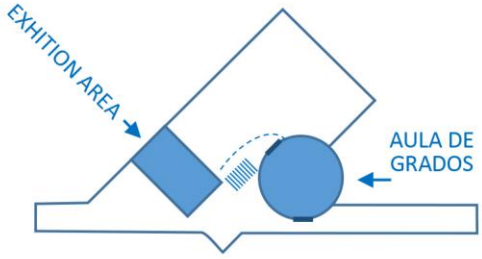
- **From the train station:** in Atocha station take the commuter train line (Cercanias) C5 to Leganés Central. Upon leaving the train station from the main exit, turn left and walk straight on for 5 minutes until you reach the University.

- **From the centre of Madrid:** the quickest way is to take the metro line 1 to Atocha Renfe station and then take the commuter train line (Cercanias) C5 to Humanes and get off at Leganés Central. Upon leaving the train station from the main exit, turn left and walk straight on for 5 minutes until you reach the University.

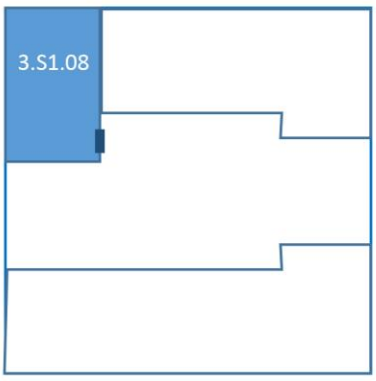
VENUE MAPS



PADRE SOLER AUDITORIUM
FIRST FLOOR



LIBRARY
BASEMENT



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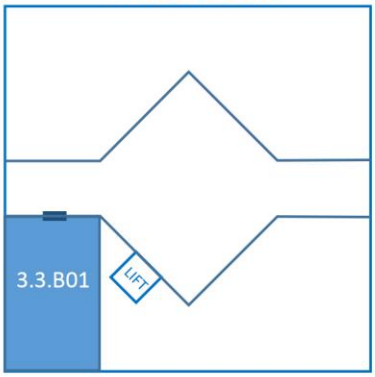


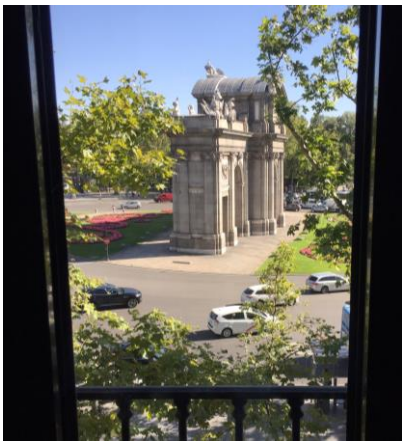
SOCIAL EVENTS

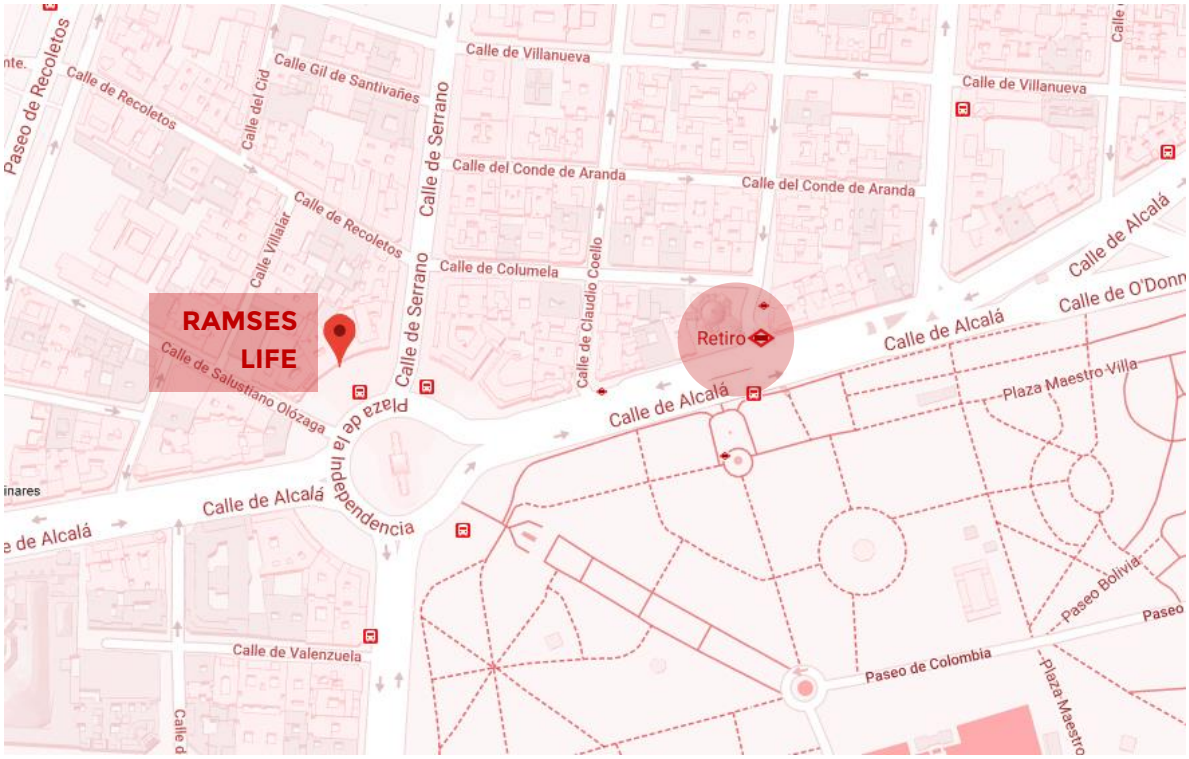
WELCOME RECEPTION: RAMSES LIFE

Tuesday, November 26th, 20:30h, Ramses Life
Plaza de la Independencia, 4, 28001 Madrid
Metro: L2, Retiro

The RAMSES restaurant is the ultimate expression of the union of Arzak and Philippe Starck. The welcome reception will take place at the Nomad House (located on the top floor of Ramses): A cosmopolitan, elegant and welcoming place, endowed with unbeatable views of the Puerta de Alcalá, the best technologies and an unsurpassed kitchen.

The entrance will be made from a passage of carriages of the nineteenth century, through which we will enter through an incredible Japanese garden and then by a private passage, to the Nomad House.





BANQUET: CASINO DE MADRID

Wednesday, November 27th, 20:30h, Casino de Madrid
Calle de Alcalá, 15, 28014 Madrid
Metro: L2, Sevilla

The banquet will take place at the Casino de Madrid, opened in 1910, placed at the heart of Madrid. After a welcome cocktail, dinner will be served at the Salón Alcalá: An old english neo-classicist music hall designed by the Hamptons house. It highlights the use of columns to create movement and its classical decoration.

EXHIBITION

CONFERENCE EXHIBITION

Alisys

Alisys promotes the digital transformation of organizations through the combination of technological solutions based on artificial intelligence, blockchain, telecommunications and digital marketing.

- Cloud Contact Center, Cloud PBX, Cloud CRM and Cloud CX for customer service through phone calls, messaging and social networks.
- Alisys Intelligence. Artificial intelligence to digitize processes and improve the user experience through bots, chatbots, virtual assistants and payment automation through IVR.
- Official Partner Softbank Robotics and Zora Bots. Design and development of custom applications for social robots such as Pepper, NAO and James.

www.alisys.net

PAL Robotics

PAL Robotics' mission is to create disruptive service robots that enhance society's quality of life and solve daily problems. Robotics can make a difference by collaborating with humans, providing support for domestic tasks and increasing efficiency in industrial workflows.

We develop customizable, tailor-made platforms and modular robotic parts that adjust to people's needs. We design and manufacture highly integrated and reliable solutions for service industries and research institutions worldwide.

www.pal-robotics.com

Microsoft

Founded in 1975, Microsoft is the worldwide leader in devices and services that help people and businesses realize their full potential. At Microsoft, we're motivated and inspired every day by how our customers use our products to find creative solutions to business problems, develop breakthrough ideas, and stay connected to what's most important to them.

www.research.microsoft.com/

Furhat Robotics

Furhat Robotics is a Stockholm based startup building the world's most advanced social robotics platform. We are a collective of doers and dreamers driven by one common goal: making the promise of social robots a reality.

www.furhatrobotics.com

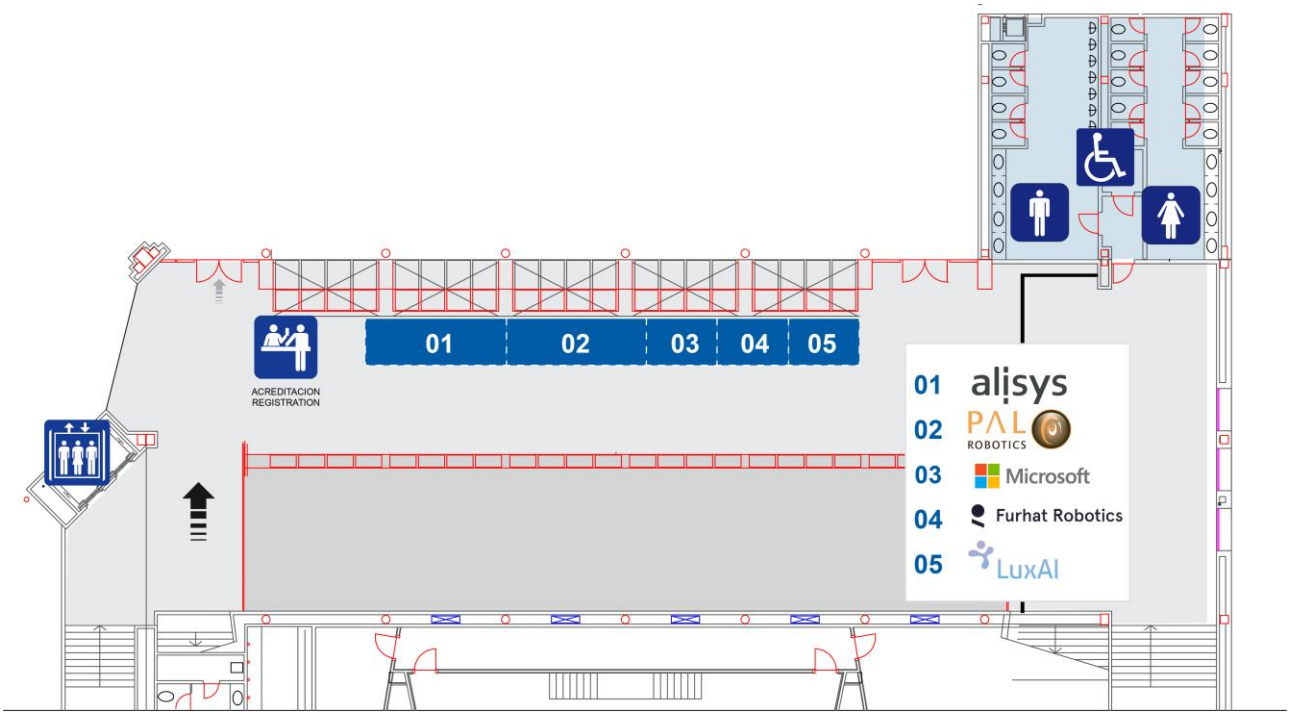
LuxAI

Our vision is a society in which social robots are seamlessly integrated and in which artificially intelligent systems provide functionality for the benefit of people and society.

Our mission is to develop hardware, software and applications for interactive robotic systems, commonly inspired by societal and industrial challenges.

www.luxai.com

EXHIBITION LAYOUT



PLENARY TALKS

PHYSICAL INTERACTION FOR SOCIAL ROBOTS

Katsu Yamane

Honda Research Institute, USA

The major communication modalities used by social robots have been speech, gesture, and facial expression, which do not involve direct physical contact between the robot and human. Furthermore, in most interactions there is a clearly defined piece of information that the robot wants to convey to the human. In social human-human interactions, however, more subtle information, such as emotion and personality, is often exchanged, sometimes through direct physical contacts. This talk highlights two ongoing projects in socially-aware physical human-robot interaction. The first project investigates how people perceive a mobile robot exhibiting different collision avoidance behaviors. Through nearly 500 human-robot crossing experiments in a controlled lab setting, we obtain statistically significant subjective and objective data on perceived safety and comfort of those behaviors, which serve as guidelines for designing motion planning algorithms for robots navigating in crowded environments. In the second project, we explore direct physical contact as a new modality for conveying emotion and personality. Despite the fact that we often observe (to our fear) people spontaneously touching robots that are not designed for direct contact with humans, this modality has rarely been used in social robots. I will describe the hardware platform and controller developed for human-robot hugging, and discuss its potential applications in the social robotics context.

Bio

Dr. Katsu Yamane is a Senior Scientist at Honda Research Institute USA. He received his B.S., M.S., and Ph.D. degrees in Mechanical Engineering in 1997, 1999, and 2002 respectively from the University of Tokyo, Japan. Prior to joining Honda in 2018, he was a Senior Research Scientist at Disney Research, an Associate Professor at the University of Tokyo, and a postdoctoral fellow at Carnegie Mellon University. Dr. Yamane is a recipient of King-Sun Fu Best Transactions Paper Award and Early Academic Career Award from IEEE Robotics and Automation Society, and Young Scientist Award from Ministry of Education, Japan. His research interests include physical human-robot interaction, humanoid robot control and motion synthesis, character animation, and human motion simulation.

INTERACTING BEYOND WORDS: PAL ROBOTICS EXPERIENCE

Francesco Ferro

PAL Robotics, Spain

Social interactions between robots and humans will be fundamental with the implementation of service robots in domestic scenarios, healthcare centers and even in industry 4.0. The social robots' assistance must go far beyond the services that a virtual software could deliver, for example, through a mobile device. Social robots have the potential to merge social interact and physical responses embodying an action. This keynote will go through the examples, benefits and challenges of social robots and the added value that they should deliver. In this keynote speech I would like to introduce our research activities.

