UAEU

جامعة الإمارات العربية المتحدة
United Arab Emirates University

جامعة نيويورك أبوظبي
NYU ABU DHABI

2nd JOINT UAE SYMPOSIUM ON SOCIAL ROBOTICS - JSSR2016

United Arab Emirates University
New York University Abu Dhabi

20-23 November 2016

CONFERENCE BOOKLET

THE FUTURE IS HERE

A future in which robots will be our social companions and will assist us in many of our activities is quickly approaching. To get ready for tomorrow, a new kind of integrated research is gaining unprecedented traction: the study of interactions between humans inspires the development of more sophisticated autonomous agents, scaffolding the creation of the next generation of social robots. At the same time, the study of interactions between intelligent social machines and people provides insights into human social cognition and can inform and validate the explanatory and predictive models advanced by the social sciences.

SOCIAL ROBOTICS

Social robotics connects these two trends, bringing together expertise from different scientific and technological areas such as human-robot interaction, software engineering, artificial intelligence, social and cognitive psychology, the behavioral and brain sciences, social cognition theory, cognitive philosophy and philosophical psychology. Various approaches to cognitive robotics, including developmental, evolutionary, embodied/situated, and “soft” robotics build on the results achieved in these areas.

THE SECOND JSSR

The United Arab Emirates is quickly emerging as an international hub for innovation. As such, it is committed to foster the progress in robotics, to assess its impact on the life of the people, and to support civil projects that can bring the greatest benefits to society. United Arab Emirates University (UAEU) and New York University Abu Dhabi (NYUAD) have joined forces in organizing the “2nd Joint UAE Symposium on Social Robotics” (JSSR2016) as part of “Innovation Week 2016”. This event features a multidisciplinary program that brings together renowned developers, roboticists, and social scientists from across the globe to discuss the state of the art in social robotics. Join the multi-site event, be part of the group of experts, share your research, check out new robot technology, and discuss the latest innovations in the field.

THEMATIC AREAS

The thematic sessions of the symposium will cover the following domains:

- Social cognition models and their implementation for human-robot interaction: neuro-robotics and artificial neural networks; theory of mind and simulation theory; narrative-practice hypothesis; enactive theory, interaction theory, and participatory sense-making; mirror neurons and embodied simulation; artificial consciousness and awareness; the frame problem, sensitivity to context, and social decision making.
- Social psychological aspects of human-robot interaction: anthropomorphism; mind attribution, perception of agency and goal recognition; intentions and emotions identification; biases and stereotype formation.
- Non-verbal communication and embodied/enactive models of the mind: applications of the embodied/enactive/interactive theory to developmental, evolutionary, and situated robotics; implementation of embodied communication through gaze, touch, gesture.
- Robots in education, tourism, and entertainment industry: narrative practices; teaching methodologies; learning through interaction; gamification; imagination, creativity, and procedural art; skill acquisition and exercise; machine learning.
- Robots in healthcare and assistive technologies: cognitive models of autism and other behavioral syndromes; robot therapy; tele-presence; sensors and diagnostic software; domotics, lifestyle, and mental health.
- Robot ethics and machine ethics: algorithmic solutions to moral dilemmas; autonomous agents and responsibility; formalization of codes of conduct; moral and legal obligations towards artificial companions; public policy, self-regulation of the developers, and good practices.
- The social impact of robotics: future trends in the job market and technological unemployment; trust; expertise and automation; public policy and autonomous agents; AI in public administration and e-finance; robots, smart cities, and the Internet of things.

CONFERENCE PROGRAM

The program of the symposium is available on our mirror websites:
http://conferences.uaeu.ac.ae/jssr2016/en/
https://wp.nyu.edu/aimlab/

REGISTRATION

There is no participation fee for attending the event, but registration is mandatory. Bus transportation between Al Ain city and Abu Dhabi will be offered to the registered participants. Certificates of participation will be provided to the attendees. To register, please send an e-mail to the following address, indicating your name, institutional affiliation, contact information, and the days you will attend:
SocialRoboticsUAE@uaeu.ac.ae

LOGISTICS AND HOSPITALITY

The UAE is a premier destination for tourism and business and offers the most modern infrastructures and hotels. Daily flights connect the airports of Abu Dhabi and Dubai with all major cities in the world. The four-day event is going to be held at UAEU campus in the oasis city of Al Ain (approximately 75 minutes away by car from both Abu Dhabi and Dubai) and at NYUAD in Abu Dhabi (the UAE capital, situated on the coast at 75 minute drive from both Dubai and Al Ain). Bus transfer between Al Ain City and Abu Dhabi will be offered to all participants during the conference. The UAE is a peaceful, safe, cosmopolite, culturally vibrant, and very fast growing society. It aims to represent a model of tolerance, progress, and stability for the Middle East. November, with its weather comparable to a warm Spring in Europe, is the best time for a visit. Contact us to ask further questions: SocialRoboticsUAE@uaeu.ac.ae

INVITED PAPERS

Hoda Alkhzaimi (NYUAD, Engineering Division)
Fady Al Najjar (UAEU, College of IT)
Mohammed Alotaibi (Tabuk University)
Christoph Bartneck (University of Canterbury)
John-John Cabibihan (University of Qatar)
Angelo Cangelosi (University of Plymouth)
Robb Cheek (Hyundai Motor Company – Investment Securities)
Ron Chrisley (University of Sussex)
Michael Decker (Karlsruhe Institute of Technology)
Jorge Dias (Khalifa University)
Mohamad Eid (NYUAD, Engineering Division)
Friederike Eyssel (Bielefeld University)
Francesco Ferro (Pal Robotics)
Dan Hutto (University of Wollongong)
Lojain Jibawi (Votek)
Lulu Hamdan & Sanad Shaikh (Amana Heathcare)
Amit Kumar Pandey (Softbank Research / Aldebaran)
Ben Robins (University of Hertfordshire)
Giulio Sandini (Italian Institute of Technology)
Rob Sparrow (Monash University)
Jun Tani (Korean Institute of Science and Technology)
Steve Torrance (University of Sussex)

SUBMITTED PAPERS

Ahmad Bany Younes (Khalifa University)
Paulo Ferreira (University of Coimbra)
Yasmina Jraissati (American University of Beirut)
M. Jawad Hashim (UAEU, College of Medicine and Health Sciences)
Nadia Hussain (Al Ain University of Science and Technology)
Gonçalo Martins (University of Coimbra)
Peer Mohamad Muhamed Ali (Al Ain Hospital)
Mohammed Randeree (UAEU, College of Engineering)
Luís Santos (University of Coimbra)

ORGANISING COMMITTEE

Abduljaleel Alwali (UAEU Philosophy Department)
Max Cappuccio (UAEU Philosophy Department and UAEU Interdisciplinary Cognitive Science Lab
Mohamad Eid (NYU Engineering Division)
Simon Langford (UAEU Philosophy Department)
Shawqi Kharbash (UAEU Science & Innovation Park)
Gunjan Khera (UAEU Philosophy Department and UAEU Interdisciplinary Cognitive Science Lab)
Mohammed Madi Yusif (UAEU Science & Innovation Park)

SCIENTIFIC COMMITTEE

Massimiliano Cappuccio (United Arab Emirates University)
Mohamad Eid (New York University Abu Dhabi)
Friederike Eyssel (Bielefeld University

PARTNERS

Amana HealthCare
NYU Institute
Pal Robotics
SoftBank Robotics – Aldebaran
UAE University Science & Innovation Park
Votek

PROGRAM OF JSSR2016

Sunday, November 20th 2016 (Venue: F3 Building, UAEU)

Time	Description
08:00	Welcome Reception & Registration
09:00	Welcome by academic authorities and opening remarks by the organizers TBA Mohamad Eid (NYUAD, Engineering Division)
First Thematic Session (9:25-15:10): "Embodied & Enactive Approaches to Robotics" Chair: Max Cappuccio	
9:25	Keynote: Giulio Sandini (IIT) *Humanizing Robots (and the three laws of robotics)*
10:10	Keynote: Daniel Hutto (Wollongong) *Knowing Others Though Anticipation and Interaction: Learning the Right Lessons From and For Social Robotics*
10:55	Keynote: Angelo Cangelosi (Plymouth) *From Babies to Robots: Developmental Robotics for Embodied Language Learning*
11:40	First Exhibition and Demonstrations session. Featuring: AIMlab - New York University Abu Dhabi, PAL Robotics, Shadow Robot, UAEU Media Lab, Votek, and others.
12:20	Lunch
13:20	Keynote: Steve Torrance (Sussex) *Artificial social agents in a world of conscious beings*
14:05	First Roundtable: "Why do robots need a body?" - Chair: Mohamad Eid. With: Max Cappuccio, Angelo Cangelosi, Ron Chrisley, Dan Hutto, Giulio Sandini, Steve Torrance
14:50	Coffee break
Afternoon session (15:10 - 16:10) - Chair: Mohamad Eid	
15:10	Presentation: Ahmed Bani Yunes (KUSTAR) *Robotics-Based Experimentation to Demonstrate and Emulate Spacecraft Maneuvers*
15:40	Presentation: Mohammed Randeree (UAEU) *Survey of University Engineering Student's Opinions on Ethical Issues in Social and Autonomous Robotics*
16:10	Closing remarks and end of the first day of the symposium

Monday, November 21st 2016 (Venue: F3 Building, UAEU)

Time	Description
08:00	Welcome Reception & Registration
Second Thematic Session (9:00-13:50): "Anthropomorphism in Human-Robot Interaction" Chair: Ben Robins	
9:00	Presentation: Friederike Eyssel (Bielefeld) *Robots as Social Agents: Getting in touch and getting out of touch with robots*
9:30	Keynote: Rob Sparrow (Monash) *Robots, racism, and representation*
10:10	Presentation: Christoph Bartneck (Canterbury) *How human are robots and how robotic are humans?*
10:40	Coffee break
11:00	Keynote: Michael Decker (KIT) *Service Robots are on their way? Some thoughts from an interdisciplinary Technology Assessment*
11:40	Keynote: Robb Cheek (Hyundai) *Social robots: These are the droids you're looking for*
12:20	Lunch
13:20	Second Roundtable: "How anthropomorphic should robots be?". Chair: Eyssel. With: Christoph Bartneck, Robb Cheek, Michael Decker, Ben Robins, Rob Sparrow, Jun Tani.
Third Thematic Session (13:50-16:30): "Robotics in Medicine and Healthcare" Chair: Fady AlNajjar	
13:50	Presentation: M Jawad Hashim (UAEU) *eHealth applications for robotics: challenges in social robotics for healthcare*
14:20	Keynote: Lulu Hamdan & Sanad Shaikh (Amana Healthcare) *Robotics and communication technology for people with disabilities*
15:00	Second Exhibition & Demonstrations session. Featuring: Amana Healthcare and others.
15:30	Presentation: Mohammed Alotaibi (Tabuk University) *A potential social robotics children diabetes management and educational system for Saudi Arabia: System architecture*
16:00	Presentation: Peer Mohamad Muhamed Ali (Al Ain Hospital) - *Robotics in Rehabilitation*
16:30	Closing remarks and end of the second day of the symposium
18:30	Reception and social dinner at Mercure Grand, Jabel Hafeet
20:30	Bus transfer to Abu Dhabi

Tuesday, November 22nd 2016 (Venue: Conference Center, NYUAD)

Time	Description
08:00	Welcome Reception & Registration
09:00	Welcome by academic authorities and opening remarks by the organizers TBA Mohamad Eid (NYUAD, Engineering Division), Max Cappuccio (UAEU, CHSS)
Fourth Thematic Session (9:20-13:20): "Theories of Conscious AI" Chair: Mohamad Eid	
9:20	Keynote: Jun Tani (KAIST) *How can we develop 'deep minds' of robots?*
10:05	Keynote: Ron Chrisley (Sussex) *Human Responsibility, Robot Mind: Conceptual Design Constraints for Social Robots*
10:50	Coffee break
11:10	Presentation: Yasmina Jraissati (American University of Beirut) *Color Categories in Context*
11:40	Third Roundtable: "What is the best cognitive architecture for social AIs?". Chair: Mohamed Eid. With: Ron Chrisley, Jorge Dias, Dan Hutto, Giulio Sandini, Jun Tani, Steve Torrance
12:20	Lunch
Fifth Thematic Session (13:20-15:40): "GrowMeUp: new advances in machine learning" Chair: Boumediene Belkhouche	
13:20	Presentation: Jorge Dias (KUSTAR) *The "GrowMeUp" project: robotic technologies for societal innovations and challenges*
13:45	Presentation: Luis Santos (Coimbra) *Random Sampling Learning: Social Robots Learning User Behaviour Routines*
14:10	Coffee break
14:30	Presentation: Gonçalo Martins (Coimbra) *User Modeling for User-Adaptive Social Robots*
14:55	Presentation: Paulo Ferreira (Coimbra) *The Challenge of Bringing Social Robots to Society*
15:20	Keynote: Francesco Ferro (Pal Robotics) *Making robots social at PAL Robotics*
15:50	Tour of the laboratories with Mohamad Eid (NYUAD) *Bringing Touch to Human Computer Interaction: a guided interactive tour of NYUAD laboratories*
16:50	Closing remarks and end of the third day of the symposium

Wednesday, November 23rd 2016 (Venue: Conference Center, NYUAD)

Time	Description
08:00	Welcome Reception & Registration
Sixth Thematic Session (9:00-13:25): "Social Robots for Autism" Chair: Friederike Eyssel	
09:00	Keynote: Ben Robins (Hertfordshire) *Robots as a therapeutic tool: Encouraging social interaction skills in children with autism*
9:45	Presentation: Fady AlNajjar (UAEU) *Robotic Therapy for Developing Social Skills in Kids with Autism*
10:25	Third Exhibition and Demonstrations Session
11:05	Keynote: John-John Cabibihan (Qatar) *Social Robots and Wearable Sensors as Assistive Tools for Autism Intervention*
11:50	Presentation: Nadia Hussain (Al Ain University of Science and Technology) *The Use of Robots to Enhance Interaction among Autistic Adolescents – observations from a social interaction study*
12:20	Lunch
Seventh Thematic Session (13:20-16:20): "Robotics Industry and Tomorrow's Society" Chair: Jorge Dias	
13:20	Keynote: Amit Kumit Pandey (Softbank) *From Artificial Intelligence towards Social Intelligence of Robots, the ultimate need but a grand R&D challenge: an industrial perspective*
14:00	Presentation: Hoda Alkhazaimi (NYU) *TBA*
14:30	Coffee break
14:50	Fourth Roundtable: "How social robots will create new jobs in UAE". Chair: Jorge Dias. With: Mohammed Alotaibi, Hoda Alkhzaimi, John-John Cabibihan, Robb Cheek, Mohamad Eid, Amit Kumit Pandey.
15:30	Closing remarks and end of the symposium

BOOK OF ABSTRACTS

INVITED PAPERS

A Potential social robotics children diabetes management and educational system for Saudi Arabia: System architecture

Mohammed Alotaibi (University of Tabuk)

The diagnosis and management of Diabetes type 1 (Children diabetes) is often a complicated process. Recent mobile health technologies are increasingly used in improving the self-management of chronic diseases such as diabetes and several studies have proven its efficiency. Further, research has shown that increased awareness of the disease helps the diabetics to effectively manage their disease and consequently reduce the complications arising due to diabetes. In this paper, an innovative social robotic children diabetes management and educational system for diabetic children in Kingdom of Saudi Arabia is presented. The presented system makes use of Aisoy1 v5 robot in parallel with mobile health technologies. The aim of the system is to improve the diabetes type 1 management with children and to empower them with relevant knowledge about disease management to improve their awareness about the disease in Saudi Arabia. The proposed system presented in this paper will be tested and evaluated extensively in a randomized controlled trial in Saudi Arabia.

Dr. Mohammed Muteb Saad Alotaibi is Assistant Professor at the faculty of computers and information technology, University of Tabuk, Tabuk, Saudi Arabia, where he is currently serving as Vice-dean of the quality and development unit at the deanship of scientific research. He is Reviewer at *International Journal of Computers and Applications* (Calgary, Canada), and developer and founder of various applications and programs for healthcare, such as Sukkari application (www.sukkari.net), SHAMS application (www.thehypertension.net), and Pregnant application (www.7amel.info).

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Robotic Therapy for Developing Social Skills in Kids with Autism

Fady AlNajjar (UAE University)

Autism results from unknown complex neural disorders in early brain development. Kids with autism experience difficulties in motor-coordination, attention, and therefore, social interaction and communications. Early intervention with effective behavioral therapies can contribute significantly in preliminary brain development and recovery speed. Current medical treatments for Autism have limited successful rate and has not been significantly improved since the last 10 to 15 years. Our idea is to combine information technology to support such medical limitation. In the recent years, social-robotics received unprecedented welcome especially in the world of children with Autism. The reason is due to that autistic children are more comfortable looking and dealing with a robot than a human therapist, who carries out naturally complex behaviors and volatile emotions. We are targeting building a novel bio-inspired social robot that can provide an effective therapy and social communication to children with Autism. Our humanoid-robot will first target to win the attention of the child, since the attention is the key factor to stimulate the child mirror neurons, the source of social development in human being. Second, we will target the motor coordination training of the autistic children through the robot. Our unique project is multi-leveled designed systems that will handle various aspects such as: communication, body-movements, evaluation, and continuality. We believe that our project has a great potential not only to enhance the lives of those who struggle with Autism, but also to solve an important issue in the ecumenical aspects to Autism treatment in UAE.

Fady S. Al-Najjar is assistant professor of Computer Science and Software Engineering at the College of IT of UAE University. He is also a visiting research scientist at the Intelligent Behavior Control Unit, BSI, RIKEN. He received a M.S. degree from the Department of Human and Artificial Intelligence System at the University Of Fukui, Japan (2007), and a Dr. Eng. degree in System Design Engineering from the same university in 2010. Over the past 3 years, he was interested in brain modeling in aim to understand higher-order cognitive

mechanisms. Recently, he started to study motor learning and adaptation from the sensory and muscle synergies perspective in order to suggest practical applications for neural-rehabilitations.

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How human are robots and how robotic are humans?

Christoph Bartneck (University of Canterbury)

Robots are being perceived as human-like and the borderline between what is a human and what is a robot becomes increasingly blurred. I will present several studies that try to explore the boundaries between what we dare to do with robots and humans.

Dr. Christoph Bartneck is an associate professor and director of postgraduate studies at the HIT Lab NZ of the University of Canterbury, New Zeland. He has a background in Industrial Design and Human-Computer Interaction, and his projects and studies have been published in leading journals, newspapers, and conferences. His interests lie in the fields of Social Robotics, Design Science, and Multimedia Applications. He has worked for several international organizations including the Technology Centre of Hannover (Germany), LEGO (Denmark), Eagle River Interactive (USA), Philips Research (Netherlands), ATR (Japan), and The Eindhoven University of Technology (Netherlands). Christoph is an associate editor of the International Journal of Social Robotics and the International Journal of Human Computer Studies.

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Social Robots and Wearable Sensors as Assistive Tools for Autism Intervention

John-John Cabibihan (Qatar University)

Autism Spectrum Disorder (ASD) is a complex developmental disability that causes problems with social interaction and communication. Available statistics indicate that in the UK, one child out of 100 children may have ASD. In the USA, the prevalence rate is one out of 68 children while in South Korea, it is one out of 38. In Qatar, the prevalence rate is not yet available, but we found that there has been an increase of 250% in the number of centres for special needs in the past 10 years. In this talk, I will present our analysis of over 20 social robotic platforms used for autism therapy worldwide. These platforms offer evidence that social robots can elicit imitation, eye contact, joint attention, turn-taking, emotion recognition, self-initiated interactions, and triadic interactions during therapy sessions. I will discuss and show some of the videos of the experiments and innovations from our lab to demonstrate that social robots can indeed be useful as assistive tools for the therapy of children with ASD. During the

talk, I will run a live demonstration of wearable sensors that can detect physiological signals and I will elaborate how these sensors could be useful as early warning detectors for impending meltdowns in children on the spectrum.

John-John Cabibihan received the Ph.D. degree in bioengineering from Scuola Superiore Sant'Anna, Pisa, Italy, in 2007. Concurrent with his Ph.D. studies, he received an international scholarship grant in 2004 from the Ecole Normale Sup rieure de Cachan, France. Therein, he spent one year with the Laboratoire de M canique et Technologie. From 2008 to 2013, he was an Assistant Professor with the Electrical and Computer Engineering Department, National University of Singapore, where he also served as the Deputy Director of the Social Robotics Laboratory and an Affiliate Faculty Member with the Singapore Institute of Neurotechnologies. He is currently an Associate Professor with the Mechanical and Industrial Engineering Department, Qatar University. He is Lead/Co-Lead Principal Investigator of several projects National Priorities Research Projects of Qatar Foundation's National Research Fund. He was mentor of the Qatar National Team for the 2014-2016 Microsoft Imagine Cup (Innovation Category). Prof. Cabibihan is active in conference organisations. He was the General Chair of the 6th IEEE International Conference on Cybernetics and Intelligent Systems (Manila, 2013), the Program Chair of the International Conference on Social Robotics (ICSR) 2012 in Chengdu, China, and ICSR 2016 in Kansas City, USA, and the Program Co-Chair of ICSR 2010 (Singapore). He also serves at the editorial boards of several international journals. Over the years, his work has been focused toward assistive and social robotics for the therapy of children with autism, lifelike prosthetics, bioinspired tactile sensing, and human-robotic touch and gestures. His innovative works have been featured by the British Broadcasting Corporation (BBC), MIT Technology Review, PhysOrg, New Scientist, Popular Science, Discovery News, and locally at the front pages of The Peninsula Qatar.