Bio

Francesco Ferro is the CEO and co-founder of PAL Robotics, one of the top service robotics companies in the world, and a euRobotics aisbl Board Director. He received a BSc+MSc degree in Telecommunications Engineering at Politecnico di Torino in 2002 (Italy), a Master at ISEN (Lille, France) and an Executive MBA at the University of Barcelona (Spain) in 2011. Since 2004 he develops cutting-edge humanoid service robots at PAL Robotics. The Barcelona company has the mission of making people's life easier by using robotics, and for more than 15 years it has developed high-tech service robots for Assistive and Industrial environments.

AUTONOMOUS FRIENDLY ROBOTS WITH A BODY AND A HEART

Lola Cañamero

University of Hertfordshire, UK

As robots are progressively entering our homes, work and social spaces, and everyday activities, the social robotics community is increasing its efforts to ascertain which social skills robots might need in different contexts, in order to be useful to and trusted by humans. Affective skills are an important element in successful social interactions, and friendliness is often posited as a desirable skill for social robots. However, designing and building friendly robots is not straightforward, and numerous questions arise: what is a friendly robot, and do we always want one? When should a robot be friendly? How can robots be friendly in ways that different people like? In this talk, I will address these and related questions from the perspectives of embodied artificial intelligence, developmental robotics, and embodied affect. In particular, I will develop and illustrate how these approaches and their emphasis on notions such as embodiment, autonomy, adaptation, learning, and interaction, can help us design autonomous affective robots that can be – or become – friendly to us as a function of our interactions with them.

Bio

© University of Hertfordshire

Lola Cañamero is Reader in Adaptive Systems and Head of the Embodied Emotion, Cognition and (Inter-)Action Lab in the School of Computer Science at the University of Hertfordshire in the UK, which she joined as faculty in 2001. She holds an undergraduate degree (Licenciatura) in Philosophy from the Complutense University of Madrid and a PhD in Computer Science (Artificial Intelligence) from the University of Paris-XI, France. She turned to Embodied AI and robotics as a postdoctoral fellow in the groups of Rodney Brooks at MIT (USA) and of Luc Steels at the VUB (Belgium). Since 1995, her research has investigated the interactions between motivation, emotion and embodied cognition and action from the perspectives of adaptation, development and evolution, using autonomous and social robots and artificial life simulations. Some of this research has been carried out as part of interdisciplinary projects where she has played Principal Investigator and coordinating roles, such as the EU-funded HUMAINE (on emotion-oriented information technology), FEELIX-GROWING (investigating emotion development in humans, non-human primates and robots), and ALIZ-E (development of social companions for children with diabetes), or currently the UH-funded Autonomous Robots as Embodied Models of Mental Disorders. She has played a pioneering role in nurturing the emotion modeling community. She is author or co-author of over 150 peer-reviewed publications in the above topics. Website: *www.emotion-modeling.info*

TECHNICAL PROGRAM

PROGRAM OVERVIEW

Time	Tuesday 26th - WORKSHOPS
8:30 - 9:00	Registration (Exhibition Area)
9:00 - 10:45	WS1(3.S1.08), WS2 (3.3.B01), WS3 (Aula de Grados)
10:45 - 11:15	Coffee break (Exhibition Area)
11:15 - 13:00	WS1(3.S1.08), WS2 (3.3.B01), WS3 (Aula de Grados)
13:00 - 14:00	Lunch (Exhibition Area)
14:00 - 15:45	WS1(3.S1.08), WS2 (3.3.B01), WS4 (Aula de Grados)
15:45 - 16:15	Coffee break (Exhibition Area)
16:15 - 18:00	WS1(3.S1.08), WS2 (3.3.B01), WS4 (Aula de Grados)
20:30	Welcome party: Ramses Life

Time	Wednesday 27th - MAIN CONFERENCE (Aula de Grados)
8:30 - 9:00	Registration (Exhibition Area)
9:00 - 9:15	Welcome
9:15 - 10:15	Plenary talk: Katsu Yamane “Physical Interaction for Social Robots”
10:15 - 11:15	Oral session I
11:15 - 12:00	Interactive session / Coffee break (Exhibition Area)
12:00 - 13:00	Oral session II
13:00 - 14:00	Lunch (Exhibition Area)
14:00 - 15:00	Plenary talk: Francesco Ferro “Interacting beyond words: PAL Robotics experience”
15:00 - 16:00	Oral session III
16:00 - 16:45	Interactive session / Coffee break (Exhibition Area)
16:45 - 18:00	Oral session IV
20:30	Banquet: Casino de Madrid

Time	Thursday 28th - MAIN CONFERENCE (Aula de Grados)
8:30 - 9:00	Registration (Exhibition Area)
9:00 - 10:00	Plenary talk: Lola Cañamero “Autonomous Friendly Robots with a Body and a Heart”
10:00 - 11:15	Oral session V
11:15 - 12:00	Competition / Coffee break (Exhibition Area)
12:00 - 13:00	Oral session VI
13:00 - 14:00	Lunch (Exhibition Area)
14:00 - 15:15	Oral session VII
15:15 - 15:45	Coffee break (Exhibition Area)
15:45 - 17:00	Oral session VIII
17:00 - 18:00	Entrepreneurial demo session
18:00 - 18:30	Awards/Farewell

Time	Friday 29th - WORKSHOPS
8:30 - 9:00	Registration (Exhibition Area)
9:00 - 10:45	WS5 (3.3.B01), WS6 (3.S1.08)
10:45 - 11:15	Coffee break (Exhibition Area)
11:15 - 13:00	WS5 (3.3.B01), WS6 (3.S1.08)
13:00 - 14:00	Lunch (Exhibition Area)
14:00 - 15:45	WS5 (3.3.B01), WS6 (3.S1.08)
15:45 - 16:15	Coffee break (Exhibition Area)
16:15 - 18:00	WS5 (3.3.B01), WS6 (3.S1.08)

PROGRAM (DETAILED)

Wednesday 27th (Aula de Grados)	
08:30 - 09:00	**Registration (Exhibition Area)**
09:00 - 09:15	**Welcome**
09:15 - 10:15	**Plenary talk: Katsu Yamane** "Physical Interaction for Social Robots" *Chair: Emilia I. Barakova*
10:15 - 11:15	**Oral session I: Perceptions and expectations of robots** *Chairs: Agnieszka Wykowska and Katsu Yamane*
	• Boundary-Crossing Robots: Societal Impact of Interactions with Socially Capable Autonomous Agents. *Kristiina Jokinen, Kentaro Watanabe* • Effects of previous exposure on children's perception of a humanoid robot. *Gabriella Lakatos, Luke Wood, Abolfazl Zaraki, Ben Robins, Kerstin Dautenhahn, Farshid Amirabdollahian* • The Attitude of Elderly and Young Adults towards a Humanoid Social Robot. *Lizzy Sinnema, Maryam Alimardani* • Spatiotemporal Coordination Supports a Sense of Commitment in Human-Robot Interaction. *Alessia Vignolo, Alessandra Sciutti, Francesco Rea, John Michael*
11:15 - 12:00	**Interactive session / Coffee break (Exhibition Area)**
	• Hug Behavior Request Model with Approaching Human for Hug Robots. *Mitsuru Jindai, Shunsuke Ota, Toshiyuki Yasuda, Tohru Sasaki* • The Contribution of Art and Design to Robotics. *Isabelle COSSIN, Ioana Ocnarescu* • More than you expect: priors influence the adoption of intentional stance toward humanoid robots. *Jairo Perez-Osorio, Serena Marchesi, Davide Ghiglino, Melis Ince, Agnieszka Wykowska* • Using human eye gaze patterns as indicators of need for assistance from a socially assistive robot. *Ulyana Kurylo, Jason Wilson* • Influence of Variable Environments and Character-Specific Design on Perception of Virtual Robots with Affective Labels. *Wali Rizvi, Ishaan Pakrasi, Amy LaViers* • Personality Synthesis Using Non-Humanoid Cues. *Sam Lee, Kotaro Funakoshi, Ritsuko Iwai, Takatsune Kumada* • Individual differences in attitude toward robots predict behavior in human-robot interaction. *Nina-Alisa Hinz, Francesca Ciardo, Agnieszka Wykowska*

	• Improving the Visual Comfort of Virtual Reality Telepresence for Robotics. *Harvey Cash, Tony J. Prescott* • Social Emotions for Social Robots∗ Studies on affective impressions in human-human and human-robot interactions *Kristiina Jokinen* • Subject Selection Bias in Intervention Experiments with Socially Assistive Robots and the Impact on the Representativeness of the Population. *Toshiharu Igarashi, Misato Nihei, Jumpei Mizuno, Takenobu Inoue, Minoru Kamata* • Third Eye: Exploring the affordances of Third-Person View in Telepresence Robots. *Aneesh Tarun, Nauman Baig, Jack (Shen-Kuen) Chang, Rabia Tanvir, Sumaiyah Shihipar, Ali Mazalek* • Knock on Wood: The Effects of Material Choice on the Perception of Social Robots. *Sanne van Waveren, Linnéa Björklund, Elizabeth J. Carter, Iolanda Leite* • Exploring the Causal Modeling of Human-Robot Touch Interaction. *Soheil Keshmiri, Hidenobu Sumioka, Takashi Minato* • Combining Static and Dynamic Predictions of Transfer Points for Human Initiated Handovers. *Janneke Simmering, Sebastian Meyer zu Borgsen, Sven Wachsmuth, Ayoub Al-Hamadi* • Investigating the Effects of Gaze Behavior on the Perceived Delay of a Robot's Response. *Vivienne Jia Zhong, Theresa Schmiedel, Rolf Dornberger* • Monitoring Blind Regions with Prior Knowledge based Sound Localization. *Jani Even, satoru satake, Takayuki Kanda*
12:00 - 13:00	**Oral session II: Cognition and metacognition for SR** *Chairs: Tony Prescott and Miguel A. Salichs*
	• Transferring Adaptive Theory of Mind to social robots: insights from developmental psychology to robotics. *Francesca Bianco* • Robots improve judgments on self-generated actions: an Intentional Binding Study. *Cecilia Roselli, Francesca Ciardo, Agnieszka Wykowska* • Perception of Creative Responses to Moral Dilemmas by a Conversational Robot. *Felix Lindner, Laura Wächter, Barbara Kuhnert, Katrin Möllney* • Creating Context Through Performance: Perception of the "Dancing Droid" Robotic Platform in Variable Valence Interactions in Distinct Office Environments. *Erin Berl, Ishaan Pakrasi, Amy LaViers*
13:00 - 14:00	**Lunch (Exhibition Area)**

14:00 - 15:00	**Plenary talk: Francesco Ferro** "Interacting beyond words: PAL Robotics experience" *Chair: Shuzhi Sam Ge*
15:00 - 16:00	**Oral session III: Game Approaches and Applications to HRI** *Chairs: Emilia Barakova and Patrick Holthaus*
	• Playing Rock-Paper-Scissors with RASA: A case study on intention prediction in human-robot interactive games. *Ehsan Ahmadi, Ali Ghorbandaei Pour, Alireza Siamy, Alireza Taheri, Ali Meghdari* • Virtual or Physical? Social Robots Teaching a Fictional Language Through a Role-Playing Game Inspired by Game of Thrones. *Hassan Ali, Shreyans Bhansali, Ilay Köksal, Matthias Möller, Theresa Pekarek-Rosin, Sachin Sharma, Ann-Katrin Thebille, Julian Tobergte, Sören Hübner, Aleksej Logacjov, Ozan Özdemir, Jose Rodriguez Parra, Mariela Sanchez, Nambiar Shruti Surendrakumar, Tayfun Alpay, Sascha Griffiths, Stefan Heinrich, Erik Strahl, Cornelius Weber, Stefan Wermter* • Stackelberg Punishment and Bully-Proofing Autonomous Vehicles. *Matt Cooper, Jun Ki Lee, Jacob Beck, Joshua D. Fishman, Michael Gillett, Zoë Papakipos, Aaron Zhang, Jerome Ramos, Aansh Shah, Michael L. Littman* • Gesture Cues in Navigational Robots: Investigating the Effects of Honesty on People's Perceptions and Performance in a Navigational Game. *Joey Verhoeven, Peter Ruijten*
16:00 - 16:45	**Interactive session / Coffee break (Exhibition Area)**
	• Lexical Entrainment in Multi-party Human–Robot Interaction. *Mitsuhiko Kimoto, Takamasa Iio, Michita Imai, Masahiro Shiomi* • Hand Gesture Based Gameplay with a Smoothie Maker Game using Myo Armband. *Sudhir Sharma, Volker Steuber, Farshid Amirabdollahian* • A Digital Wooden Tabletop Maze for Estimation of Cognitive Capabilities in Children. *Seethu M Christopher, Corrie C. Urlings, Henri van den Bongarth, Karien M. Coppens, Petra P.M. Hurks, Lex Borghans, Rico Möckel* • Companion Transporter: A Co-worker in the Greenhouse. *Alireza Nemati, Dongjie Zhao, Wanyue Jiang, Shuzhi Ge* • Adding a Context: Will It Influence Human-Robot Interaction of People Living with Dementia? *Jorien Hendrix, Yuan Feng, Marieke van Otterdijk, Emilia Barakova* • The impact of a robot game partner when studying deception during a card game. *David-Octavian Iacob, Adriana Tapus* • How a Robot's Social Credibility Affects Safety Performance. *Patrick Holthaus, Catherine Menon, Farshid Amirabdollahian* • Robostress, a new approach to understanding robot usage, technology, and stress. *Kimmo Vänni, Sirpa Salin, John-John Cabibihan, Takayuki Kanda* • I`m not playing anymore! A Study Comparing Perceptions of Robot and