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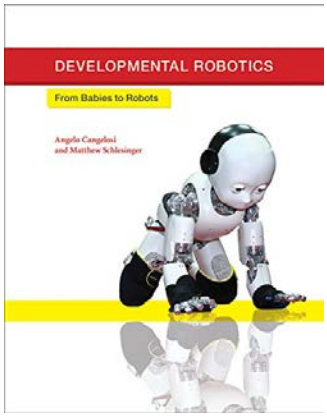
From Babies to Robots: Developmental Robotics for Embodied Language Learning

Angelo Cangelosi (University of Plymouth)



Growing theoretical and experimental research on action and language processing and on number learning and gestures clearly demonstrates the role of embodiment in cognition and language processing. In psychology and neuroscience this evidence constitutes the basis of embodied cognition, also known as grounded cognition (Pezzulo et al. 2012; Borghi & Cangelosi 2014). In robotics, these studies have important implications for the design of linguistic capabilities in cognitive agents and robots for human-robot communication, and have led to the new interdisciplinary approach of Developmental Robotics (Cangelosi & Schlesinger 2015). During the talk we

will present examples of developmental robotics models and experimental results from iCub experiments on the embodiment biases in early word acquisition and grammar learning (Morse et al. 2015), experiment on the pointing and finger counting in number learning (De La Cruz et al. 2014) and on mental imagery and rotation (Seepanomwan et al. 2015). The presentation will also discuss the implications for the symbol grounding problem (Cangelosi, 2012) and how embodied robots can help addressing the issue of embodied cognition and the grounding of symbol manipulation use on sensorimotor intelligence.

References

Cangelosi A, Schlesinger M (2015). *Developmental Robotics: From Babies to Robots*. Cambridge, MA: MIT Press.

Cangelosi A. (2012). Solutions and open challenges for the symbol grounding problem. *International Journal of Signs and Semiotic Systems*, 1(1), 49-54 (with commentaries)

De La Cruz V., Di Nuovo A., Cangelosi A., Di Nuovo S. (2014). Making fingers and words count in a cognitive robot. *Frontiers in Behavioral Neuroscience*, 8, 13.

Morse A., Belpaeme T, Smith L, Cangelosi A. (2015). Posture affects how robots and infants map words to objects *PLoS ONE*, 10(3)

Borghi A.M., Cangelosi A. (2014). Action and language integration: From humans to cognitive robots. *Topics in Cognitive Science*, 6, 344–358.

Pezzulo G., Barsalou L.W., Cangelosi A., Fischer M.H., McRae K., Spivey M. (2013). Computational grounded cognition: A new alliance between grounded cognition and computational modelling. *Frontiers in Psychology*, 6(612), 1-11.

Seepanomwan K., Caligiore D., Cangelosi A., Baldassarre G. (2015). Generalization, decision making, and embodiment effects in mental rotation: A neurorobotic architecture tested with a humanoid robot. *Neural Networks*, 7:31-47.

Angelo Cangelosi is Professor of Artificial Intelligence and Cognition and the Director of the Centre for Robotics and Neural Systems at Plymouth University (UK). Cangelosi studied psychology and cognitive science at the Universities of Rome La Sapienza and at the University of Genoa, and was visiting scholar at the University of California San Diego and the University of Southampton. Cangelosi's main research expertise is on language grounding and embodiment in humanoid robots, developmental robotics, human-robot interaction, and on the application of neuromorphic systems for robot learning. He currently is the coordinator of the UK EPSRC project "BABEL: Bio-inspired Architecture for Brain Embodied Language" (2012-2016) and of the EU H2020 Marie Skłodowska-Curie European Industrial Doctorate "APRIL: Applications of Personal Robotics through Interaction and Learning" (2016-2019). He also is Principal investigator for the ongoing projects "THRIVE" (US Air Force Office of Science and Research, 2014-1018), the FP7 projects POETICON++ and ROBOT-ERA, and the Marie Curie projects SECURE, DCOMM, ORATOR and DECORO. He was coordinator of the ITALK Integrating project and the RobotDoc ITN. Overall, he has secured over £15m of research grants as coordinator/PI. Cangelosi has produced more than 250 scientific publications, and has chaired numerous workshops and conferences including the IEEE ICDL-EpiRob

2011 and 2013 Conferences (Frankfurt 2011, Osaka 2013). In 2012-13 he was Chair of the IEEE Technical Committee on Autonomous Mental Development. Cangelosi is Editor (with K. Dautenhahn) of the journal *Interaction Studies*, and in 2015 was Editor-in-Chief of *IEEE Transactions on Autonomous Development*. His latest book "Developmental Robotics: From Babies to Robots" (MIT Press; co-authored with Matt Schlesinger) was published in January 2015.

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Social robots: These are the droids you're looking for

Robert Cheek (HMC Investment Securities – Hyundai Motor Company)

For the most part, business, academia, and the media have traditionally defined and created social robots as an embodiment of technology, typically in a humanoid form. In order to interact with humans, robots built for social purposes typically have a face and an upper torso, with arms and hands, but lack legs, due to the inherent challenges in making robots walk like humans. With the advent of technologies such as embodied and disembodied personal assistants (in the form of such products as Jibo and Siri), as well as the growth of other autonomous systems, we see the emergence of a new phenomenon called robotization. Alongside this new paradigm shift in social robotics, we must reconsider the ways in which we think of social robots. The robotization of the world will bring about tectonic changes, not unlike those that accompanied the computerization of the world. Robotics technologies will soon be integrated into everything, much like computers were in the recent past. We are in the earliest stage of the Robotics Internet of Things (RIoT) era. If someone today were to ask someone born in 1916 what a computer was, they would most likely define it in terms of a room, or something that was situated on a desk. Someone born in 1916 would perhaps describe it at something that can be placed on the lap that enables a user to process data at previously impossible rates. In contrast, a person born in 1956 might say that computers are ubiquitous, cheap, and integrated into areas that had been unthinkable only a decade ago. The smart home, smart devices, and wearables are all items that until very recently we would not have described as computers. The social role of computers came about through the rise of intelligent assistants, social media, new entertainment forms (such as eSports), and networked cloud-based co-working. We are now seeing this take place in robotics, in the form of elderly care robots, entertainment robots (such as Anki), robot fighting, Formula E racing, and the newest type of flying robot to emerge, the racing drone. Drone racing at some levels is actually a kind of test bed for robots that can operate at very high speeds, in much the same way as Formula One racing serves as a proving ground for cutting-edge automotive technologies. The emergence of autonomous systems in high-speed drones will give rise to a new breed of aerial robots that will interface with ground-based robots, as well as other robots in the RIoT ecosystem, to handle challenges that current systems find difficult or impossible. The new face of social robotics has cultural and societal implications that the public and private sectors must prepare for to ensure optimum outcomes for all.

Robert Cheek is the robotics analyst for HMC Investment Securities, the investment-banking arm of the Hyundai Motor Group. He is also the Head of Business Development for UVify, a Silicon Valley-based developer of drones, autonomous vehicle technologies, and artificial intelligence systems. Cheek spearheaded the GoCart project, an autonomous medical and elderly care logistics robot while Director of Business Development at Korea's Yujin Robot. He was also head of business development at aerobotX, a Germany-based startup building autonomous airships. Mr. Cheek has published a number of research reports about robotics for investors, as well as articles for various media outlets. Cheek holds an MBA from the Helsinki School of Economics, and a BA from the University of Florida. In addition, Mr. Cheek attended Cambridge University and holds several licenses and certifications, including a Project Management Certificate from Stanford University.

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Human Responsibility, Robot Mind: Conceptual Design Constraints for Social Robots

Ron Chrisley (University of Sussex)

Advances in social robot design will be achieved hand-in-hand with increased clarity in our concepts of responsibility, folk psychology, and (machine) consciousness. 1) Since robots will not, in the near future, be responsible agents, avoiding some moral hazards (e.g., that of abdication of responsibility) will require designs that assist in tracing complex lines of responsibility backwards from outcomes, through the robot, and back to the appropriate humans and/or social institutions. 2) An intuitive understanding by human users of the (possibly quite alien) perceptual and cognitive predicament of robots will be essential to improving cooperation with them, as well as assisting diagnosis, robot training, and the design process itself. Synthetic phenomenology is the attempt to combine robot designs with assistive technologies such as virtual reality to make the experience-like states of cognitive robots understandable to users. 3) Making robot minds more like our own would be facilitated by finding designs that make robots susceptible to the same (mis-)conceptions concerning perception, experience and consciousness that humans have. Making a conscious-like robot will thus involve making robots that find it natural to believe that their inner states are private and non-material. In all three cases, improving robot-human interaction will be as much about an increased understanding of human responsibility, folk psychology and consciousness as it will be about technological breakthroughs in robot hardware and architecture.

Ron Chrisley is Reader in Philosophy in the School of Engineering and Informatics at the University of Sussex. He received a Bachelors of Science in Symbolic Systems, with honours and distinction, from Stanford University in

1987. He was an AI research assistant at Stanford, NASA, and Xerox PARC, and investigated neural networks for speech recognition as a Fulbright Scholar at the Helsinki University of Technology and at ATR Laboratories in Japan. In 1997 he received a DPhil in Philosophy from the University of Oxford, and in 1992 he took up a lectureship in Philosophy in the School of Cognitive and Computing Sciences at the University of Sussex. From 2001-2003 he was a Leverhulme Research Fellow in Artificial Intelligence at the School of Computer Science at the University of Birmingham. Since 2003 he has been the director of the Centre for Research in Cognitive Science (COGS) at the University of Sussex, where he is also on the faculty of the Sackler Centre for Consciousness Science.

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Service Robots are on their way? Some thoughts from an interdisciplinary Technology Assessment

Michael Decker (Karlsruhe Institute of Technology)

Service-Robotic - mainly defined as "non-industrial robotics" - is identified as the next economical success story to be expected after robots have been ubiquitously implemented into industrial production lines. Under the heading of service-robotic we found a widespread area of applications reaching from robotics in agriculture and in the public transportation system to service robots applied in private homes. In order to reach this robots need to be “social” and the configuration and the design of the human-machine interface becomes more crucial. Co-operation or substitution becomes a central question. Interdisciplinary Technology Assessment takes the human user/worker as common focus asking if, - and if yes - how far human actors can be replaced by robots. In this presentation a comprehensive interdisciplinary framework is introduced, which allows to scrutinize some of the most relevant applications of service robotics; a combination of technical, economical, legal, philosophical/ethical and psychological perspectives enables a thorough and comprehensive expert based technology assessment. This allows us to understand the potentials as well as the limits and even the threats connected with the ongoing and the planned implementation of service robots into human lifeworld - particularly of those technical systems displaying increasing grades of machine learning and autonomy.