	Human Cheating Behavior. *Kerstin Sophie Haring, Kristin Nye, Ryan Darby, Elizabeth Phillips, Ewart de Visser, Chad Tossell* • Privacy Concerns in Teleoperation: Does Personality Influence What Should Be Hidden? *Sogol Balali, Ross Sowell, William Smart, Cindy Grimm* • Interactive Robot Learning for Multimodal Emotion Recognition. *Chuang YU, Adriana Tapus* • Safe human-robot interaction through crowd contact video analysis. *Fernando Garcia, Alexandre Mazel, Arturo Cruz Maya* • Robot-Assisted Therapy for the Severe form of Autism: Challenges and Recommendations. *Zhansaule Telisheva, Aizada Turarova, Aida Zhanatkyzy, Anara Sandygulova* • Evaluating the Valence of Affective Sounds for Robotics Pediatric Health-care. *Silvia Rossi, Elena Dell'aquila, Benedetta Bucci* • User testing of cognitive training games for people with mild cognitive impairment: Design implications. *Mikaela Law, Ho Seok AHN, Bruce MacDonald, Dina-Sara Vajsakovic, Christopher Lee, JongYoon Lim, Craig Sutherland, Kathy Peri, Ngaire Kerse, Elizabeth Broadbent* • Toward robot-assisted psychosocial intervention for children with Autism Spectrum Disorder (ASD). *Vasiliki Holeva, Vasiliki-Aliki Nikopoulou, Maria Papadopoulou, Eleni Vrochidou, George Papakostas, Vassilis Kaburlasos* • Proactive Intention Recognition for Joint Human-Robot Search and Rescue Missions through Monte-Carlo Planning in POMDP Environments. *Dimitri Ognibene, Lorenzo Mirante, Letizia Marchegiani*
16:45 - 18:00	**Oral session IV: Collaborative SR in the Workplace and in Education** *Chairs: H. Cuijpers and Birgit Lugrin*
	• Collaborative Human-Robot Hierarchical Task Execution with an Activation Spreading Architecture. *Bashira Akter Anima, Janelle Blankenburg, Mariya Zagainova, S. Pourya Hoseini Alinodehi, Muhammed Tawfiq Chowdhury, David Feil-Seifer, Monica Nicolescu, Mircea Nicolescu* • A Human Factor approach to HRI. *Susanne Frennert* • Teaching Persian Sign Language to a Social Robot via Learning from Demonstrations Approach. *Seyed Ramezan Hosseini, Alireza Taheri, Ali Meghdari, Minoo Alemi* • Natural Teaching of Robot-Assisted Rearranging Exercises for Cognitive Training. *Antonio Andriella, Alejandro Suárez Hernández, Javier Segovia-Aguas, Carme Torras, Guillem Alenyà* • Static and Temporal Differences in Social Signals Between Error-Free and Erroneous Situations in Human-Robot Collaboration. *Dito Eka Cahya, Rahul Ramakrishnan, Manuel Giuliani*
20:30	**Banquet at Casino de Madrid**

Thursday 28th (Aula de Grados)	
08:30 - 09:00	**Registration (Exhibition Area)**
09:00 - 10:00	**Plenary talk: Lola Cañamero** "Autonomous Friendly Robots with a Body and a Heart" *Chair: Miguel A. Salichs*
10:10 - 11:15	**Oral session V: Robots at Home and at public spaces** *Co-chairs: Koen Hindriks and Ho Seok Ahn*
	• Now I need help! Passing doors and using elevators as an Assistance Requiring Robot. *Jonathan Liebner, Andrea Scheidig, Horst-Michael Gross* • Mobile Assistive Robot in an Inclusive Space: the MARIS Project. *Yesenia Aquilina, Michael A. Saliba, Simon G. Fabri* • Should a robot guide like a human? A qualitative four-phase study of a shopping mall robot. *Päivi Heikkilä, Hanna Lammi, Marketta Niemelä, Kathleen Belhassein, Guillaume Sarthou, Antti Tammela, Aurélie Clodic, Rachid ALAMI* • Identifying Social Context Factors Relevant for a Robotic Elderly Assistant. *Birgit Lugrin, Astrid Rosenthal-von der Pütten, Svenja Hahn* • Improving the interaction of Older Adults with Socially Assistive Robots for Table setting. Samuel Olatunji, Noa Markfeld, Dana Gutman, Shay Givati, Vardit Sarne-Fleischmann, Tal Oron-Gilad, Yael Edan
11:15 - 12:00	**Competition / Coffee break (Exhibition Area)**
12:00 - 13:00	**Oral session VI: Applications in Heath Domain** *Chairs: Silvia Rossi and Gabriela Lakatos*
	• Getting Acquainted for a Long-Term Child-Robot Interaction. *Mike Ligthart, Mark A. Neerincx, Koen Hindriks* • Use of robotics in the German healthcare sector: Application scenarios - drivers and barriers - time savings. *Marija Radic, Agnes Vosen, Birgit Graf* • In Their Own Words: A Companion Robot for Detecting the Emotional State of Persons with Parkinson's Disease. *Andrew Valenti, Meia Chita-Tegmark, Michael Gold, Theresa Law, Matthias Scheutz* • Train With Me: A Preliminary Study Comparing a Socially Assistive Robot and a Virtual Agent for a Rehabilitation Task. *Valentina Vasco, Cesco Willemse, Pauline Chevalier, Davide De Tommaso, Valerio Gower, Furio Gramatica, Vadim Tikhanoff, Ugo Pattacini, Giorgio Metta, Agnieszka Wykowska*
13:00 - 14:00	**Lunch (Exhibition Area)**
14:00 - 15:15	**Oral session VII: Technical innovations in SR**

	Chairs: Yael Edan and Kotaro Funakoshi
	• Teaching Commonsense and Dynamic Knowledge to Service Robots. *Stephan Opfer, Stefan Jakob, Kurt Geihs* • A Robot Math Tutor that Gives Feedback. *Koen Hindriks, Sander Liebens* • Learning to gesticulate by observation using a deep generative approach. *Unai Zabala, Igor Rodriguez, José María Martínez-Otzeta, Elena Lazkano* • Towards using social cues for acceptable, human-aware robot navigation. *Noelia Fernández Coleto, Eduardo Ruiz Ramírez, Frederik Haarslev, Leon Bodenhagen* • No Need to Scream: Robust Sound-based Speaker Localisation in Challenging Scenarios. *Tze Ho Elden Tse, Daniele De Martini, Letizia Marchegiani*
15:15 - 15:45	**Coffee break (Exhibition Area)**
15:45 - 17:00	**Oral session VIII: Emerging topics in SR** *Chairs: Álvaro Castro González and Amit Kumar Pandey*
	• Privacy, Utility, and Cognitive Load in Remote Presence Systems. *Jeffrey Klow, Jordan Proby, Matthew Rueben, Ross Sowell, Cindy Grimm, William Smart* • Optimal Use Of Verbal Instructions For Multi-Robot Human Navigation Guidance. *Harel Yedidsion, Jacqueline Deans, Connor Sheehan, Mahathi Chillara, Justin Hart, Peter Stone, Raymond J. Mooney* • Understanding Intentions: Detection of Human-Object Interactions in Video Streams. *Lilli Bruckschen, Sabrina Amft, Julian Tanke, Juergen Gall, Maren Bennewitz* • What Makes a Good Robotic Advisor? *Raul Paradeda, Maria José Ferreira, Raquel Oliveira, Carlos Martinho, Ana Paiva* • Online Evaluation of Text to Speech Systems for three Social Robots. *Fernando Alonso Martin, Maria Malfaz, Álvaro Castro-González, José Carlos Castillo, Miguel A. Salichs*
17:00 - 18:00	**Entrepreneurial demo session**
18:00 - 18:30	**Awards/Farewell**

ABSTRACTS

ORAL SESSION I: PERCEPTIONS AND EXPECTATIONS OF ROBOTS

WEDNESDAY 27th (10:15 – 11:15)

Boundary-Crossing Robots: Societal Impact of Interactions with Socially Capable Autonomous Agents

Kristiina Jokinen, Kentaro Watanabe

The paper introduces the notion of a Boundary-Crossing Robot which refers to the use of AI research and novel technology in symbiotic interaction with human users, especially in the meaning creation processes that makes the world sensible and interpretable in the course of everyday activities. Co-evolution of collaboration is considered from the point of view of social ro-bots with dual characteristics as an agent and an elaborated computer, and the focus is on the robot's interaction capability. The paper emphasizes im-portant questions related to trust in social encounters with boundary-crossing agents.

Effects of previous exposure on children's perception of a humanoid robot

Gabriella Lakatos, Luke Wood, Abolfazl Zaraki, Ben Robins, Kerstin Dautenhahn, Farshid Amirabdollahian

The study described in this paper investigated the effects of previous exposure to robots on children's perception of the Kaspar robot. 166 children aged between 7 and 11 participated in the study in the framework of a UK robotics week 2018 event, in which we visited a local primary school with a number of different robotic platforms to teach the children about robotics. Children's perception of the Kaspar robot was measured using a questionnaire following a direct interaction with the robot in a teaching scenario. Children's previous exposure to other robots and Kaspar itself was manipulated by controlling the order of children's participation in the different activities over the event. Effects of age and gender were also examined. Results suggest significant effects of previous exposure and gender on children's perception of Kaspar, while age had no significant effect. Important methodological implications for future studies are discussed.

The Attitude of Elderly and Young Adults towards a Humanoid Social Robot

Lizzy Sinnema, Maryam Alimardani

The main objective of this research was to gain insight in the attitude that groups of elderly and young students have towards social robots. A total of 52 participants (24 elderly vs. 28 students) took part in a short-term interaction with a humanoid social robot. In small groups of two to four people, they engaged in a conversation with a Nao robot. Their attitude was measured before and after the interaction using the Unified Theory of Acceptance and Use of Technology (UTAUT) questionnaire. Furthermore, the role of the robot as a facilitator for conversation was assessed by observing the interaction between individuals after the robot was removed. This research explored the use of social robots as a means to improve socialization between individuals rather than aiming to replace the human contact. Results from the questionnaire and an additional observational analysis showed a positive attitude towards the robot and the interaction from both age groups. After the interaction, elderly perceived the robot as significantly more useful than students, which could be assigned to a difference in needs and expectations they had from it. Furthermore, anxiety towards the robot for both groups decreased after the interaction. Future research can investigate the effect of long-term interaction with a similar robot. In the long-term, social robots could possibly

be deployed to decrease loneliness, a common issue among elderly.

Spatiotemporal Coordination Supports a Sense of Commitment in Human-Robot Interaction

Alessia Vignolo, Alessandra Sciutti, Francesco Rea, John Michael

Previous research has shown that a high degree of spatiotemporal coordination can promote a sense of commitment in joint actions involving two human agents. In the current study, we extend this research to human-robot interaction. We designed and implemented an online study in which we presented participants with videos in which a humanoid robot (iCub) and a human agent were tidying up by moving toys from a table into a container. In the High Coordination condition, the two agents formed a chain, with the human picking up the toys and passing them to the robot. In the Low Coordination condition, they worked in parallel without forming a chain. Participants were asked to imagine themselves in the position of the human agent and to respond to a battery of questions to probe the extent to which they felt committed to the joint action. While we did not observe a main effect of our coordination manipulation, the results do reveal that participants who perceived a higher degree of coordination also indicated a greater sense of commitment to the joint action. Moreover, the results show that participants'sensitivity to the coordination manipulation was contingent on their prior attitudes towards the robot: participants in the High Coordination condition reported a greater sense of commitment than participants in the Low Coordination condition, except among those participants who were a priori least inclined to experience a close sense of relationship with the robot.

INTERACTIVE SESSION I

WEDNESDAY 27th (11:15 - 12:00)

Hug Behavior Request Model with Approaching Human for Hug Robots

Mitsuru Jindai, Shunsuke Ota, Toshiyuki Yasuda, Tohru Sasaki

Hug behavior can promote synchronization of embodied rhythms effectively as it is one of the types of embodied interactions wherein humans contact whole-body with each other. In the case of a human and a robot, it is likely that a robot effectively synchronizes an embodied rhythm with a human using hug behavior. Therefore, in this paper, a hug behavior request model with an approaching human is proposed for hug robots. Furthermore, a hug robot system that employs the proposed model is developed. In this model, the robot requests hug behavior when a human approaches it, and generates hug behavior with humans. Using the developed robot system, a preferred timing which begins with the hand motion of the robot is determined to request hug behavior by sensory evaluations. Furthermore, the effectiveness of the proposed model is demonstrated.

The Contribution of Art and Design to Robotics

Isabelle COSSIN, Ioana Ocnarescu

Today the industrial interests for technological objects, the increasing number of robotic solutions that appear on the market and the powerful imagi- native stories demand a deep exploration on what “living with robots” means. Often a small paradigm shift, like an overview of the imaginary related to ro- botics or insights coming from field research could redirect an exploration fo- cused solely on the technical feasibility. This is why a look at the experiences of art and design related to robotics could bring a complementary approach to the approach of roboticians. This article shows different explorations

coming from artists and designers whose concerns are finally very similar to those of ro- boticians. These experiments allow not only to create technical and artistic ob- jects but also to work on the way to give them meaning.

More than you expect: priors influence the adoption of intentional stance toward humanoid robots

Jairo Perez-Osorio, Serena Marchesi, Davide Ghiglino, Melis Ince, Agnieszka Wykowska

Expectations about other's behavior based on mental states modulate the way we interact with people. On the brink of the introduction of robots in our social environment, the question of whether humans would use the same strategy when interacting with artificial agents gain relevance. Recent research shows that people can adopt the mentalistic statement to explain the behavior of humanoid robots [1]. Adopting such a strategy might be mediated by the expectations that people have about robots and technology, among others. The present study aims to create a questionnaire to evaluate such expectations and to test whether these priors in fact modulate the adoption of the intentional stance. We found that people's expectations directed to a particular robot platform have an influence on the adoption of mental state based explanations regarding an artificial agent. Lower expectations were associated with anxiety during interaction with robots and neuroticism. Meanwhile, high expectations are linked to feeling less discomfort when interacting with robots and a higher degree of openness. Our findings suggest that platform-directed expectations might also play a crucial role in HRI and in the adoption of intentional stance toward artificial agents.

Using human eye gaze patterns as indicators of need for assistance from a socially assistive robot

Ulyana Kurylo, Jason Wilson

With current growth in social robotics comes a need for well developed and fine tuned agents which respond to the user in a seamless and intuitive manner. Socially assistive robots in particular have become popular for their uses in care for older adults for medication adherence and socializing. Since eye gaze cues are important mediators in human-human interactions, we hypothesize that gaze patterns can be applied to human-robot interactions to identify when the user may need assistance. We reviewed videos (N=16) of robot supported collaborative work to explore how recognition of gaze patterns for an assistive robot in the context of a medication management task can help predict when a user needs assistance. We found that mutual gaze is a better predictor than confirmatory request, gaze away, and goal reference. While eye gaze serves as an important indicator for need for assistance, it should be combined with other indicators, such as verbal cues or facial expressions to sufficiently represent assistance needed in the interaction and provide timely assistance.

Influence of Variable Environments and Character-Specific Design on Perception of Virtual Robots with Affective Labels

Wali Rizvi, Ishaan Pakrasi, Amy LaViers

As robotic systems move out of the factory, it is essential that they adapt to changing environments. Distinct contextual settings may cause users to have a different perception of these systems. This paper explores the relationship between context and expression by looking at various combinations of robot characters and environments in a virtual setting. The robots are designed after characters from pop-culture. Physical traits such as color, eye

shape, and motion profiles are abstractly analyzed and infused onto the robot. Six different robot characters and six different environments are used to see if individuals perceive each robot differently in varying environments. Additionally, the effect of character-specific priming as a context generator is also surveyed. It is found that the character with an affect label with positive valence was rated more favorably than characters with negative valence affect labels in positive valence environments and vice versa is true for environments with negative valence associated. Qualitative feedback from participants provides a meaningful description for each rating choice. This study shows the importance of contextual realizations while designing robotic systems that can be considered in future work looking at user perception.

Personality Synthesis Using Non-Humanoid Cues

Sam Lee, Kotaro Funakoshi, Ritsuko Iwai, Takatsune Kumada

Currently there exists literature and research done on the role of personality in robots. However the existing research involves exhibiting personality on some platform which contains human cues. On the other hand, there exists little research on attempts to synthesize and exhibit personality without the use of any humanoid cues. In our research, we explore this challenge. In concrete, we define four parameters that modulate the behavior (motion path and schedule) of an information-seeking agent in a virtual 2D environment where only moving triangles and static rectangles reside. The presented synthesis model will be applicable to any mobile social robots. We setup five different agent behaviors as video stimuli and asked subjects to evaluate the agent's personality based on the Big Five personality traits model. The results suggest that people perceives different personalities from different parameter settings. We will discuss the future direction and issues based on the results.

Individual differences in attitude toward robots predict behavior in human-robot interaction

Nina-Alisa Hinz, Francesca Ciardo, Agnieszka Wykowska

Humans are influenced by the presence of other social agents, sometimes performing better, sometimes performing worse than alone. Humans are also affected by how they perceive the social agent. The present study investigated whether individual differences in the attitude toward robots can predict human behavior in Human-Robot Interaction (HRI). Therefore, adult participants played a game with the Cozmo robot (Anki Inc., San Francisco), in which their task was to stop a balloon from exploding. In individual trials, only the participants could stop the balloon inflating, while in joint trials also Cozmo could stop it. Results showed that in joint trials, the balloon exploded less often than in individual trials. However participants stopped the balloon earlier in joint than in individual trials, although this was less beneficial for them. This effect of Cozmo joining the game, nevertheless, was influenced by the negative attitude of the participants toward robots. The more negative they were, the less their behavior was influenced by the presence of the robot. This suggests that robots can influence human behavior, although this influence is modulated by the attitude toward the robot.

Improving the Visual Comfort of Virtual Reality Telepresence for Robotics

Harvey Cash, Tony J. Prescott

Telepresence technologies enable users to exhibit a presence in a remote location, through the use of sensors, networks and robotics. State of the art telepresence research swaps conventional desktop monitors for Virtual Reality (VR) headsets, in order to increase the user's immersion in the remote environment, though often at the

cost of increased nausea and oculomotor discomfort.

We describe a novel method for telepresence via VR, aimed at improving comfort, by accounting for discrepancies between robot and user head pose. This is achieved through a “decoupled” image projection technique, whereby the user is able to look across captured imagery rendered to

virtual display plane. Evaluated against conventional projection techniques, in a controlled study involving 19 participants, decoupled image projection substantially reduced mean perceived nausea and oculomotor discomfort within a 95% statistical confidence interval while also improving task performance, immersiveness, and the perceived sensation of presence.

Social Emotions for Social Robots∗ Studies on affective impressions in human-human and human-robot interactions

Kristiina Jokinen

In this paper, social emotions and expressive interaction is discussed in the context of human-robot interaction. The focus is on the understanding of natural human behavior and how human interest, perception, and understanding manifest themselves in various interactive settings. The paper compares two different types of agents, human participants and humanoid robot agents, and studies how the human participants' behaviour and their impressions of the interaction differ depending on the agents. The paper seeks to answer the question of how to model social emotions and affective behavior on social robots which aim at expressive and engaging human-robot interaction.

Subject Selection Bias in Intervention Experiments with Socially Assistive Robots and the Impact on the Representativeness of the Population

Toshiharu Igarashi, Misato Nihei, Jumpei Mizuno, Takenobu Inoue, Minoru Kamata

The subjects of all studies have their own personalities and characteristics. For example, the characteristics of elderly individuals being assisted by Socially Assistive Robots (SARs) needs to be investigated. However, the attributes of subjects' personalities that affect the outcome of intervention experiments involving SARs have been analyzed mainly by gender so far. The purpose of this study is to clarify the selection criteria of the subjects in intervention experiments with SARs and their influence on subjects' attributes. Semi-structured interviews were conducted to clarify the criteria by which subjects were selected and the relationship between the subjects and the facility personnel. We interviewed 13 staff members who were involved in the selection of subjects for SAR intervention experiments in six facilities. According to the subject selection criteria discovered in these interviews, we did follow-up research to clarify the influence on the attributes of the selected subjects. In conclusion, the subject selection criteria reported by the staff were analyzed according to four categories based on the interview surveys. It was verified that the selection criteria affected the selection attributes of subjects' degree of involvement, relationship, and character. Going forward, it is necessary to link this research to not only the personality of the elderly person being assisted but also to their family structure and hobbies, friendship characteristics, and the function of the SARs.

Third Eye: Exploring the affordances of Third-Person View in Telepresence Robots

Aneesh Tarun, Nauman Baig, Jack (Shen-Kuen) Chang, Rabia Tanvir, Sumaiyah Shihipar, Ali Mazalek

Social interaction through telepresence robots can be challenging for a robot operator due to lack of spatial awareness caused by limited idiothetic cues and narrow field-of-view of a robot's camera. We explore the use of a third-person perspective, popular in video game design, to provide missing spatial cues and understand their effects on remote robot operators and local collaborators. We present the design and implementation of Third Eye, a system that enables controlling telepresence robots through a third-person view. Third Eye comprises a controllable third-person camera with a wide field-of view, attached to a robot, and bimanual controls for remote operation. Observations from a user study show that the Third Eye enabled the robot operators to have a better awareness of the robot 'bodies' they controlled. This, in turn, afforded new behavior for operators. In addition, the camera design supported ecologically valid interaction for social telepresence. Quantitative data shows the Third Eye has comparable navigation efficiency to existing systems.

Knock on Wood: The Effects of Material Choice on the Perception of Social Robots

Sanne van Waveren, Linnéa Björklund, Elizabeth J. Carter, Iolanda Leite

Many people who interact with robots in the near future will not have prior experience, and they are likely to intuitively form their first impressions of the robot based on its appearance. This paper explores the effects of component material on people's perception of the robots in terms of social attributes and willingness to interact. Participants watched videos of three robots with different outer materials: wood, synthetic fur, and plastic. The results showed that people rated the perceived warmth of a plastic robot lower than a wooden or furry robot. Ratings of perceived competence and discomfort did not differ between the three robots.

Exploring the Causal Modeling of Human-Robot Touch Interaction

Soheil Keshmiri, Hidenobu Sumioka, Takashi Minato

The growing emergence of socially assistive robots in our daily lives inevitably entails such interactions as touch and hug between robots and humans. Therefore, derivation of robust models for such physical interactions to enable robots to perform them in naturalistic fashion is highly desirable. In this study, we investigated whether it was possible to realize distinct patterns of different touch interactions that were general representations of their respective types. For this purpose, we adapted three touch interaction paradigms and asked human subjects to perform them on a mannequin that was equipped with a touch sensor on its torso. We then applied Wiener-Granger causality on the time series of activated channels of this touch sensor that were common (per touch paradigm) among all participants. The analyses of these touch time series suggested that different types of touch can be quantified in terms of causal association between sequential steps that form the variation information among their patterns. These results hinted at the potential utility of such generalized touch patterns for devising social robots with robust causal models of naturalistic touch behaviour for their human-robot touch interactions.

Combining Static and Dynamic Predictions of Transfer Points for Human Initiated Handovers

Janneke Simmering, Sebastian Meyer zu Borgsen, Sven Wachsmuth, Ayoub Al-Hamadi

In many scenarios where robots could assist humans, handover situation are essential. But they are still challenging for robots, especially if these are initiated by the human interaction partner. Human-human handover studies report average reaction times of 0.4s, which is only achievable for robots, if they are able to predict the object transfer point (OTP) sufficiently early and then adapt to the human movement. In this paper, we propose a hand tracking system that can be used in the context of human initiated handovers as a basis for human reaching motion prediction. The OTP prediction implemented is based on the minimum jerk model and combines a static estimation utilizing the human's initial pose and a dynamic estimation from the current hand trajectory. To evaluate the hand tracking and OTP prediction different human initiated handover scenarios were defined and recorded. For these cases we examine the dynamics of different variants of the proposed prediction algorithm, i.e. how early is a robot's prediction of the OTP within a certain error range? The tracking delivers results with an average delay, after the initialization, of 0.07s. The prediction delivers results with an initial prediction error that is usually below 35cm in each 3D direction and an end time error of below 10cm in most cases. We show that these results can already be achieved when only 75% of the movement is observed.

Investigating the Effects of Gaze Behavior on the Perceived Delay of a Robot's Response

Vivienne Jia Zhong, Theresa Schmiedel, Rolf Dornberger

Slow responses of social robots cause user frustration in human-robot communication. This paper investigates how far the way the robot looks at a conversation partner, that is, its gaze behavior, influences the perceived delay of a robot's response in small talk conversations between a human and a robot. To enhance a natural conversation pattern and avoid that a social robot only stares at a human conversation partner, a gaze behavior was designed and implemented into a humanoid robot. A within-subject experiment involving 31 test subjects was designed with two conditions (with and without gaze behavior). The results generally show a positive correlation between the gaze behavior that the robot exhibits and the perceived responsiveness of the robot (in the condition with gaze behavior). However, the perceived responsiveness is the same in both conditions. One reason for this finding may be that the response time of the robot might have been generally too short to identify an effect in the experimental setting. Future research can directly build on our research to assess the relation between gaze behavior and perceived responsiveness in further detail and draw upon the finding that gaze behavior generally plays an important role with regard to the perceived responsiveness of a robot. Robot designers can also build on our research and consider both gaze behavior and additional factors to address a perceived delay in a robot's response.

Monitoring Blind Regions with Prior Knowledge based Sound Localization

Jani Even, satoru satake, Takayuki Kanda

This paper presents a sound localization method designed for dealing with blind regions. The proposed approach mimics Human's ability of guessing what is happening in the blind regions by using prior knowledge. A user study was conducted to demonstrate the usefulness of the proposed method for human-robot interaction in environments with blind regions. The subjects participated in a shoplifting scenario during which the shop clerk was a robot that has to rely on its hearing to

monitor a blind region. The participants understood the enhanced capability of the robot and it favorably affected the rating of the robot using the proposed method.

ORAL SESSION II: COGNITION AND METACOGNITION FOR SR

WEDNESDAY 27th (12:00 – 13:00)

Transferring Adaptive Theory of Mind to social robots: insights from developmental psychology to robotics

Francesca Bianco

Despite the recent advancement in the social robotic field, important limitations restrain its progress and delay the application of robots in everyday scenarios. In the present paper, we propose to develop computational models inspired by our knowledge of human infants' social adaptive abilities. We believe this may provide solutions at an architectural level to overcome the limits of current systems. Specifically, we present the functional advantages that adaptive Theory of Mind (ToM) systems would support in robotics (i.e. mentalizing for belief understanding, proactivity and preparation, active perception and learning) and contextualise them in practical applications. We review current computational models mainly based on the simulation and teleological theories, and robotic implementations to identify the limitations of ToM functions in current robotic architectures and suggest a possible future developmental pathway. Finally, we propose future studies to create innovative computational models integrating the properties of the simulation and teleological approaches for an improved adaptive ToM ability in robots with the aim of enhancing human-robot interactions. To achieve this goal, we suggest directing future research towards the modern cross-talk between the fields of robotics and developmental psychology.

Robots improve judgments on self-generated actions: an Intentional Binding Study

Cecilia Roselli, Francesca Ciardo, Agnieszka Wykowska

In near future, robots will become a fundamental part of our daily life; therefore, it appears crucial to investigate how they can successfully interact with humans. Since several studies already pointed out that a robotic agent can influence human's cognitive mechanisms such as decision-making and joint attention, we focus on Sense of Agency (SoA). To this aim, we employed the Intentional Binding (IB) task to implicitly assess SoA in human-robot interaction (HRI). Participants were asked to perform an IB task alone (Individual condition) or with the Cozmo robot (Social condition). In the Social condition, participants were free to decide whether they wanted to let Cozmo press. Results showed that participants performed the action significantly more often than Cozmo. Moreover, participants were more precise in reporting the occurrence of a self-made action when Cozmo was also in charge of performing the task. However, this improvement in evaluating self-performance corresponded to a reduction in SoA. In conclusion, the present study highlights the double effect of robots as social companions. Indeed, the social presence of the robot leads to a better evaluation of self-generated actions and, at the same time, to a reduction of SoA.