Michael Decker is Institute director and Professor of Technology Assessment at the Institute of Philosophy of Karlsruhe Institute of Technology (KIT), where he is also Head of division II "Computer science, economy and society". Since November 2009 he is professor for Technology Assessment at the Institute of Philosophy at KIT, working on Concepts of Technology Assessment, Methodology of interdisciplinary research, and TA of Robotics and Nanotechnology. He is spokesperson for the "Topic Key Technologies and Innovation Processes" in the Helmholtz Program "Technology, Innovation and

Society". He is chairman of the Advisory Board "Technik und Gesellschaft" (Technology and Society) of the VDI. He is Head of the Advisory Board "Innovation- and Technology Analysis" of the Federal Ministry of Education and Research. He is spokesperson of the Netzwerk Technikfolgenabschätzung (NTA).

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The "GrowMeUp" project: robotic technologies for societal innovations and challenges

Jorge Manuel Miranda Dias (Khalifa University)

The research community has been gradually pushing technologies in order to address the problems of an ageing society. In the specific case of robotics, albeit numerous projects and initiatives have been put forward, few to none have succeeded in having an actual functional robot (beyond the classic "*Skype on Wheels*"). From a technology's perspective, realistically the fact remains, multi-purpose robotic technologies are not yet mature enough to free roam on people's homes, but the research community is working determinately for it. Moreover, there is the need to overcome the barriers of the suspicious human nature when it comes to robots with the slightest degree of autonomy in their decisions. In this talk we present the GrowMeUp European project that is responsible for integrating different innovative science and technologies into an affordable mobile robotic platform. The project addresses specific domain problems associated to the transference of robots into society, testing technology acceptance, user adaptiveness, safety, security and performance. GrowMeUp's main aim is developing an affordable ICT Robotics framework to be deployed at elderly houses in order to increase the years of independent and active living, and the quality of life of older persons with light physical or mental problems, that live alone and lack the motivation for daily activities and/or social tasks. To reach this goal, the project's highlighted innovations are as follows: Multi-modality behavior understanding, Intelligent Dialogue Management, Adaptive Decision Making using Multi-modality Input, an Affordable Service Robot and Cloud based ICT-Services for Reliable and Smarter Service Robots. A consortium of several partners that includes Universities, Companies and non-profitable associations of End-Users develop the project. University of Coimbra specifically contributes to multi-modal behavior learning and adaptive decision-making. Our research focuses on generative learning algorithms capable of optimizing procedures to efficiently learn from continuous streams of multi-modal data, which span from the classical examples of facial and speech recognition to user preferences and other cloud-derived data. Perceiving information is but one side of the problem, whereas we aim to endow the robotic platform with the ability to process the information and, based on a user profile model, propose a set of actions (or services) that will comply with the specificities of that particular user's needs and requirements. On top of the aforementioned scientific and technological developments, we are addressing one additional technological/societal challenge: how to transfer the GrowMeUp solution from laboratories and controlled environment to general use on society? Developers

and end-users speak differently and have different sets of skills when it comes to interact with technology. In GrowMeUp we are proposing a systematic methodology, which gradually moves technology from the laboratories to people's homes, with intermediate stages of verification and validation, which are suitable for different types of user categories.

Jorge Manuel Miranda Dias is Professor at the ECE/Robotics Institute of Khalifa University and at the Institute of Systems and Robotics of University of Coimbra. Jorge Dias has a Ph.D. in Electrical Engineering by the University of Coimbra, Portugal, specialization in Control and Instrumentation. Jorge Dias has been professor at the Department of Electrical Engineering and Computers (www.deec.uc.pt) and researcher from the Institute of Systems and Robotics (ISR) (www.isr.uc.pt) from the University of Coimbra (UC) (www.uc.pt). Jorge Dias research is in the area of Computer Vision and Robotics and has contributions on the field since 1984. Jorge Dias coordinates the research group for Artificial Perception for Intelligent Systems and Robotics (http:://ap.isr.uc.pt) of Institute of Systems and Robotics from University of Coimbra and the Laboratory of Systems and Automation (http://las.ipn.pt) from the Instituto Pedro Nunes (IPN) (www.ipn.pt) - a technology transfer institute from the University of Coimbra, Portugal.

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Bringing Touch to Human Computer Interaction: a guided interactive tour of NYUAD laboratories

Mohamad Eid (New York University Abu Dhabi)

Haptics technology has changed the way humans interact with computers and each other via computers. Incorporating the sense of touch into human computer interaction has opened a new era of interactive applications ranging from medical simulations and rehabilitation to entertainment and social interaction. This presentation will give an overview of the latest developments at the Applied Interactive Multimedia Research Laboratory (AIMLab) of New York University Abu Dhabi. Several projects will be introduced such as the Haptogram system (a contact-less 3D tactile display technology), Affective Haptics system (a system to communicate emotions via touch), Haptic Learning tool (haptics for teaching Arabic language handwriting), and Haptic dental simulation for teaching periodontal procedures.

Mohamad Eid received the PhD in Electrical and Computer Engineering from the University of Ottawa, Canada, in 2010. He is currently an assistant professor of electrical engineering at New York University Abu Dhabi (NYUAD). He was previously a teaching and research associate at the University of Ottawa from June 2008 until April 2012. He is the co-author of the book: "Haptics Technologies: Bringing Touch to Multimedia", Springers 2011, the co-chair of the 3rd International IEEE Workshop on Multimedia Services and Technologies for E-health (MUST-EH 2013), technical chair

for the Haptic-Audio-Visual Environment and Gaming (HAVE) workshop in 2013. He is the recipient of the best paper award of DS-RT 2008 conference and the prestigious ACM Multimedia 2009 Grand Challenge Most Entertaining Award for "HugMe: Synchronous Haptic Teleconferencing" System. He has more than 75 conference and journal publications and 4 patents. His academic interests include multimedia haptics, affective haptics, and tangible human computer interaction for assistive living.

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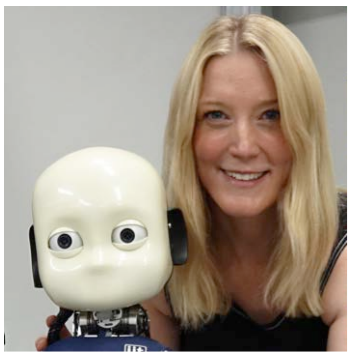
Robots as Social Agents: Getting in touch and getting out of touch with robots

Friederike Eyssel (Bielefeld University)

The talk focuses on key psychological aspects that contribute to the perception of robots as social agents: To illustrate this notion, we will first present experimental studies on effects of social touch and real versus imagined contact with the robot NAO on attitudes towards social robots. These findings show that implementing touch in human-robot interaction may backfire, while imagining contact with robots before actual HRI might serve a valuable psychological function: That is, by means of a brief imagination intervention, attitudes toward robots can likely be increased, so that successful and positive HRI can be initiated. This is particularly relevant in light of the fact that in near future, social robots will be deployed in many areas, e.g., in elderly care and in home contexts. At the same time, resentiments against robots are still widespread. Therefore, the second part of the talk will focus on the psychological consequences of „negative" HRI. That is, we will shed light on psychological processes, such as self-dehumanization, showing that people perceive it immoral to ostracize a robot. Importantly, this even leads to self-dehumanization after particpants had ostracized a robot. These results replicates findings on human-human social exclusion. We interpret this as evidence that robots are indeed perceived as thinking and feeling social agents. Implications for research in psychology and social robotics will be discussed.



Dr. Friederike Eyssel is Full Professor of Applied Social Psychology and Gender Research at Center of Excellence Cognitive Interaction Technology (CITEC) at Bielefeld University, Germany, where she heads the Applied Social Psychology and Gender Research Lab. Dr. Eyssel is interested in various research topics ranging from social robotics, social agents, and ambient intelligene to attitue change, prejudice reduction and sexual objectification of women. Crossing disciplines, Dr. Eyssel has published vastly in the field of social psychology, human-robot interaction and social robotics and serves as a reviewer for > 20 journal. Current third-party funded research projects (DFG, BMBF, FP7) address user experience and smart home technologies, and ethical aspects associated with assistive technology.

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Making robots social at PAL Robotics

Francesco Ferro (PAL Robotics)

It is a fact that robots will become part of our future and this requires that robots become social. PAL Robotics has the mission of creating robots that can provide services in our daily life taking care of tasks that nobody does and thus increasing the quality of life. To make direct interactions between robots and people successful, robots need to have social skills. This means recognizing faces and speech, interacting through verbal and non-verbal communications, making robots safe and user-friendly, among others. PAL Robotics has put a lot of efforts in improving the social behavior of all the robots developed. Our service robots have been designed to interact with people in events, fairs, conferences, domestic environments and collaborative industrial settings.

Besides, it is very important to push R&D in robotics' social if we want them to become an integral part of our daily life. One example of this is the SocSMCs project, a research where PAL Robotics participates, framed in the Future Emerging Technologies (FET) call of the European Commission's H2020 program. SocSMCs project aims to investigate the human behaviour and its cognitive system to improve Human-Human and Human-Robot interactions. For this purpose, researchers perform trials with both humans and robots. PAL Robotics' biped humanoid REEM-C is one of the two robots used as platforms to develop and test the project. Robots have also proven to be a great platform for research on biological processes and the human mind. Having to study all the steps that a person follows unconsciously, so that a robot can perform it as well, gives a better understanding of our nature. REEM-C is ideal for this kind of investigations, which will also improve its social interaction. Its humanoid design, close to human anatomy, works well in real-life situations as it is suitable for human environments.

Francesco Ferro, CEO of the company PAL Robotics, is an Engineer in Telecommunications with a large experience in robotics. Ferro spent two years doing a PhD in Computer Vision at an Italian company until he decided to focus on a new project in Barcelona, the start of PAL Robotics. In 2004 Ferro was part of the PAL Robotics founding team: four engineers who accepted a pioneering project that would prove the team's outstanding capability developing cutting-edge robots. The first robot of the company was REEM-A, a humanoid robot that could walk and play chess assigned by PAL Group (UAE). REEM-A successfully built in 14 months. This achievement leaded to the improvement of the bipedal humanoid technology which resulted in REEM-B (2008), one of the most robust and powerful robots at that time.

Ferro has a broad experience in vision, sensors processing and navigation, and after being the PAL Robotics Software Manager he was promoted in 2011 to lead PAL Robotics as its Chief Executive Officer. From that moment on, the company's activity evolved from purely R&D in robotics to combining research with the development of different robots with applications in many different environments. Meanwhile he expanded his academic qualifications and knowledge with an Executive Master in Business Administration (UB-IL3). Today PAL Robotics' service robots are being used by institutions, enterprises, research labs and universities worldwide. Ferro has been

speaker at the main robotics congresses, conferences and symposiums as an expert in robotics, sharing his vast knowledge in the field.