Perception of Creative Responses to Moral Dilemmas by a Conversational Robot

Felix Lindner, Laura Wächter, Barbara Kuhnert, Katrin Möllney

Moral HRI is investigating humans' perception and reasoning regarding robots' responses to moral dilemmas. Understanding moral dilemmas as cases of tragedy, we identify creative responses as an alternative to responses based on ethical

principles such as deontology or utilitarianism. We propose a computational procedure based on AI planning that can generate such responses. We report results from an exploratory study to obtain a preliminary understanding of how the character of creative ethical reasoning robots is perceived compared to the more commonly discussed utilitarian and deontological robots.

Creating Context Through Performance: Perception of the "Dancing Droid" Robotic Platform in Variable Valence Interactions in Distinct Office Environments

Erin Berl, Ishaan Pakrasi, Amy LaViers

Operating robots in multiple contexts and environments is currently a challenge, both in functional aspects of design as well as expressive aspects. This paper presents a pilot study using performance and environment to create distinct contexts around the same robotic system. Three distinct environments and three distinct performative interactions with the robot were used to test whether or not individuals experienced the same robotic system differently based on which condition they were exposed to and whether they noticed differences between the distinct scenarios when viewing in series. This study used three observation scenarios (Positive, Negative, and Neutral), combining choreographic design (a human performer's movement and behavior, especially in relation to robots) and interior design (the elements of the physical observation space). This study found that the Positive Scenario robot was most successful as a companion robot, and that the Negative Scenario robot made participants the least comfortable, aligning with the predicted effect. Qualitative feedback provides further insight into why participants rated the robots this way. This work gives an example of how moving the same robot in between new contexts may result in unanticipated expressive characteristics or interpretation by human viewers.

ORAL SESSION III: GAME APPROACHES AND APPLICATIONS TO HRI

WEDNESDAY 27th (15:00 – 16:00)

Playing Rock-Paper-Scissors with RASA: A case study on intention prediction in human-robot interactive games

Ehsan Ahmadi, Ali Ghorbandaei Pour, Alireza Siamy, Alireza Taheri, Ali Meghdari

Interaction quality improvement in a social robotic platform can be achieved through intention detection of the user. In this research, we tried to study the effect of intention detection during a human-robot game scenario. We used our humanoid robotic platform, RASA, and rock-paper-scissors was chosen as our game scenario. In the first step, a Leap Motion sensor and a Multilayer Perceptron Neural Network is used to detect the hand gesture of the human-player. On the next level, in order to study the intention detection effect in our human-robot gaming platform, we implemented two different playing strategies for RASA. One of the strategies was to play randomly, while the other one used Markov Chain model, to predict the next move. Then 32 players with the ages between 20 to 35 were asked to play rock-paper-scissors with RASA for 20 rounds in each strategy mode. Participants did not know about the difference in the robot's decision-making strategy in each mode and the intelligence of each strategy modes and the Acceptance/Attractiveness of the robotic gaming platform were assessed quantitatively through a questionnaire. Finally, 2-sample T-tests indicated a significant difference between the random playing strategy and the other two strategies predicting players' intention during the game.

Virtual or Physical? Social Robots Teaching a Fictional Language Through a Role-Playing Game Inspired by Game of Thrones

Hassan Ali, Shreyans Bhansali, Ilay Köksal, Matthias Möller, Theresa Pekarek-Rosin, Sachin Sharma, Ann-Katrin Thebille, Julian Tobergte, Sören Hübner, Aleksej Logacjov, Ozan Özdemir, Jose Rodriguez Parra, Mariela Sanchez, Nambiar Shruti Surendrakumar, Tayfun Alpay, Sascha Griffiths, Stefan Heinrich, Erik Strahl, Cornelius Weber, Stefan Wermter

In recent years, there has been an increased interest in the role of social agents as language teachers. Our experiment was designed to investigate whether a physical agent in form of a social robot provides a better language-learning experience than a virtual agent. We evaluated the interactions regarding enjoyment, immersion, and vocabulary retention. The 55 participants who took part in our study learned 5 phrases of the fictional language High Valyrian from the TV show Game of Thrones. For the evaluation, questions from the Almere model, the Godspeed questionnaire and the User Engagement Scale were used as well as a number of custom questions. Our findings include statistically significant results regarding enjoyment ($p=0.008$) and immersion ($p=0.023$) for participants with little or no prior experience with social robots. In addition, we found that the participants were able to retain the High Valyrian phrases equally well for both conditions.

Stackelberg Punishment and Bully-Proofing Autonomous Vehicles

Matt Cooper, Jun Ki Lee, Jacob Beck, Joshua D. Fishman, Michael Gillett, Zoë Papakipos, Aaron Zhang, Jerome Ramos, Aansh Shah, Michael L. Littman

Mutually beneficial behavior in repeated games can be enforced via the threat of punishment, as enshrined in game theory's well-known "folk theorem." There is a cost, however, to a player for generating these disincentives. In this work, we seek to minimize this cost by computing a "Stackelberg punishment," in which the player selects a behavior that sufficiently punishes the other player while maximizing its own score under the assumption that the other player will adopt a best response. This idea generalizes the concept of a Stackelberg equilibrium. Known efficient algorithms for computing a Stackelberg equilibrium can be adapted to efficiently produce a Stackelberg punishment. We demonstrate an application of this idea in an experiment involving a virtual autonomous vehicle and human participants. We find that a self-driving car with a Stackelberg punishment policy discourages human drivers from bullying in a driving scenario requiring social negotiation.

Gesture Cues in Navigational Robots: Investigating the Effects of Honesty on People's Perceptions and Performance in a Navigational Game

Joey Verhoeven, Peter Ruijten

As robots have become better in tasks such as motion planning and obstacle avoidance, they will soon face a new challenge: sharing a physical space with humans. This challenge means that robots and humans need to be able to interpret what the other is doing at the moment, and predict what will happen in the near future. In the current study we tested whether people would learn from a robot's navigation behavior while playing a navigational game. The robot was either honest or dishonest in showing its navigational intentions. Results showed differences in people's understanding of the robot's behavior, the perceived human-likeness of the robot, and performance in the game. People also improved their performance throughout the dishonest rounds. These findings can be used in the design of robots that need to function effectively in mixed human-robot environments.

INTERACTIVE SESSION II

WEDNESDAY 27th (16:00 - 16:45)

Lexical Entrainment in Multi-party Human–Robot Interaction

Mitsuhiko Kimoto, Takamasa Iio, Michita Imai, Masahiro Shiomi

This paper reports lexical entrainment in a multi-party human–robot inter-action, wherein one robot and two humans serve as participants. Humans tend to use the same terms as their interlocutors while making conversation. This phenomenon is called lexical entrainment. In the field of human–robot interaction, lexical entrainment has been investigated as a one-to-one inter-action, and it is still unknown how humans entrain to a robot and/or anoth-er human interlocutor in a multi-party interaction. In this study, we investi-gate which participant, a robot or a human, strongly entrains to the other human's lexical choices in a multi-party group interaction. Moreover, we investigate whether witnessing interaction about whether a human is en-trained to a robot affects the entrainment frequency of the other human par-ticipant. We conducted a map navigation task wherein a robot and two hu-mans guide each other by describing icon images on the map. Our results showed that the human participants were lexically entrained to a greater ex-tent to the robot than the human participant in the multi-party interaction. We found no significant effect proving that a human participant witnessing an interaction between a human and a robot would become entrained to the robot on the entrainment frequency of the other human participant.

Hand Gesture Based Gameplay with a Smoothie Maker Game using Myo Armband

Sudhir Sharma, Volker Steuber, Farshid Amirabdollahian

Serious games have the potential to guide the relearning process via encouraging and motivating meaningful interaction. This paper focused on assessing the feasibility of gameplay by performing hand gestures using an off the shelf myoelectric armband to make smoothies in a functional game. The game was designed in Unity3D and interfaced with the wireless Myo Armband as an input device for performing the tasks in game. Based on earlier work on feasibility of incorporating machine-learning based gesture recognition, cylindrical, spherical, and tripod grasps were incorporated into the game. Smoothie Maker game was designed with two versions Game-A \& Game-B. Participants, $(n=20)$, were randomly assigned to an AB or BA group which differs in order of gameplay for the two games. After playing each game, participants offered their insights using the Intrinsic Motivation Inventory (IMI). The results featured multiple parameters including score, time to pick, idle time, as well as gesture recognition accuracy for both game versions. Most outcomes indicated that games A and B did not have a statistically significant difference, but when comparing using gesture accuracy, the two game differed slightly with statistical significance. Analysis of the qualitative IMI survey did not provide a significant difference between the two game versions. Conclusions are drawn from our findings towards improving the games and their recognition accuracy, highlighted for our future work.

A Digital Wooden Tabletop Maze for Estimation of Cognitive Capabilities in Children

Seethu M Christopher, Corrie C. Urlings, Henri van den Bongarth, Karien M. Coppens, Petra P.M. Hurks, Lex Borghans, Rico Möckel

Standardized tests play an important role in assessing a child's cognitive capabilities. The results of such tests are used e.g. in schools and kindergartens to analyze and support the development of the tested child. Unfortunately, with classical standardized tests often only limited information on a child's behavior can be documented even by

a professional observer. Obtaining detailed information would required automated data recording procedures. Also, standardized tests typically rely on well-controlled and thus rather artificial environments. As a result, young children age (e.g. with an age below 7) might not be able to fully understand the test instructions, feel uncomfortable being tested out-side their natural environment, and thus test results become less relevant. Computer-based stealth-assessments that e.g. use a gaming environment to be fun and to hide the assessment from children might present a valid alternative. However, for children of lower age (e.g. below an age of 7) computer-based tests are not easily applicable due to technological boundaries. In this paper we thus explore an alternative approach: physical game devices with a look and feel similar to toys typically provided to children of their age group but that embed the electronics required for computer-based stealth testing. As a result, the game device – in our case a wooden tabletop maze – combines advantages of standardized computer-free and computer-based assessments. The device allows for stealth assessments in less structured environments without creating technological boundaries for the children.

Companion Transporter: A Co-worker in the Greenhouse

Alireza Nemati, Dongjie Zhao, Wanyue Jiang, Shuzhi Ge

Demands to produce food is increasing every day in China, and greenhouses are a part of the solution to solve this problem. The tough condition, long working hours, and working alone in the small greenhouses, makes the work environment more unpleasant compare to many other work fields. In this paper, we present a smart robot for carrying the payloads in the greenhouses. Moreover, the robot is a companion robot and an assistant to the workers. The robot can socially interact with the workers, make conversation with them, answer to the work related questions, and receive orders through voice commands. Social interaction and communication with the robot, make more delightful work environment for the workers, who mostly work alone in a small greenhouse. Main brain of the robot is online and the robot have access to the server through the 4G network. The robot become more intelligent as working in the greenhouse without any need to be-come updated by the users. As well as reducing the mental pressure, the robot decrease the pressure of physical work by carrying the cargos and materials in the greenhouse. The aim of this project is to put a true co-worker in the small green-houses.

Adding a Context: Will It Influence Human-Robot Interaction of People Living with Dementia?

Jorien Hendrix, Yuan Feng, Marieke van Otterdijk, Emilia Barakova

Improving the quality of life of people with dementia in long-term care facilities is very important and can be achieved by designing engaging activities for the residents. The introduction of social robots for people with dementia has already proven its benefits and we expected that adding contextual cues to this interaction would enhance the positive engagement of these individuals. A total of five participants took part in a comparison study in which they engaged in a free-play session with the robot PLEO and in a free-play session with the robot PLEO within a jungle-themed context. The gaze and arm/hand behaviors of the participants were measured and were used to determine the level of their engagement. Contrary to our expectations, we found a significant decrease in engagement for the sessions where the con-text was added to the interaction. Our explanation of this result is that the added cues increased the threshold to interact with the robot, but the elderly were still engaged as spectators.

The impact of a robot game partner when studying deception during a card game

David-Octavian Iacob, Adriana Tapus

Our previous work in detecting deception in HRI was based on research findings from the psychology of inter-human interactions. Nonetheless, these conclusions may or may not be directly applied in HRI, as humans may not behave similarly when deceiving a robot. This paper studies the differences between human physiological manifestations during a deception card game scenario when playing it with a human or a robot partner. Our results show the existence of significant differences between the participants' skin conductance, eye openness, and head pose when playing the game with a robot partner compared to when playing the game with a human partner. These results will then be used to improve the ability of robots to detect deception in HRI.

How a Robot's Social Credibility Affects Safety Performance

Patrick Holthaus, Catherine Menon, Farshid Amirabdollahian

This paper connects the two domains of Human-Robot Interaction (HRI) and safety engineering to ensure that the design of interactive robots considers an effect of social behaviours on safety functionality. We conducted a preliminary user study with a social robot that alerts participants during a puzzle-solving task to an environmental hazard. Our study findings show an indicative trend that users who were interrupted by a socially credible robot are more likely to act and mitigate the hazard than users interrupted by a robot lacking social credibility.

Robostress, a new approach to understanding robot usage, technology, and stress

Kimmo Vänni, Sirpa Salin, John-John Cabibihan, Takayuki Kanda

Robostress is a user's perceived or measured stress in relation to the use of robots. It is an offshoot from techno-stress where a user perceives experience of stress when using technologies. We explored robostress and the related variables. The methods consisted of a cross-sectional survey conducted in Finland, Qatar and Japan among university students and staff members (n=60). The survey data was analyzed with descriptive statistics and a Pearson Correlation Test. The results presented that people perceived stress when or if using the robots and the concept of robostress exists. The reasons for robostress were lack of time and technical knowledge, but the experience of technical devices and applications mitigate robostress.