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Robotics and communication technology for people with disabilities

Lulu Hamdan & Sanad Shaikh (Amana Healthcare)

What role can robotics play in transforming the lives of people with disabilities? This presentation gives a general overview of the state of robotic technology for people with disabilities and will illustrate this with concrete examples from the UAE. It will also highlight how the intersection between robotics and communication technology is opening up new horizons for people with profound disabilities, including those who require 24/7 medical supervision due to the severity of their underlying conditions.

Lulu Hamdan is the Marketing and Communications Manager of Amana Healthcare. She obtained her Bachelor of Science in Business Administration Degree as a Finance Major and a French Minor from Webster University in Geneva, Switzerland. After completing her studies, Lulu worked in Global Public Relations and Advertising Agencies managing healthcare clients for five years in Dubai, United Arab Emirates. She further continued her education in London, United Kingdom receiving a certification in the Sciences of Nutrition from the College of Naturopathic Medicine. While studying in London, Lulu gained experience working alongside national Nutritional Therapist Vicki Edgson, managing her public relations and providing research and content for nutrition books published in the United Kingdom. By combining her experience in healthcare and communications, Lulu currently manages media exposure, marketing strategies, event conferences, and online communications.

Sanad Sheikh is Marketing and Communications Coordinator at Amana Healthcare.

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Knowing Others Though Anticipation and Interaction: Learning the Right Lessons From and For Social Robotics

Daniel Hutto (University of Wollongong)

In *Surfing Uncertain*, Clark (2016) supplies a vision of the new, dynamic model of the mind, one that turns standard thinking about cognition upside down. Clark bills this as the ultimate radical step in the move away from traditional thinking about cognition that has held back research until now. A major aspiration of his new program is to build bridges with and benefit from new approaches in robotics that rediscover “many ideas

explicit in the continuing tradition of J. J. Gibson and ecological psychology" (p. 246). This presentation argues that Clark's way of doing this misses a fundamental opportunity and leaves us, still, with an overly conservative vision of cognition. It will be argued that taking the last and most radical step requires giving up certain treasured ideas about the nature of information processing. It then goes on to apply this result to the domain of basic social cognition in ways that will matter to how we think about how to build social robots with whom we can successfully interact.

Daniel D. Hutto is Professor of Philosophical Psychology at the University of Wollongong and member of the Australian Research Council College of Experts. His most recent books, include: *Wittgenstein and the End of Philosophy* (Palgrave, 2006), *Folk Psychological Narratives* (MIT, 2008). He is co-author of the award-winning *Radicalizing Enactivism* (MIT, 2013) and editor of *Narrative and Understanding Persons* (CUP, 2007) and *Narrative and Folk Psychology* (Imprint Academic, 2009). A special yearbook, *Radical Enactivism*, focusing on his philosophy of intentionality, phenomenology and narrative, was published in 2006. He regularly speaks at conferences and expert meetings for anthropologists, clinical psychiatrists, educationalists, narratologists, neuroscientists and psychologists.

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From Artificial Intelligence towards Social Intelligence of Robots, the ultimate need but a grand R&D challenge: an industrial perspective

Amit Kumar Pandey (SoftBank Robotics / Aldebaran)

AI is the basic ingredient for a consumer robot, but not sufficient anymore. It is important now to elevate the social robots' reasoning capabilities towards achieving a kind of social intelligence, for such robots to learn in social context and behave in socially expected and accepted manners. The talk will reinforce that the humanoid robots have a range of potential societal applications, and that as a robotics industry, SoftBank Robotics' R&D and Innovation is around the centrality of wellbeing of people. The time has arrived, when social robots are getting deployed, evaluated and available for practical purposes and coexisting with us in our environment. For example, *Pepper* robot from SoftBank Robotics, which is mass produced and already being used in thousands of homes, and at public places; the *Romeo* humanoid robot companion for everyday life of people needing assistance; the *Nao* robot as teaching assistant. However diverse the application might be, ranging from companionship to assistance, there are various common requirements and R&D challenges to achieve a kind of social intelligence. The first part of the talk will illustrate some of the use cases for humanoid robot grounded with some European Projects, and will outline the future of service and assistance robotics

market. The second part will highlight some of the immediate R&D challenges from industrial perspective. The last part will present the feedback and needs from the real users and will conclude with some open and grand challenges ahead, including social and ethical issues.

Dr. Amit Kumar Pandey is Head Principal Scientist (Chief Scientist) at SoftBank Robotics (formerly Aldebaran Robotics), Paris, France, also serving as the scientific coordinator (R&D) of its various collaborative projects. Earlier for 6 years he worked as researcher in Robotics and AI at LAAS-CNRS (French National Center for Scientific Research), Toulouse, France. His Ph.D. thesis in Robotics (title: Towards Socially Intelligent Robots in Human Centered Environment), is the second prize winner (tie) of the prestigious Georges Giralt Award for the best Ph.D. Thesis in Robotics in Europe, awarded by euRobotics (the European Union Robotics Community). His current research interest includes Socially Intelligent Robots, Human Robot Interaction (HRI), Robot's Cognitive Architecture and Lifelong Learning. On these aspects, he has been actively contributing as principal investigator, researcher, and industrial scientific coordinator in various national and European Union (EU) projects, as well as involved in their design and proposal. Among other responsibilities, he is the founding coordinator of Socially Intelligent Robots and Societal Applications (SIRo-SA) Topic Group (TG) of euRobotics, and an active contributor in the Multi-Annual Roadmap (MAR) and Strategic Research Agenda (SRA) of euRobotics, which aim to shape the future of robotics in Europe in collaboration with European Commission (EC) through PPP SPARC (the largest civilian-funded robotics innovation programme in the world). He is also the recipient of Pravashi Bihari Samman Puruskar 2014 (Non Residential Bihari Honour Award), for Science, Technology and Education, one of the highest level civilian honors, awarded by the state of Bihar, India.

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Robots as a therapeutic tool: Encouraging social interaction skills in children with autism

Ben Robins (University of Hertfordshire)

Our research investigates the potential use of robots as tools to encourage communication and social interaction skills in children with autism. The talk will present several robots including the child like robot KASPAR which was developed at the University of Hertfordshire, UK, and the ways in which the robots can engage autistic children in simple interactive activities such as turn-taking and imitation games, and how the robots assume the role of *social mediator*s - encouraging children with autism to interact with other people (children and adults). KASPAR has been designed to help teachers and parents support the children in many ways. The talk will present several case study examples taken from the work with children with autism at schools, showing possible implementation of KASPAR for therapeutic or educational objectives. These case studies show how the robot can:
* helps to break the isolation;
* encourages the use of language;
* mediates child-child or child-adult interaction;

* helps children with autism manage collaborative play;
* compliments the work in the classroom;
* provides the opportunity for basic embodied and cognitive learning, resulting in the emerging awareness of cause and effect.

Dr. Ben Robins is a Senior Research Fellow in the School of Computer Science at the University of Hertfordshire, UK. Ben's qualifications and many years of work experience lie in two disciplines: Computer Science (since 1980) and Dance Movement Therapy (since 1992). Ben completed his PhD research degree in the school of Computer Science at the University of Hertfordshire, focusing on assistive technology for children with autism, bringing together his expertise and experience in these two disciplines. Ben has over 45 scientific publications, including book chapters, articles in scientific journals and in international conferences proceedings. His publications have won several best conference paper awards. Ben's research, which started in 2002 in the AURORA Project and continued in the FP6/7 European projects IROMEC and ROBOSKIN, investigates the potential use of robots as therapeutic or educational tools, encouraging basic communication and social interaction skills in children with autism. His current work, part of the KASPAR project, continues the development of the KASPAR robot for children with autism (http://kaspar.herts.ac.uk). This include overseeing clinical studies in collaboration with psychologists in several universities as well as running several long term studies with KASPAR and children with autism in collaboration with schools and medical centres internationally. In recent years Ben was program co-chair, committee member and special session organiser in several international conferences and has been an invited speaker in workshops, seminars and symposiums in various countries.

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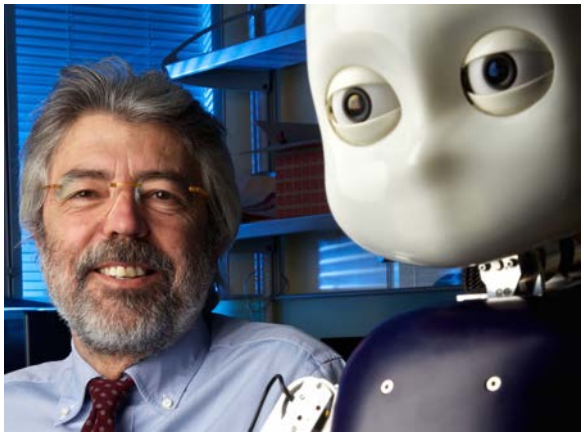
Humanizing Robots (and the three laws of robotics)

Giulio Sandini (Italian Institute of Technology)

In the recent years robot technology has advanced dramatically producing machines able to move like a human and, at the same time, being faster, stronger and more resilient than humans. The variety of humanoid robots being built and, to some extent, commercialized has increased enormously since the first humanoid robot announced by Honda 30 years ago. Since then the complexity and the performance of these systems has been steadily increasing and nowadays we can claim that more and more sensing and motion abilities of robots are approaching those of humans. Moreover, the computational power of today's computers and the possibility of expanding it through cloud-based solutions, has created the impression that the science fiction world described by Asimov where humans and robots co-exist and collaborate is not very far away. Is this true? Is there some major missing ingredient we have to develop? What is the role of robotics research in this endeavour? Does it still make sense to think to robotics as an engineering activity waiting for the

technological solutions required to fulfil Asimov's dream, or should robotics get involved head-on in actively seeking the knowledge which is still missing?
During the talk I will argue that robots interacting with humans in everyday situations, even if motorically and sensorially very skilled and extremely clever in action execution are still very much primitive in their ability to understand actions executed by others and that this is the major obstacle for the advancement of social robotics. I will argue that the reason why this is happening is rooted in our limited knowledge about ourselves and the way we interact socially. I will also argue that robotics can serve a very crucial role in advancing this knowledge by joining forces with the communities studying the cognitive aspects of social interaction and the important features of our being humans. In this endeavour robotics can, on one side, provide the physical platform where to test the models of how human perceive and act during social interaction and on the other realize a more humane robot able to execute actions and to establish a mutual communication channel with the human partner in order to discover and fulfil a shared goal (the distinctive mark of human social interaction).



Giulio Sandini is Director of Research at the Italian Institute of Technology and full professor of bioengineering at the University of Genoa. After his graduation in Electronic Engineering (Bioengineering) at the University of Genova in 1976 he was research fellow and assistant professor at the Scuola Normale Superiore in Pisa until 1984. During this period, working at the Laboratorio di Neurofisiologia of the CNR, he investigated aspects of visual processing at the level of single neurons as well as aspects of visual perception in human adults and children. He has been Visiting Research Associate at the Department of Neurology of the Harvard Medical School in Boston where he developed diagnostic techniques based on brain electrical activity mapping. After his return to Genova in 1984 as associate professor, in 1990 he founded the LIRA-Lab (Laboratory for Integrated Advanced Robotics, www.liralab.it). In 1996 he was Visiting Scientist at the Artificial Intelligence Lab of MIT.
Since July 2006 Giulio Sandini is on absence of leave from University of Genoa as he has been appointed Director of Research at the Italian Institute of Technology where he has established and is currently directing the department of Robotics, Brain and Cognitive Sciences. RBCS department concentrates on a multidisciplinary approach to human centered technologies encompassing machine learning and artificial cognition, exploring the brain mechanisms at the basis of motor behavior, learning, multimodal interaction, and sensorimotor integration. The department's multidisciplinary research staff is composed of researchers with different backgrounds (engineers, biologists, psychologists, mathematicians, physicists, medical doctors) addressing four, strictly interconnected, streams of research: Cognitive Robotics; Motor Learning, Assistive and Rehabilitation Robotics, Dynamic Touch and Interaction, Spatial Awareness and Multisensory Integration.

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Robots, racism, and representation

Rob Sparrow (Monash University)

It would clearly be possible for a robot to constitute a racist caricature. A social robot might express and reinforce racist ideas in its physical presentation and also in its social interactions with human beings. To build such a robot would be *prima facie* unethical. These judgements are possible because, as complex aesthetic works designed by human beings, robots have a semantic or representational content. They communicate ideas and sometimes these ideas will be morally problematic. Engineers will therefore need to carefully consider what the robots they build represent and how they represent it. The fact that robots have a representational content also means that the way people interact with robots will have a representational content. For instance, it will be possible for people to display racism in their interactions with robots as long as the latter are racially coded. Similarly, as I have discussed at length elsewhere, in so far as robots are gendered, human interactions with social robots will have a gender politics. Arguably, in some cases, what people communicate through particular sorts of interactions with robots may be so ethically problematic as to render the design of robots to facilitate such interaction morally impermissible. This thought is especially challenging for the project of social robotics because in many contexts humanoid robots will represent slaves and representing people as slaves seems troubling, to say the least.

However, accounts of what robots and/or our interactions with them represent are complicated by the fact that certain sorts of relationships can't properly be said to exist between a human being and a robot; nor can certain sorts of attitudes be held towards a robot. That is to say, where robots represent robots rather than people our behaviours towards them have a different semantic content and thus a different ethics and politics. Understanding the ethics of the design of social robots therefore requires understanding what they represent and how. In this presentation I will offer some initial thoughts on how we should navigate this complex intellectual terrain. I will argue that the representational content of our relations with robots will depend on the interpretations of a community but that there are two different, plausible, accounts of how the semantic practices of a community shape the meaning of our actions. Which of these accounts we hold to be *more* plausible in any given context will therefore play a crucial role in determining the ethics of the design of social robots.

Rob Sparrow is a Professor in the Philosophy Program, a Chief Investigator in the Australian Research Council Centre of Excellence for Electromaterials Science, and an adjunct Professor in the Centre for Human Bioethics, at Monash University, where he works on ethical issues raised by new technologies. He has been a Visiting Scholar at the National University of Singapore and a Japanese Society for the Promotion of Science Visiting Scholar at Kyoto University. He has published extensively on topics as diverse as the ethics of military robotics, Just War Theory, human enhancement, and nanotechnology. He is a co-chair of the IEEE Technical Committee on Robot Ethics and was one of the founding members of the International Committee for Robot Arms Control.

How can we develop 'deep minds' of robots?

Jun Tani (Korea Advanced Institute of Science and Technology)

My research motivation has been to investigate how cognitive agents can acquire structural representation via iterative interaction with the world, exercising agency and learning from resultant perceptual experience. Over the past 20 years, my group has tackled on this problem by investigating the idea of predictive coding applied to development of cognitive constructs of robots. Under the principle of predictive coding, dense interaction take place between the top-down intention proactively acting on the outer world and the resultant bottom-up perceptual reality accompanied with the prediction error. Our finding has been that compositionality or systematicity enabling some conceptualization can emerge via such iterative interaction when constraints such as multiple spatio-temporal scale property applied to the neural network modeling and the way of tutoring the robots applied to the behavioral interaction level act on the development of the whole system in terms of 'downward causation'. The talk will highlight our recent results on interactive and integrative learning among multimodality of perceptual channels including pixel level dynamic vision, proprioception and linguistic inputs using a humanoid robot platform. Finally, I will point to one aim of future research, how the deep mind of a robot may arise through long-term educational tutoring program.

Jun Tani received a Doctor of Engineering degree in electrical engineering from Sophia University in Tokyo in 1995. He worked for Sony Corp. and later for Sony Computer Science Lab as a researcher from 1990 to 2001. Then, he worked at Riken Brain Science Institute from 2001 to 2012 where he has been a PI of Lab. for Behavior and Dynamic Cognition. He had been also appointed as a Visiting Associate Professor, Graduate School of Arts and Sciences, University of Tokyo from 1997 to 2002. He became a full professor of Electrical Engineering in Korea Advanced Institute of Science and Technology (KAIST) in 2012 where he started Cognitive Neuro-Robotics Lab. His research interests include neurorobotics, deep learning, complex systems, brain science, developmental psychology, and philosophy of mind.

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Artificial social agents in a world of conscious beings

Steve Torrance (University of Sussex)

It is an important fact about each of us that we are conscious beings, and that the others we interact with in our social world are also conscious beings. Yet we are appear to be on the edge of a revolution in new social relationships – interactions and intimacies with a variety of non-conscious artificial social agents (ASAs) – both virtual and physical. Granted, we often behave, in the company of such ASAs *as though* they

are conscious, and *as though* they are social beings. But in essence we still think of them, at least in our more reflective moments, as "tools" or "systems" – smart, and getting smarter, but lacking phenomenal awareness or real emotion. In my talk I will discuss ways in which reflection on consciousness – both natural and (would-be) artificial – impacts on our intimate social relationships with robots. And I will propose some implications for human responsibilities in developing these technologies. I will focus on two questions: (1) What would it take for an ASA to be conscious in a way that "matters"? (2) Can we talk of genuine social relationships or interactions with agents that have no consciousness?

On question (1), I will look at debates in the fields of machine consciousness and machine ethics, in order to examine the range of possible positions that may be taken. I will suggest that there is a close relation between thinking of a being as having a conscious phenomenology, and adopting a range of *ethical* attitudes towards that being. I will also discuss an important debate between those who take a "social-relational" approach to phenomenological and ethical attributions, and those who take an "objectivist" approach. I will offer ways to resolve that debate. This will help provide guidance, I hope, to those who are developing the technologies for smarter ASAs, which possibly may have stronger claims to be taken as conscious. On (2), I will suggest that, even for ASAs that are acknowledged not to be conscious, it is possible that there could be a range of ethical roles that they could come to occupy, in a way that would justify our talking of "artificial social agents" in a rich sense, one that would imply that they had both genuine ethico-social responsibilities and ethico-social entitlements. The spread of ASAs – whether or not genuinely conscious, social or ethical – will impose heavy responsibilities upon technologists, and those they work with, to guide the social impacts of such agents in acceptable directions, as such agents increasingly inter-operate with us and with our lives. I will thus conclude by pointing to some issues of urgent social concern that are raised by the likely proliferation of ASAs in the coming years and decades.

Steve Torrance is Emeritus Professor of Cognitive Science at Middlesex University, and Visiting Senior Research Fellow at the School of Engineering and Informatics, University of Sussex, Brighton, UK. He was trained in philosophy at Sussex and Oxford. His doctoral work was in the logical status of moral judgments. Since the 1980s he has worked at the intersection of philosophy, psychology, cognitive science and AI and robotic technologies. His recent publications and conference contributions have covered AI and ethical theory; the implications of artificial ethics and artificial consciousness as research goals; the potential status of AI agents as sources and recipients of ethical action; machine ethics in the health and social care domains; singularity theory and transhumanism; technocentrism and ecology; and enactivist approaches to cognition and action. Steve has been a visiting fellow at the University of Sussex since the early 2000s, based in the School of Engineering and Informatics. With Ron Chrisley he was a co-founder of the Centre for Research in Cognitive Science (COGS) at Sussex. He is also Professor Emeritus in Cognitive Science from Middlesex University: before

retirement from there he held holding positions, successively, within the subject departments of Philosophy, Computer Science and Psychology. He recently completed nearly a decade as a part-time associate lecturer at Goldsmiths, University of London, and was recently a visiting professor at the University of Twente, in the Netherlands. He has for some years been a technology consultant for the European Commission, currently in the role of expert ethics reviewer for Horizon 2020 and related programmes. He is also a jazz musician, and is currently working with a fellow cognitive scientist in Paris in a collaborative exploration of enactivist theory in relation to jazz improvisation, which combines theoretical discussions with live performance.

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SUBMITTED PAPERS

Robotics-Based Experimentation to Demonstrate and Emulate Spacecraft Maneuvers

Ahmad Bani Younes (Khalifa University)

In conceiving and planning space missions, ground-based experiments are required that combine theory with experimental hardware to reduce mission risks. These experiments replicate expected on-orbit behavior, and provide a virtual “wind-tunnel-like” environment for gaining insights into the complicated behaviors that characterize interactions between multiple critical subsystems. Such Risk Reduction Ground-Based Experiments provide anomaly resolution experiments in an operationally relevant environment. At Khalifa University, we have recently developed a suitable approach to ground-based mobile platform technology that simultaneously permits large general motions and highly precise inertial and relative navigation and control, by building the Spacecraft Platform for Astronautic and Celestial Emulation (SPACE) laboratory. The key contribution of such ground robotics-based experimentation is a low-risk method to validate dynamic models, control laws and space technology and to demonstrate aerospace missions. The main purpose of this capability is to develop high-fidelity ground-based experiments to emulate and demonstrate autonomous spacecraft proximity operations. On-orbit servicing (OOS) is a complex high-risk activity that critically depends on coordinated sensing, navigation, guidance, and control. Ground-based experiments are required that combine theory with experimental hardware to retire mission risks, understand the expected on-orbit behavior, and provide a virtual “wind-tunnel-like” environment for gaining insights into the complicated behaviors that critically characterize interactions between multiple subsystems. OOS is an open challenge and important element in the telecom satellite operations. The ground robotics-based experimentation is a low-risk method to validate dynamic models, control laws and space technology and also to demonstrate several aerospace missions. The key technologies to be demonstrated include:

• Sensing, navigation, guidance and control.