I`m not playing anymore! A Study Comparing Perceptions of Robot and Human Cheating Behavior

Kerstin Sophie Haring, Kristin Nye, Ryan Darby, Elizabeth Phillips, Ewart de Visser, Chad Tossell

Cheating is a universally salient and disliked behavior. Previous research has shown that a cheating robot dramatically increases perception of its perceived agency. However, this research did not directly compare human cheating to robot cheating. We examined whether the human and the robot were evaluated differently in terms of attribution of mental states and perception of competence, warmth, agency, and capabilities to experience. This study was able to partially recreate the previous study findings [10] showing participants being highly socially engaged with the cheating robot and showing opposition reactions to the cheating action of the robot. However, these reactions were

not observed for the human condition. Additionally, play interactions with the robot were rated as more discomforting compared to the experience with the human player. Finally, it was found that the robot was perceived as less warm, competent, agentic, and able to experience than the human although this could be attributed primarily due to the difference in agents.

Privacy Concerns in Teleoperation: Does Personality Influence What Should Be Hidden?

Sogol Balali, Ross Sowell, William Smart, Cindy Grimm

Advances in robotics technology will bring more teleoperated robots into homes to perform a variety of household tasks. This raises new privacy concerns as the remote operator can control the robot and its camera, and record its sensor data. One way to provide some privacy protection is through on-board processing of the data to filter out sensitive visual information. But what do people want hidden, and how should we hide it? Do the personality traits of a particular user influence that choice? We designed an 85-question survey to help answer these questions and analyzed the data from 81 respondents. We found that people are most concerned about hiding identifiable personal or financial information and valuables from a household robot, and we found that they prefer stronger filters to hide such items. We also found some correlations between a person's familiarity with technology, sociability, and trust and their privacy concerns.

Interactive Robot Learning for Multimodal Emotion Recognition

Chuang YU, Adriana Tapus

Interaction plays a critical role in skills learning for natural communication. In human-robot interaction (HRI), robots can get feedback during the interaction to improve their social abilities. In this context, we propose an interactive robot learning framework using multimodal data from thermal facial images and human gait data for online emotion recognition. We also propose a new decision-level fusion method for the multimodal classification using Random Forest (RF) model. Our hybrid online emotion recognition model focuses on the detection of four human emotions (i.e., neutral, happiness, angry, and sadness). After conducting offline training and testing with the hybrid model, the accuracy of the online emotion recognition system is more than 10% lower than the offline one. In order to improve our system, the human verbal feedback is injected into the robot interactive learning. With the new online emotion recognition system, an accuracy of 12.5% higher than the online system without interactive robot learning is obtained.

Safe human-robot interaction through crowd contact video analysis

Fernando Garcia, Alexandre Mazel, Arturo Cruz Maya

This work proposes a human-like contact management approach, using Pepper robot, which focuses on safety constraints for navigation through cluttered environments. Firstly, we conduct an analytical study to identify the most common undesired physical contacts between humans in crowded scenes. Based on that, a set of recommendations for robot reaction is provided. Special emphasis is given to contact detection and reaction by proposing a sensorless detection method and different body compliance strategies, respectively, that match the safety guidelines proposed. Finally, an experimental validation is conducted in a controlled environment and through user studies.

Robot-Assisted Therapy for the Severe form of Autism: Challenges and Recommendations

Zhansaule Telisheva, Aizada Turarova, Aida Zhanatkyzy, Anara Sandygulova

This paper details research conducted that included a series of Robot-Assisted Therapy (RAT) sessions utilizing a humanoid NAO robot with five children with a severe form of Autism for two weeks. Children aged 4-8 years old attended six 15-minutes sessions that included different types of applications programmed on the robot. The aim of this research was to analyze the effect of RAT for a severe form of ASD children to evaluate the proposed RAT methodology. The cumulative results obtained from the observations and interviews of children's parents showed that participants did not demonstrate significant progress in their social skills. Also, this paper explains the challenges and provides recommendations for further improvements of patient-centered interaction design in the area of RAT.

Evaluating the Valence of Affective Sounds for Robotics Pediatric Health-care

Silvia Rossi, Elena Dell'aquila, Benedetta Bucci

Social Assistive Robots are starting to be widely used in pediatric health-care environments. In this domain, the development of effective strategies to keep the children engaged during the interaction with a social robot is still an open research area. In this direction, some approaches are investigating the combination of distraction strategies, as used in human-human interaction, and the display of emotional behaviours. In this study, we presented the results of a pilot study aimed at evaluating the emotional valence of non-verbal sounds with children. The aim is to select a set of valence validated para-linguistic behaviours to endow the robot NAO with affective sounds. Results show that children aged 3-8 years perceive the robot's behaviours and the related selected emotional semantic free sounds performed by the robot in terms of different degrees of arousal, valence and dominance. However, while children are able to clearly distinguish valence and dominance, arousal is resulted more difficult to assess.

User testing of cognitive training games for people with mild cognitive impairment: Design implications

Mikaela Law, Ho Seok AHN, Bruce MacDonald, Dina-Sara Vajsakovic, Christopher Lee, JongYoon Lim, Craig Sutherland, Kathy Peri, Ngaire Kerse, Elizabeth Broadbent

Mild cognitive impairment (MCI) occurs in older adults whose cognitive decline is greater than in normal aging, and it is a risk-factor for dementia. Cognitive training through games is a potential way to protect against fur-ther decline and delay the onset of dementia. This study investigated the usability and acceptability of a set of cognitive games for people with MCI when delivered on a robotic interface. 10 older adults played a set of cogni-tive games delivered on a robot with a touch-screen. Participants evaluated their experience through questionnaires. Observations of their interaction with the robot were also conducted by the researchers and experts in aged care to get further insight into the usability of these games. Findings demonstrated that both the users and experts believed the games to have po-tential to improve cognition in people with MCI. However, there were many functional issues with the robot that needed improvement including tech-nical difficulties, problems with understanding the robot's speech and lan-guage, and problems for the older adult in using the touch-screen to com-plete the games. This study highlights design considerations for cognitive games for older adults on robotic devices.

Toward robot-assisted psychosocial intervention for children with Autism Spectrum Disorder (ASD)

Vasiliki Holeva, Vasiliki-Aliki Nikopoulou, Maria Papadopoulou, Eleni Vrochidou, George Papakostas, Vassilis Kaburlasos

The effectiveness of social robots in education is typically demonstrated, circumstantially, involving small samples of students [1]. Our interest here is in special education in Greece regarding Autism Spectrum Disorder (ASD) involving large samples of children students. Following a recent work review, this paper reports on the specifications of a protocol for testing statistically the effectiveness of robot (NAO)-based treatment of ASD children comparatively with conventional human (therapist)- based treatment. The proposed protocol has been compiled by the collaboration of a clinical scientific team with a technical scientific team. The modular structure of the aforementioned protocol allows for implementing parametrically a number of tools and/or theories such as the theory-of-mind from psychology; moreover, the engagement of the innovative Lattice Computing (LC) information processing paradigm is considered here toward making the robot more “autonomous”, i.e. more “intelligent”. The experimental application of the proposed protocol is under way; the corresponding results will be reported in a future publication.

Proactive Intention Recognition for Joint Human-Robot Search and Rescue Missions through Monte-Carlo Planning in POMDP Environments

Dimitri Ognibene, Lorenzo Mirante, Letizia Marchegiani

Proactively perceiving others' intentions is a crucial skill that allows humans to effectively interact in unstructured, dynamic and novel environments. This work proposes a first step towards extending the use of robots in search and rescue missions, by allowing them to anticipate human first responders' actions. Predicting the responders' actions, indeed, will enable exploration approaches which will identify and prioritise areas that are more relevant for the responder and, thus, for the task, leading to the development of safer, more robust and efficient joint exploration strategies. More specifically, this paper presents an active intention recognition paradigm to perceive, even under sensory constraints, not only the target's position but also the first responder's movements, which can provide information on his/her intentions (e.g. reaching the position where he/she expects the target to be). This mechanism is implemented by employing an extension of Monte-Carlo-based planning techniques for partially observable environments, where the reward function is augmented with an entropy reduction bonus. We test several configurations of reward augmentation, both information theoretic and not, and belief state approximations an obtain substantial improvements over the basic approach.

ORAL SESSION IV: COLLABORATIVE SR IN THE WORKPLACE AND IN EDUCATION

WEDNESDAY 27th (16:45-18:00)

Collaborative Human-Robot Hierarchical Task Execution with an Activation Spreading Architecture

Bashira Akter Anima, Janelle Blankenburg, Mariya Zagainova, S. Pourya Hoseini Alinodehi, Muhammed Tawfiq Chowdhury, David Feil-Seifer, Monica Nicolescu, Mircea Nicolescu

This paper addresses the problem of human-robot collaborative task execution for hierarchical task plans. The main contributions are the ability for dynamic allocation of tasks in human-robot teams and opportunistic task execution given different environmental conditions. The human-robot collaborative task is represented in a tree structure which consists of sequential, non-ordering, and alternative paths of execution. The general

approach to enable human-robot collaborative task execution is to have the robot maintain an updated, simulated version of the human's task representation, which is similar to the robot's own controller for the same task. Continuous peer node message passing between the human's and the robot's task representations enables both to coordinate their task execution, so that they perform the task given its required execution constraints and they do not both work on the same task component. To validate the architecture, a tea-table task scenario is designed with overlapping and non-overlapping sub-tasks between a human and a Baxter robot.

A Human Factor approach to HRI

Susanne Frennert

In today's competitive marketplace, robotics and HRI is an exciting new paradigm for changing how work is done in organisations. Its po-tential success depends on how HRI fit to humans and other technologies in an organisation. The paper argues that the Human-Technology-Organisation framework may be used as an analytic tool to widen the understanding of prerequisites for successful development, implementation and deployment of HRI in organisations as well as for evaluations of exist-ing HRI applications at work. This paper describes the Human-Technology-Organisation (HTO) framework, and ties it to HRI. It helps the reader to see HRI as a situated, local enactment involving diverse users, formal and in-formal rules and practices. Furthermore, it de-centers technology as the main agent of change. The aim of the paper is to provoke reflection and discus-sion about HRI, that through subtle interactions between humans, robots and organizsations influence the quality of its development, implementation and deployment.

Teaching Persian Sign Language to a Social Robot via Learning from Demonstrations Approach

Seyed Ramezan Hosseini, Alireza Taheri, Ali Meghdari, Minoo Alemi

This paper proposes a novel framework for teaching sign language to RASA, a humanoid teaching assistant social robot. The ultimate goal was to design a user friendly process, by which the RASA robot could learn new signs from non-expert users. In the proposed method, user would wear a motion capture suit and perform a sign for multiple times. Then, a set of parallel Hidden Markov Models had been trained to encode each sign. Later, by utilizing a special mapping from user's workspace to the robot's joint space, the collision avoidance and sign's comprehensibility was ensured. At the end, the performance of the system was assessed by teaching 10 signs of Persian Sign Language (PSL) to the robot and asking the familiar and unfamiliar participants with PSL to score the robot's performance as well as their viewpoints regarding the using of social robots in teaching sign languages.

Natural Teaching of Robot-Assisted Rearranging Exercises for Cognitive Training

Antonio Andriella, Alejandro Suárez Hernández, Javier Segovia-Aguas, Carme Torras, Guillem Alenyà

Social Assistive Robots are a powerful tool to be used in patients' cognitive training. The purpose of this study is to evaluate a new methodology to enable caregivers to teach cognitive exercises to the robot in an easy and natural way. We build upon our existing framework, in which a robot is employed to provide encouragement and hints while a patient is physically playing a cognitive exercise. In this paper, we focus on empowering the caregiver to easily teach new board exercises to the robot by providing positive examples. The proposed learning method has two main advantages i) the teaching procedure is human-friendly ii)

the produced exercise rules are human-understandable. The learning algorithm is validated in 6 exercises with different characteristics, correctly identifying and representing the rules from a few examples.

Static and Temporal Differences in Social Signals Between Error-Free and Erroneous Situations in Human-Robot Collaboration

Dito Eka Cahya, Rahul Ramakrishnan, Manuel Giuliani

The capability of differentiating error situations from error-free situations in human-robot collaboration is a mandatory skill for collaborative robots. One of the variables that robots can analyse to differentiate both situations are the social signals from the human interaction partner. We performed an extensive human-robot collaboration user study involving 50 participants in which the robot purposefully executed erroneous behaviours. We annotated the occurrences and the duration of multimodal social signals from the participants during both error-free situations and error situations using an automatic video annotation method based on OpenFace. The result of the analysis shows that our participants express more facial expressions, head gestures, and gaze shifts during erroneous situations than in error-free situations. The duration of the facial expressions and gaze shifts is also longer during error situations. Our results additionally show that people look at the robot and the table with a longer duration and look at the objects with a shorter duration in error situations compared to error-free situations. The results of this research are essential for the development of automatic error recognition and error handling in human-robot collaboration.

ORAL SESSION V: ROBOTS AT HOME AND AT PUBLIC SPACES

THURSDAY 28th (10:00 - 11:15)

Now I need help! Passing doors and using elevators as an Assistance Requiring Robot

Jonathan Liebner, Andrea Scheidig, Horst-Michael Gross

The ability to handle closed doors and elevators would extend the applicability of Socially Assistive Robots (SAR) enormously. In this paper, we present a new approach which integrates uninstructed persons as helpers to open doors and to call and to operate elevators. The current implementation status of these two abilities into a robotic application developed for real-world scenarios together with first experimental results obtained are presented below.

Mobile Assistive Robot in an Inclusive Space: the MARIS Project

Yesenia Aquilina, Michael A. Saliba, Simon G. Fabri

Elderly or infirm persons who live alone may encounter difficulties in carrying out the instrumental activities of daily living. Often such persons who would pre-fer to live independently are forced to rely on outside assistance from family, friends, or social workers, or possibly even to leave their homes. A potential ap-proach to address this social issue involves the use of an assistive robot to pro-vide help within the home. However the challenges involved in achieving a satis-factory robot design for reliable operation within the typically unstructured do-mestic environment remain difficult to meet. To date, attempts reported in the lit-erature to mitigate this problem by developing a more amenable home environ-ment – a robot-inclusive space – remain sparse and preliminary. In this work, a new systematic engineering approach is taken to address this problem. A struc-tured data collection exercise has been carried out with

samples of older adults and of associated allied healthcare professionals to first identify those regular tasks within the home that are typically problematic for the elderly. These tasks are then analyzed to extract those specific steps, movements and performance skills that could benefit from facilitation through a combined approach of envi-ronment-redesign and robot assistance. A new conceptual design for a robot-inclusive kitchen has been generated, and an associated prototype six-degree-of-freedom tele-operated domestic robot has been designed and constructed.

Should a robot guide like a human? A qualitative four-phase study of a shopping mall robot

Päivi Heikkilä, Hanna Lammi, Marketta Niemelä, Kathleen Belhassein, Guillaume Sarthou, Antti Tammela, Aurélie Clodic, Rachid ALAMI

Providing guidance to customers in a shopping mall is a suitable task for a social service robot. To be useful to customers, the guidance needs to be intuitive and effective. We conducted a four-phase qualitative study to explore what kind of guidance customers need in a shopping mall, which characteristics make human guidance intuitive and effective there, and what aspects of the guidance should be applied to a social robot. We first interviewed staff working at the information booth of a shopping mall and videotaped demonstrated guidance situations. In a human-human guidance study, ten students conducted seven way-finding tasks each to ask guidance from a human guide. We replicated the study setup to study guidance situations with a social service robot with eight students and four tasks. The robot was controlled using Wizard of Oz technique. The characteristics that make human guidance intuitive and effective, such as estimation of the distance to the destination, appropriate use of landmarks and pointing gestures, appear to have the same impact when a humanoid robot gives the guidance. Based on the results, we identified nine design implications for a social guidance robot in a shopping mall.

Identifying Social Context Factors Relevant for a Robotic Elderly Assistant

Birgit Lugrin, Astrid Rosenthal-von der Pütten, Svenja Hahn

Social robots are envisioned to support elderly people in their daily lives. To interact in a socially competent way with its users a Robotic Elderly Assistant (REA), just as any other social robot, should consider the full social context of the situation in which it is interacting. In this paper, we investigate how to identify important factors that are relevant to distinguish social situations. Our study aims at determining social context factors that are important for a REA to consider when deciding when and how to deliver a message. Therefore, we describe the creation of video-based stimuli that were used in an interview study with senior users (n=8). Our results suggest that the content of the message and certain factors of the social situation are important for the decisions of elderly users. They can serve as a basis for future studies that will further investigate social context modelling.

Improving the interaction of Older Adults with Socially Assistive Robots for Table setting

Samuel Olatunji, Noa Markfeld, Dana Gutman, Shay Givati, Vardit Sarne-Fleischmann, Tal Oron-Gilad, Yael Edan

This study provides user-studies aimed at exploring factors influencing the interaction between older adults and a robotic table setting assistant. The influence of the level of automation (LOA) and level of transparency (LOT) on the quality of the interaction were considered. Results revealed that the interaction effect of LOA and LOT significantly influenced the interaction. A lower LOA which required the user to control some of the actions of the robot influenced the older adults to

participate more in the interaction when the LOT was low compared to situations with higher LOT (more information) and higher LOA (more robot autonomy). Even though the higher LOA influenced more fluency in the interaction, the lower LOA encouraged a more collaborative form of interaction which is a priority in the design of robotic aids for older adult users. The results provide some insights into shared control designs which accommodates the preferences of the older adult users as they interact with robotic aids such as the table setting robot used in this study.

ORAL SESSION VI: APPLICATIONS IN HEATH DOMAIN

THURSDAY 28th (12:00-13:00)

Getting Acquainted for a Long-Term Child-Robot Interaction

Mike Ligthart, Mark A. Neerincx, Koen Hindriks

We are developing a social robot that should autonomously interact long-term with pediatric oncology patients. The child and the robot need to get acquainted with one another before a long-term interaction can take place. We discuss the results of a user study (N = 75, 8-11 y.o.) evaluating robot behaviors in a getting acquainted interaction. Specifically, we are exploring whether the children successfully got acquainted with the robot and to what extend the children bonded with the robot. Results show that children effectively picked up how to talk to the robot. This is important, because the better the performance the more comfortable the children are, the more socially attractive the robot is, and the more intimate the conversation gets. The evaluation furthermore revealed that it is important for children, in order to get familiar with the robot, to have shared interests with the robot. Finally, most children did initiate a bond with the robot.

Use of robotics in the German healthcare sector: Application scenarios - drivers and barriers - time savings

Marija Radic, Agnes Vosen, Birgit Graf

Assistance robots have a large potential to support patients and staff in out-patient and inpatient settings. Despite the need and large potential, the diffu-sion of robotic applications in the German healthcare sector is only slowly picking up pace. The objective of this study is to shed some light on the rea-sons and identify measures that support involved stakeholders in closing this gap in the upcoming years. Using an online survey, we addressed more than 150 clinics and nursing service providers throughout Germany with respect to the benefit of different robot application scenarios, drivers and barriers for the introduction of service robots in healthcare settings as well as esti-mated time savings. Concerning possible application areas, disinfection and cleaning robots are currently perceived to have the highest benefit, whereas the value of robots to support personal hygiene is considered rather low. The greatest drivers for using robot assistants in healthcare settings are their po-tential to save time for the staff as well as to increase employer attractiveness and higher efficiency in processes. The most frequently cited barriers are fi-nancing, data protection, legal obstacles and the importance of human con-tact. For three selected scenarios: assistance robots as guides, lifting robots and activation and communication robots, we further asked for the expected time savings. The results show differences between clinics as well as inpa-tient and outpatient nursing services. In order to accelerate the diffusion of robot assistants in Germany, several implications have to be considered: Ac-ceptance and experience are positively correlated i.e. from a political stand-point, research programs are needed to support joint development of robot assistants by research, industry and end users. Legal and financial barriers should be reduced. For manufacturers,

creating testing possibilities and close interaction with potential users for the identification of adequate scenarios and clarifying legal questions could prove to be beneficial in terms of a higher acceptance in the market.

In Their Own Words: A Companion Robot for Detecting the Emotional State of Persons with Parkinson's Disease

Andrew Valenti, Meia Chita-Tegmark, Michael Gold, Theresa Law, Matthias Scheutz

In typical human interactions emotional states are communicated via a variety of modalities such as auditory (through speech), visual (through facial expressions) and kinesthetic (through gestures). However, one or more modalities might be compromised in some situations, as in the case of facial masking in Parkinson's disease (PD). In these cases, we need to focus the communication and detection of emotions on the reliable modalities, by inferring emotions from what is being said, and compensate for the modalities that are problematic, by having another agent (e.g., a robot) provide the missing facial expressions. We describe the initial development stage of a robot companion that can assist the communication and detection of emotions in interactions where some modalities are totally or partially compromised. Such is the case for people living with Parkinson's disease. Our approach is based on a Latent Dirichlet Allocation topic model as a principled way to extract features from speech based on a trained classifier that can be linked to measures of emotion. The trained model is integrated into a robotic cognitive architecture to perform real-time, continuous speech detection of positive, negative, or neutral emotional valence that is expressed through the facial features demonstrated of a humanoid robot. To evaluate the integrated system, we conducted a human-robot interaction experiment in which the robot credibly detected and displayed emotions as it listened to utterances spoken by a confederate. The utterance were directly extracted from interviews with people with Parkinson's Disease. The encouraging results will form the basis for further developments of finer prediction models to be employed in a companion robot for persons with PD.

Train With Me: A Preliminary Study Comparing a Socially Assistive Robot and a Virtual Agent for a Rehabilitation Task.

Valentina Vasco, Cesco Willemse, Pauline Chevalier, Davide De Tommaso, Valerio Gower, Furio Gramatica, Vadim Tikhanoff, Ugo Pattacini, Giorgio Metta, Agnieszka Wykowska

Long-term motor deficits affect approximately two thirds of stroke survivors, severely reducing their quality of life. An effective rehabilitation therapy requires intense and repetitive training, which is highly resource demanding. Virtual Agents (VAs) and Socially Assistive Robots (SARs) have the potential to offer high intensity, repetitive and reproducible therapy and are thus both promising as rehabilitation tools. In this paper, we compare a SAR and a VA during a rehabilitation task in terms of users' engagement and movement performance, while leveraging neuroscientific methods to investigate potential differences at the neural level. Results show that our participants' performance on the exercise was higher with a SAR than with a VA, which was especially clear under conditions of decreased perceptual information. Our participants reported higher levels of engagement with the SAR. Taken together, we provide evidence that SARs are a favorable alternative to VAs as rehabilitation tools.

ORAL SESSION VII: TECHNICAL INNOVATIONS IN SR

THURSDAY 28th (14:00-15:15)

Teaching commonsense and dynamic knowledge to service robots

Stephan Opfer, Stefan Jakob, Kurt Geihs

Incorporating commonsense and coping with dynamic knowledge are key capabilities of service robots to efficiently interact with humans. In the presented system, we demonstrate how to equip service robots with commonsense knowledge and the dynamic reasoning capabilities of Answer Set Programming (ASP). We investigated the response of our system to basic human needs and evaluated the viability and scalability of the combination of the commonsense knowledge database ConceptNet\,5 and the ASP solver Clingo. Our results show the flexibility and versatility of our approach. Further, we identified the need for research on scalability in case of environments that are abundant with objects.

A Robot Math Tutor that Gives Feedback

Koen Hindriks, Sander Liebens

We report on our exploratory design and study of a robot math tutor that can provide feedback on specific errors made by children solving basic addition and subtraction problems up to 100. We discuss two interaction design patterns for speech recognition of answers when children think aloud and for providing error-specific feedback. We evaluate our design patterns and whether our feedback mechanism motivates children and improves their performance at two primary schools with children ($N=41$) aged $7-9$. We did not find any motivational or learning effects of our feedback mechanism but lessons learnt include that the robot can execute our interaction design patterns autonomously, and advanced algorithms for error classification and adaptation to children's performance levels in our feedback mechanism are needed.

Learning to gesticulate by observation using a deep generative approach

Unai Zabala, Igor Rodriguez, José María Martínez-Otzeta, Elena Lazkano

The goal of the system presented in this paper is to develop a natural talking gesture generation behavior for a humanoid robot, by feeding a Generative Adversarial Network (GAN) with human talking gestures recorded by a Kinect. A direct kinematic approach is used to translate from human poses to robot joint positions. The provided videos show that the robot is able to use a wide variety of gestures, offering a non-dreary, natural expression level.

Towards using social cues for acceptable, human-aware robot navigation

Noelia Fernández Coleto, Eduardo Ruiz Ramírez, Frederik Haarslev, Leon Bodenhagen

The introduction of service robots to our daily life requires adaptation of the current navigation strategies. In the presence of humans, robots must be designed to ensure their safety and comfort. This paper proposes a layered costmap architecture that incorporates social norms to generate trajectories compatible with human preferences. The implemented framework creates a social abstraction of the environment – in the form of an occupancy grid – to plan human-friendly paths. It employs information about individuals in the scene to model their personal spaces. In addition, it uses predicted human trajectories to improve the efficiency and legibility of the robot trajectory. Different simulation scenarios resembling everyday situations have been used to evaluate the proposed framework. The results of the experiments have demonstrated its ability to behave according to social conventions. Furthermore, the navigation system was assessed in real life experiments where it was proved capable of following similar paths to those performed by humans.

No Need to Scream: Robust Sound-based Speaker Localisation in Challenging Scenarios

Tze Ho Elden Tse, Daniele De Martini, Letizia Marchegiani

This paper is about speaker verification and horizontal localisation in the presence of conspicuous noise. Specifically, we are interested in enabling a mobile robot to robustly and accurately spot the presence of a target speaker and estimate his/her position in challenging acoustic scenarios. While several solutions to both tasks have been proposed in the literature, little attention has been devoted to the development of systems able to function in harsh noisy conditions. To address these shortcomings, in this work we follow a purely data-driven approach based on deep learning architectures which, by not requiring any knowledge neither on the nature of the masking noise nor on the structure and acoustics of the operation environment, it is able to reliably act in previously unexplored acoustic scenes. Our experimental evaluation, relying on data collected in real environments with a robotic platform, demonstrates that our framework is able to achieve high performance both in the verification and localisation tasks, despite the presence of copious noise.

ORAL SESSION VIII: EMERGING TOPICS IN SR

THURSDAY 28th (15:45-17:00)

Privacy, Utility, and Cognitive Load in Remote Presence Systems

Jeffrey Klow, Jordan Proby, Matthew Rueben, Ross Sowell, Cindy Grimm, William Smart

As robotics technology improves, remotely-operated telepresence robots will become more prevalent in homes and businesses, allowing guests, business partners, and contractors to visit and accomplish tasks without being physically present. These devices raise new privacy concerns: a telepresence robot may be used by a remote operator to spy on the local area, or recorded video may be viewed by a third party. Video filtering is one method of reducing spying ability while still allowing the remote operator to perform their task. In this paper, we examine the effects of three different visual conditions (filters) on the remote operator's ability to discern details while completing a navigation task. We found that applying such filters protected privacy without significantly affecting the operator's ability to perform the task, and that a depth image filter was the most effective privacy protector. We also found that the cognitive load of driving the robot has a slight privacy-protecting effect.