• An accurate (and fast) solution of coupled orbital/attitude motion and exact high-order sensitivity models for the perturbed motion that enables stable orbital estimation.
• Fast Trajectory Optimization for debris removal.
• Performing high-fidelity ground experiments of spacecraft relative motion.
• Mobile robotics linked to Stewart platform for high-fidelity 6DOF motion emulation.
• Emulation of general near-proximity operation of multiple vehicles in a ground-based facility.
• Coordinated Metrology Systems—Laboratory truth models for relative/absolute motion.
• Facilitate testing and validation of algorithms and hardware.
• Providing a capability for advancing fundamental new technologies for proximity sensing, interference and control.
• Computational vision for fusing information for 3D camera imaging and target tracking.
• Multibody and contact dynamics for multi-vehicle interactions.
• Develop high-fidelity end-to-end modeling and simulation environment for studying the performance of the notional hardware design during all aspects of the mission profile in a virtual laboratory environment.
• Guidance, Navigation and Control (GNC) strategies for space applications.
These goals directly support the state-of-objective of Abu Dhabi 2030 for building a UAE-based space industry and providing a pipeline of students for assuming leadership roles in UAE's emerging space industry.

Dr. Ahmad Bani Younes completed his PhD degree in Aerospace Engineering at Texas A&M University where he continues to serve as an adjunct faculty member. Dr. Bani Younes has worked on a wide range of space research topics, including the development of fast and high fidelity gravity model for the earth anomalies; fast and efficient trajectories propagation for satellite motions; optimal control theory, which is focused on spacecraft Guidance, Navigation, and Control (GNC) issues, trajectory generation, spacecraft attitude tracking, and feedback control methodologies; and, algorithms development for optimization theory, perturbation theory, orbital motion, and very broadly algorithmic differentiation for automatically generating first- through fourth-order mixed sets of partial derivatives. In addition, Dr. Bani Younes is the founder of the Spacecraft Platform for Astronautics & Celestial Emulation (SPACE) at Khalifa University, which aims to be a nationally unique 6DOF facility. SPACE will support comprehensive studies and hardware experiments for sensing, guidance, dynamics, & control of space operations in an operationally relevant environment. It operates as a "robotic wind tunnel" where faculty and students can work on space topics spanning conceptual design cartoons to advanced proof of concept hardware realizations. The lab conducts research in robotic sensing and control with an aim to enhance the fields of proximity operations, human-robot interaction, stereo vision, swarm robotics, and autonomous aerial vehicles.

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The Challenge of Bringing Social Robots to Society

Paulo Ferreira (University of Coimbra)

In this article we propose a phased methodology that will support the transference of technology across the scale of Technology Readiness Levels (TRL) within the specific area of social robots in Ambient Assisted Living (AAL) domain.
Nowadays, robotic systems dedicated to society have an emergent importance. As social technologies, they have the main aim of being used by a large number of citizens with some particular needs, or by society in general. All this technology has to be transferred from developers to the society, but most of the times there is an educational barrier between these two user groups, which prevents a common ground of understanding and often leading technology's failure, one way or another, to meet the "market's" needs. This challenge of transferring technological solutions from researchers to society became apparent in the GrowMeUp Project. We understood that standard transference methodologies could not be applied, as they were ill-suited for such a complex technologies and because they do not bring a usable and mature technology that complies with the participation of end-users at different phases. Therefore, within the GrowMeUp Project we propose a systematic approach, which supports this technology transfer with a high level of acceptance by end-users.
The proposed methodology considers different User Readiness Levels (URL), which are a specifica- tion of the skills and roles in AAL Domain within the known Human Readiness Levels (HRL). The URL concept will clarify the readiness assessments by combining the capabilities of the robotic system, the skills/abilities of each involved user, associated to the different experimental phases of the technology readiness levels. This methodology aims to bridge the gap between different user types, towards technology acceptance. Also, it is an inclusive, user-in-the-loop process that aims to provide a system that is the closest to meet user needs as possible. With this approach we create a clear and traceable workflow, which will allow accountability and specific problems identification.
The implementation of this technology leads to a better understanding of both sides of the user spec- trum, promoting a smooth technology transition, involving co-verification and co-validation of processes and technologies. This results in a better communication and a product that is able to efficiently cope with user's needs.

Paulo Ferreira is a Research Fellow on GrowMeUp Project at the Institute of Systems and Robotics of the University of Coimbra. Paulo Ferreira holds an M.Sc. in Electrical Engineering from the University of Coimbra (Portugal) with specialization in Automation. He worked at CWJ Projecto SA where he was involved in magnetic, thermal and lighting FEM, and has developed commercial and efficient lighting products. He teaches Robotics and Automation and Measures and Instrumentation at ISEC - Coimbra Institute of Engineering. He also worked in a portuguese research project: Diagnosis and Assisted Mobility for People with Special Needs, where was involved on the development of innovative products for human gait analysis and rehabilitation, and had co-supervised several masters and graduate students in the field of Human Gait Analysis. He is currently a research fellow on GrowMeUp Project at the AP4ISR Team at University of Coimbra.

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Color Categories in Context

Yasmina Jraissati (American University of Beirut)

As beings immersed in the physical world, we navigate our environment and interact with it on the basis of information we gather. We are bombarded by different forms of energy. As perceiving agents, we are equipped with sensory receptors that act as transducers and transform these energies into different sensations. In these sensations lies the information we need to safely navigate and interact with the world. We get boundless input, but our processing capacities are limited. For these sensations to be of any use, we need to organize them, or categorize them: Categories are the building blocks of cognition. To this extent, the question of why we categorize the way we do is crucial. Various responses have been offered in the past century, ranging from an extreme nativist to an extreme empiricist view. In all these approaches the question of the nature of these categories is never explicitly tackled. Most of time, they are assumed to be entities that are represented in the mind, stored in long-term memory, and retrieved when required. Whether innate or acquired, it is assumed we "have" these categories for an extended period of time, ranging over a given historical period. Thus, in the color categorization literature, the focus of which is accounting for color categorization and identifying the mechanisms at play, it is assumed that categories are fixed entities, which are uncovered in color naming and sorting studies. Yet, it is also agreed that categorization is context sensitive, and that context plays a role in why our categories are the way they are. Though this is acknowledged in the case of color as well, the way context is supposed to influence color categorization is never spelled out. And importantly, the assumed fixed nature of color categories is at odds with their context sensitivity. This paper steers away from the wealthy categorization literature, and takes a different starting point by asking the preliminary question of *how* we categorize color in our daily interactions with it? From the answer to this question results a unified framework that makes room for context sensitivity, while accounting for color categorization, and possibly sensory categorization more generally. The resulting framework is dynamic, in the sense that I propose that categories are constructed online, rather than retrieved from memory. Specifically, I argue that a given object is "red" or "brown" depending on its relevant degree of similarity to other "red" or "brown" objects, and to the poles of a structured color space; where relevance is determined by context, understood by surrounding objects and purpose of the agent. Depending on the regularity of context, some categories will be more or less permanent.

The framework sketched here is both simple and powerful enough to potentially account for sensory categorization more generally. Whether such a framework could also allow machines to create the categories they need as they navigate and interact with the world is plausible, and a question worth pursuing in future research.

Yasmina Jraissati holds a PhD in Philosophy and Cognitive Sciences (2009) from the Institut Jean Nicod, EHESS, ENS, CNRS, Paris, France. She is a lecturer in Philosophy at the American University of Beirut, Lebanon. Yasmina's primary area of research is color categorization, or specifically, how we organize our color sensations into categories, at the interface between perceptual and cognitive

constraints on one hand, and language use and other external cultural factors on the other. Yasmina's research is more generally centered on the cognitive relation of agents to the world and to others. Topics she has recently researched are: The influence of language on color perception; cross-modal associations between touch and color; comparisons between olfaction and color categorization; the limits of optimality in color categorization; the role of context in sensory categorization. A few other topics she would be interested in exploring: categorization of tactile sensations; the predictive nature of perception; proprioception and body awareness in virtual reality; multisensory integration in perception of space.

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eHealth applications for robotics – challenges in social robotics for healthcare

M Jawad Hashim (UAE University)

Robotics applications in healthcare are rising as the demand for services continues to outstrip available resources including trained professionals. Robotic devices can assist and independently perform certain routine tasks in healthcare delivery. Such tasks include nursing, service, remote monitoring, telemedicine and social support. We conducted this study to identify applications of social robotics to healthcare. We conducted a MEDLINE search via PubMed (https://www.ncbi.nlm.nih.gov/pubmed/) using the keyword phrase "social robotics NOT surgery [tiab] NOT surgical" without limits on language of publication. The search filters included: publication within 5 years of search date, human (not animal or lab studies) and availability article abstracts. The results were sorted by the MEDLINE Relevance algorithm. Studies that addressed social robotics issues were selected. Studies focussing on robotic surgery were excluded. Original research studies were preferentially included over review articles.
A total of 157 articles were listed in the search results. The research articles reported studies on human-robot interactions, acceptance of robotics by patients, artificial empathy, machine cognition and the use of robotics in specific patient groups such as the elderly and children with autism. A randomized controlled trial of a companion robot among 40 rest home residents found significant decreases in loneliness. In one of the largest studies involving robots and children with autism, children interacted more with a social dinosaur robot than a touchscreen computer game. Several articles discussed the ethical and social implications of robotics in healthcare. Social robotics in healthcare is a rapidly emerging field with new developments in improving care of isolated elderly and children with autism.

M. Jawad Hashim, a faculty member at the College of Medicine and Health Sciences of the UAE University, is one of the notable authorities on innovations in medical education having developed the miniworkshop, the teaching pyramid and a new learning taxonomy. Dr. Hashim is the co-Director of the Clinical Skills course held in the state-of-the-art Clinical Simulation Center at UAE University Al Ain, where he pioneered the development of a new assessment format – the CERT. Winning

several intramural and competitive external grants, he leads research in health systems improvement and is invited to present on emerging trends in this domain. His early work led to the development of a new framework in e-Health. In recognition of his work, Dr Hashim was recently awarded the Excellence in Teaching Award.