Optimal Use Of Verbal Instructions For Multi-Robot Human Navigation Guidance

Harel Yedidsion, Jacqueline Deans, Connor Sheehan, Mahathi Chillara, Justin Hart, Peter Stone, Raymond J. Mooney

Efficiently guiding humans in indoor environments is a challenging open problem. Due to recent advances in mobile robotics and natural language processing, it has recently become possible to consider doing so with the help of mobile, verbal robots. In the past, stationary verbal robots have been used for this purpose at Microsoft Research, and mobile non-verbal robots have been used at UT Austin in their multi-robot human guidance system. This paper extends that mobile multi-robot human guidance research by adding the element of natural language instructions, which are dynamically generated based on the robots' path planner, and by implementing and testing the system on real robots. Generating natural language instructions from the robots' plan opens up a variety of optimization opportunities such as deciding where to place the robots, where to lead humans, and where to verbally instruct them. We present experimental results of the full multi-robot human guidance system and show that it is more effective than two baseline systems: one which only provides

humans with verbal instructions, and another which only uses a single robot to lead users to their destinations.

Understanding Intentions: Detection of Human-Object Interactions in Video Streams

Lilli Bruckschen, Sabrina Amft, Julian Tanke, Juergen Gall, Maren Bennewitz

The detection of human-object interactions is a key component in many applications, examples include activity recognition, human intention understanding or the prediction of human movements. In this paper, we propose a novel framework to detect such interactions in RGB-D video streams based on spatio-temporal and pose information. Our system first detects possible human-object interactions using position and pose data of humans and objects. To counter false positive and false negative detections, we calculate the likelihood that such an interaction really occurs by tracking it over subsequent frames. Previous work mainly focused on the detection of specific activities with interacted objects in short prerecorded video clips. In contrast to that our framework is able to find arbitrary interactions with 510 different objects exploiting the detection capabilities of R-CNNs as well as the Open Image dataset and can be used on online video streams. In the experimental evaluation, we demonstrate the robustness of our of the approach on various published videos recorded in indoor environments. The system achieves precision and recall rates of 0.82 on this dataset. Furthermore, we also show that our system can be used for online human motion prediction in robotic applications.

What Makes a Good Robotic Advisor?

Raul Paradeda, Maria José Ferreira, Raquel Oliveira, Carlos Martinho, Ana Paiva

The display of different levels of assertiveness by a robot can be an essential factor in determining the way it is perceived and the extent to which it can influence its' users. To gain more knowledge about the persuasive abilities of social robots, we devised an interactive storytelling scenario, in which users had to make several decisions while being persuaded by two autonomous robots (each one displaying low, high or neutral levels of assertiveness). To evaluate how different levels of assertiveness had an effect in the decision-making process of participants, we conducted a user study (n=61) in which we measured participants' perceptions of the robots, the valence of their emotional state and level of assertiveness. Our findings revealed that users' perception of assertive robots significantly differed from their initial expectations about robots in general, and that robots displaying personality (versus those not displaying), were able to influence participants by making them change their decisions during the storytelling task.

Online Evaluation of Text to Speech Systems for three Social Robots

Fernando Alonso Martin, Maria Malfaz, Álvaro Castro-González, José Carlos Castillo, Miguel A. Salichs

The success of social robots is mainly based on their capacity for interaction with people. In this regard, verbal and non-verbal communication skills are essential for social robots to get a natural human-robot interaction. This paper focuses on the first of them since the majority of social robots implement a Text to Speech system. We present a comparative study of 8 off-the-shelf systems used in social robots where 125 participants evaluated the performance of the systems. The results show that, in general, the participants detect differences between the Text to Speech systems, being able to determine which are the more intelligible, expressive, and artificial ones. Besides, the participants also conclude that there are some systems more suitable than others depending on the physical appearance of the robots.

WORKSHOPS

WS1	The Communication Challenges in Joint Action for Human-Robot Interaction
WS2	Perspectives on human-aware navigation
WS3	Self-coaching tools for conducting responsible research and innovation (RRI) with social robots
WS4	Quality of Interaction in Socially Assistive Robots (QISAR)
WS5	Experimental and Integrative Approaches to Robo-ethics (EIAR 2019)
WS6	Robots in the Wild: from the lab, field and showrooms to real-world experiences in social robotics

WS1 - The Communication Challenges in Joint Action for Human-Robot Interaction

An important area of social robotics is devoted to design robotic agents able to establish interpersonal interactions with humans, so they can work together as a team to perform a joint action. In order to do that, social robotics have taken inspiration from a psychology and philosophy of mind to explore multiple psychological devices and abilities that are required to achieve joint actions. Some of these mechanisms underpinning human interactions aim at establishing communication, so the participants can receive and provide reliable information they can use to coordinate to achieve their common goal.

These communicative skills open up a group of questions, especially when they are posed in the context of human-robot interaction. How do humans integrate such a diverse array of communicative skills? What desiderata are required for establishing communication in joint action? Are there differences between the communicative skills necessary for conversations and those necessary for joint action? Are the differences between verbal and non-verbal communication important for HRI? Which can be applied to the domain of human-robot interaction? Does the actual state of robotic regarding communication allow to improve the necessary condition for joint actions for HRI?

The aim of this workshop is to establish an interdisciplinary debate on the challenge that communication supposes for joint action in the context of human-robot interaction. As part of "toward a framework for Joint Action" series (fja.sciencesconf.org), it aims to give philosophers, psychologists and roboticists a venue to discuss and share their knowledge and questions regarding the notion of communication during robot-human interaction.

WS2 - Perspectives on human-aware navigation

As robots are becoming better at navigating in dynamic environments, their operating areas start to include humans. Furthermore, there exist more and more robots with a dedicated social task involving humans. With these developments, robots need to acquire skills for sharing a physical

space with humans. This includes navigating in a human-friendly way and adhering to social rules. As a minimum, robots need to take the personal space of humans into account and respect social distances. In psychology there is a broad discipline studying social distances, called proxemics. It is relevant to investigate how robots can take our personal space into account. Several studies have investigated the relation between personal space and comfortable approach distances of a robot with varying results. From a more technological perspective, several navigational algorithms have been developed that take humans into account.

The main goal of the current workshop is to bring researchers within the field together to allow them to share their view on the topic. Furthermore, several different perspectives of human-aware navigation will be highlighted to try and find the common ground. This includes a psychological perspective on proxemics and human-aware navigation, and also a more technological perspective focusing on human-aware navigation algorithms. Additionally, there will be focus on a perspective on experimental research where human-robot proxemics is investigated. Lastly, the aim is an overview paper together with the attendants of the workshop on the different perspectives of human-aware navigation and publish this in a relevant journal.

WS3 - Self-coaching tools for conducting responsible research and innovation (RRI) with social robots

Innovating is about creating and transforming the future of society. However, to ensure a desirable future for humanity, innovation needs to be responsible. The Responsible Research and Innovation (RRI) framework guides all the societal actors involved in research and innovation (R&I) processes towards reflecting upon the consequences of their research for society. One of the most challenging aspects of being able to put into practice RRI, however, is HOW TO specifically implement it in everyday R&I practices.

Our workshop has an eminently practical structure. The main focus is to provide attendees with a series of tools based on auto-coaching techniques that will empower them to be able to conduct self-guided RRI in a very short period of time (half-day session). Also, we aim at developing together with the participants a series of guidelines useful to the social robots' research community to conduct RRI. The workshop will also provide room for short paper presentations on the topic of conducting RRI with social robots.

This half-day workshop will focus on the quality of interaction in socially assistive robots. Robots are entering our everyday lives, which brings about human-robot interactions across in diverse settings including private homes, workplaces, health care centers, schools, and public spaces. To facilitate successful interaction between humans and robots, it is essential that the interaction between robots and their users be of high quality; not only to ensure that the interaction is natural for the users but also to prevent misunderstandings by the users with potential harm as a result.

WS4 - Quality of Interaction in Socially Assistive Robots (QISAR)

This half-day workshop will focus on the quality of interaction in socially assistive robots. Robots are entering our everyday lives, which brings about human-robot interactions across in diverse settings including private homes, workplaces, health care centers, schools, and public spaces. To facilitate successful interaction between humans and robots, it is essential that the interaction between robots and their users be of high quality; not only to ensure that the interaction is

natural for the users but also to prevent misunderstandings by the users with potential harm as a result.

The workshop aims to be a forum for discussion on what defines the quality of interaction from a range of different perspectives. It will be an opportunity to discuss methodologies and approaches to achieve a high quality of interaction, as well as how to combine different qualitative and quantitative metrics for a general evaluation of interaction between SAR and their users. This workshop aims to enhance our knowledge of the quality of human-robot interactions to lead better HRI.

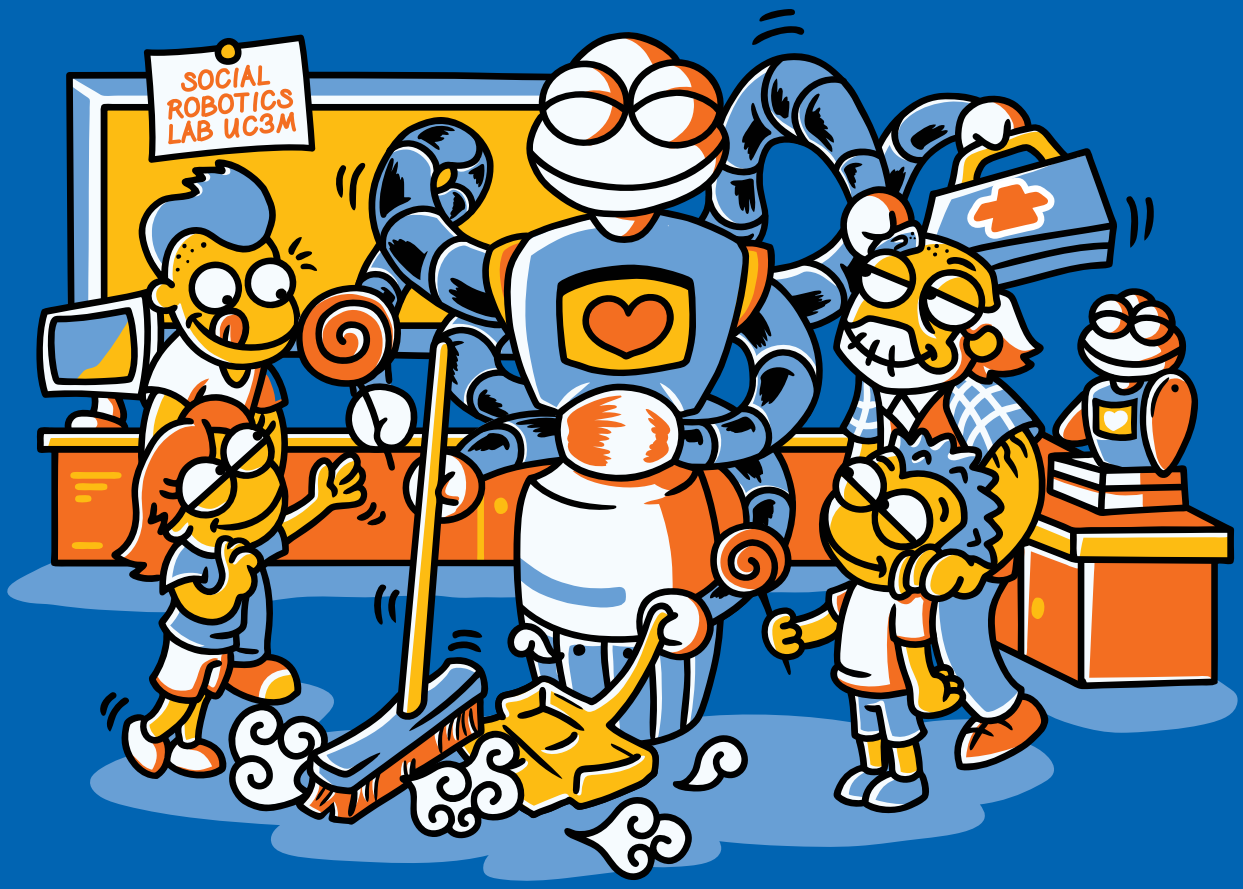
WS5 - Experimental and Integrative Approaches to Robo-ethics (EIAR 2019)

The development and diffusion of social robots gives increasingly rise to ethical and legal concerns related to, e.g., responsibility assignments in cooperative tasks, implementation of moral rules in robots, possible dual uses and misuses of artificial agents, unintended modifications of social, cognitive, emotive and communication abilities in humans interacting with robots. The urgency of developing effective ethical inquiries related to these issues leads specialists to acknowledge the need to overcome classical approaches, based exclusively on philosophical analysis. Emerging trends are incorporating, within the frameworks of ethical inquiries on social robots, a series of methods, tools and scenarios defining empirical research in Social Robotics and HRI.

The main goal of the Experimental and Integrative Approaches to Robo-ethics (EIAR 2019) workshop is to discuss possibilities, limits and ways of this new orientation, with a specific focus on the role that experiments can play in addressing ethical and legal issues concerning (social) human-robot interaction. To this end the workshop will propose a number of presentations illustrating concrete pioneering experimental and integrative approaches in Robo-ethics, and stimulate structured discussion directed to their development, improvement and diffusion. The ultimate aspiration is to activate the process of constitution of an interdisciplinary community engaged in the development of a well-defined research line in Experimental and Integrative Robo-ethics.

WS6 - Robots in the Wild: from the lab, field and showrooms to real-world experiences in social robotics

The aim of this full-day workshop is to bring together researchers who work with robots in real-world settings, as opposed to laboratory settings, with particular focus on those who work on ethnographic and in-the-wild studies. Together, we will identify usability and design issues for the future social robots and the scientific and technological barriers towards successful innovation. In addition to oral and poster presentations of accepted abstracts, the workshop will include keynote presentations and panel discussions. By the end of the workshop, we aim to lay the foundations to generate ethical and legal guidelines for deploying such robots in various social settings.



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