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The Use of Robots to Enhance Interaction among Autistic Adolescents – observations from a social interaction study

Nadia Hussain (Al Ain University of Science and Technology)

Autism is a global development disorder that usually manifests as a wide range of symptoms. Most people who are autistic experience several difficulties in the development of social behaviour. Research has focused on the introduction of robots in the classroom of children with autism, with the main goal of supporting professionals and families in the promotion of the children's cognitive capabilities, social interaction and communication skills. Robots seem to act as a key tool able to call for attention of autistic children, and promote their cognitive and social development. The aim of this study was to assess improvement in the social life of adolescents with autism and mental impairment. This focus was on the promotion of communication skills and social interaction. To assess how robots can serve as educational or therapeutic tools for adolescents with autism, in particular to increase their social skills and communication skills. Materials and Methods: An experiment that was designed to attract the adolescents' attention and assist their collaboration is detailed. A LEGO MindStorm robot was used to be the mediator of this interaction. The robot was introduced to the adolescents through three basic stages: exploration, demonstration and interaction phases. Accuracy skills and sensory motor coordination of these participants were also explored. We used strong colours and cyclic and repetitive movements because these seem to attract autistic individuals more. Results: Four behaviors were considered: Ignores Robot; Motor Manifestations; Looks for Help and Stares at the Robot. The tendency to produce no movement and just to look at the robot, the behavior Stares at the Robot, decreased over time as the adolescent gets used to the robot and it is no longer new but rather something he accepted. The behavior Ignores Robot decreased throughout the sessions. In fact, the adolescent became so engaged with the robot that it ignored completely. The motor manifestations presented no specific pattern, and overall showed some tendency to decrease with the session's number. We also believe that a social interaction was in fact achieved since the adolescent tried to progressively include the researcher more and more in the experiment. Conclusion: We aimed to better establish what type of robots and robot features would be more suitable for autistic children to capture their attention, improve their learning and development capabilities. In future studies, we will focus on temporal analysis to shed light to better understand how interactions

evolve over time. We also plan to carry out more experiments to incorporate more traditional therapy goals using robotic experiments.

Dr. Nadia Hussain is an Assistant Professor in Al Ain University of Science and Technology. She has extensive experience in both clinical and academic aspects of her medical profession. She is a passionate educator who has obtained her Masters from University of London and has completed her PhD from UAE University. She is also a published author and has given various presentations in prestigious regional conferences. Her most recent award has been in the UAE National Research conference 2015 where she won Best paper award in the category of Health Sciences. Her research interests include diabetes, nervous system disorders and the use of technology for patient progress.

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Robotics in Rehabilitation

Peer Mohamad, Muhamed Ali (Al Ain Hospital)

The presentation aims at summarizing the need, demand and principles for integrating advanced robotic technology in rehabilitation. The Objective of Rehabilitation Robotics is to investigate the application of robotics to therapeutic procedures for achieving the best possible motor, cognitive, and functional recovery for persons with impairments associated with ageing, disease, or trauma (e.g., stroke, neuromotor disorders, brain trauma, orthopedic trauma, cognitive disease) and Integration of technology in rehabilitation and the potential to expand possibilities for healing, adaptation, compensation, and recovery for individuals with neurological impairments. Robotics and technology are considered supplemental to “one-on-one rehabilitative therapy,” not a replacement for individual therapy. Rehabilitation robotics can Indirectly augment functional independence of individuals with impairments by performing mobility tasks for individuals at the home, minimizing the need for assistance from another individual, performing functional activities of daily living and helping perform difficult or repetitive tasks at work. Rehabilitation robotics can also directly improve human motor skill capabilities of individuals with impairments to enable them to perform functional tasks independently, improve voluntary control, perfect quality of movement and learn new skills. The various applications of advanced robotics in rehabilitation of disability, impairment and Handicap and the future directions are herewith discussed.

Peer Mohamad, Muhamed Ali graduated from Chennai, India in 1998 after completing his Bachelors in Physiotherapy and was adjudged the Best outgoing student with first rank. After graduation he joined Harvard Medical International associate institution- Sri Ramachandra Medical Centre a JCIA accredited 1650 bedded tertiary care hospital. Peer did his Masters in Physiotherapy in Cardiopulmonary Sciences from the same institution. He moved to Abu Dhabi, United Arab Emirates in June 2006

to join Sheikh Khalifa Medical City. After working with the Rehabilitation team initially Peer pioneered in forming the first Cardiac rehabilitation department in the Middle East with inpatient and outpatient services. Peer transferred to Al Ain Hospital, United Arab Emirates in September 2009 as Senior Physiotherapist. Currently he is Head of Physiotherapy and BLS Training center faculty for the American Heart Association. Peer is a Member of American Heart Association, WCPT Network for Health Promotion in Life and Work, WCPT Network for Physical Therapist Educators, International Confederation of Cardiorespiratory Physical Therapists and European Association for Cardiovascular Prevention and Rehabilitation.

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User Modeling for User-Adaptive Social Robots

Gonçalo S. Martins (University of Coimbra)

One of the key elements of technology acceptance by society is the interaction between artificial and human agents. Unlike smartphones or tablets, where predictability is a requirement, users expect robots to behave more like humans do, and mechanized behavior often demotivates people to continuously use these systems beyond the novelty period. Thus, it becomes necessary for a robot to learn the user's characteristics and continuously adapt its actions to them. This has recently become a trend in the scientific community, which has been endowing robots with the ability to create representations of users using a variety of information.
We are developing a user model, which represents various types of information and uses Bayesian methods to perform inference. The model comprises information inferred from multimodal sources, fusing it into an attribute-based representation of the user. The aim is that a user-adaptive robot can use such a representation to tailor its behavior to the characteristics of the user. This allows the system to automatically exhibit user-adaptive behavior, increasing its levels of interaction autonomy and easing user acceptance.
A modular design approach is followed, where different and independent components process different types of information. This work describes one such module, which aims at inferring over some of the properties that a person exhibits when communicating, such as: How quickly do they speak? How does their facial expression change when reacting to the robot's actions? These properties are inferred from a set of inputs from the robot's sensors, measured while the interaction takes place. The characteristics are labeled using the Big Five traits of personality, which we found suitable to describe these interaction properties. The proposed methodology and parametric instantiation were fine-tuned and validated in simulated scenarios. Additionally, a proof-of-concept test was implemented in a robotic platform that interacts with real users, under controlled conditions, for estimating user acceptance. Despite positive results, the model can still be improved by optimizing evidence selection and applying an adequate parameter learning strategy. We discuss the integration of this model on a previously-developed framework for generating user-adaptive behavior from a user profile. This integration closes the loop between action and perception, endowing the robot with full autonomy in interaction. We end by discussing the potential impact of the integration of user-adaptive and user modelling

techniques to a wider variety of domestic robot tasks, introducing the concept of adaptiveness on a number of previous applications.

Gonçalo S. Martins is a PhD Student at the Institute of Systems and Robotics, University of Coimbra. He holds an M.Sc. in Electrical and Computer Engineering from the University of Coimbra, with specialization in Computers. On September 2013, he joined the Institute of Systems and Robotics in order to carry out his M.Sc. dissertation on multi-robot SLAM in the context of the CHOPIN (Cooperation between Human and rObotic teams in catastroPhic INcidents) Project. He joined the GrowMeUp Project (H2020 Grant# 643647) on March 2015 as a Ph.D. candidate, and is currently conducting research on the field of User-Adaptive Systems and User Modeling for Social Robots.

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Survey of University Engineering Student's Opinions on Ethical Issues in Social and Autonomous Robotics

Mohammed Randeree (UAEU, College of Engineering)

University engineering students learn about and discuss responsibility, morals, values and ethical dilemmas during a course in engineering ethics. Along with this, they study new developments and look at creativity, design and innovation in the field of engineering including robotics, artificial intelligence and automation. However in general little discussion is provoked in the realm of social and autonomous robotics. Thus students can complete the course having not formed carefully considered personal views based upon their own morals, values and cultural structures about the real impacts social robotics is having and will have in their lives as well as how they may be involved in this impact in the future either through their career progression or as customers and consumers. Three groups of students were surveyed regarding their thoughts on ethical questions relating to social robotics, autonomous vehicles and autonomous weapons. Issues that were considered in the survey related to: rationales for ownership of social robots; ethical decision-making based on ownership; differences in views and values, whether as a consumer or producer; and the range from service to recreational and companionship robots. Students were segmented into three groups. The first group had not completed the course on Engineering Ethics and had no additional pre-discussion or collaborative thinking, whilst the second, who had also not completed their studies, incorporated additional time for discussion, research and brainstorming before submitting answers individually. Thus more emotive responses based on biases, media and movie depictions could be separated somewhat from more rationalised, thoughtful responses. The second group's collaboration also led to consensus and agreement on some of the survey points. The third group had previously completed the course in Engineering Ethics but answered the questionnaire individually in their own time, allowing reflection and thoughtful

responses from a personal perspective. A summary of some of the survey results are presented.

Mohammed Hussain Randeree is a Lecturer in the College of Engineering, United Arab Emirates University. He holds a Master Degree in Control Engineering from Bradford University, UK.

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Random Sampling Learning: Social Robots Learning User Behaviour Routines

Luís Santos (University of Coimbra)

In this work, we present a random sampling algorithm to learn a behaviour routine for a determined user along time. For a robot to maximize its daily support to an elderly, it needs to know its typical daily routine, so that it can anticipate needs and provide timely support. However, on deployment, a robot has no knowledge about the users habits, therefore, it needs to learn them on a daily basis. By randomly sampling the current behaviour state of an elderly over the course of their interactions, the robot will be able to construct a stochastic representation of the sequence of events an elderly typically has. The goal is to give a social robot the capability to autonomously capture the underlying structure and patterns of a person's routine and, if possible, in an asynchronous manner and over timely unstructured data, adapting the selected representation to the changes caused by numerous factors. The algorithm considers relevance, activity gaps and intrinsically deals with the dynamics of the user's routine.
The proposed work, builds on top of our previous research on a multi-label classifier approach to capture a multi-information behaviour state of a person at a given time [1]. These behaviour states encode relevant information about an elderly at a given time of the day, such as: what is he doing, where is he doing it, etc. In that research, we have laid the fundamentals for the design of the transition state approach to capture the sequence of events defining a user routine in a social robotic platform. We demonstrated that this approach was suitable to encode routines and detect a range of unexpected events, which could be used to trigger caregiver interventions. However the transition matrix, as the majority of approaches using it, was learned using a naive approach, a solution not deemed ideal to deal with realistic scenarios. We have put our approach through simulated stress tests analysing how efficiently it deals with false negative and positive transitions, randomness of sampling and long term effects on adaptability.

References

[1] Luís Santos and Jorge Dias, "User Routine Model using a Cloud-Connected Social Robot". In the 5th IEEE International Conference on Cloud Networking (ICCN), 2016

Luís Santos holds a PhD from the University of Coimbra (UC), Portugal. He is currently an Invited Assistant Researcher at University of Coimbra and is acting as a Project and Technical Manager for the H2020 GrowMeUp Project (GA 643647). He has experience as post-doctoral at the Institute of Systems and Robotics of the University of Coimbra, as a seconded researcher from the UC to a company, Citard Services Ltd., within the scope of the Marie Curie IAPP Project Social Robot (GA 285870). He also worked for the BACS European Project from 2007 to 2010 in the areas of Bayesian methodologies for action recognition. His current research interests are in the area of human-robot interaction and machine learning methods for autonomous cognitive systems in the AAL domain of robotics for society.