

## Guest Editorial

### Special Issue on “2014 IEEE-RAS International Conference on Humanoid Robots” Humans and Humanoids Face to Face

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The 14th edition of the IEEE-RAS Humanoids conference ([www.humanoids2014.com](http://www.humanoids2014.com)) was held in Madrid, Spain, during November 18–20th, 2014, and was organized by the University Carlos III of Madrid (<http://roboticslab.uc3m.es>). The conference theme was “Humans and robots face to face”, confirming the growing interest in the field of human–humanoid interaction. A lot of research efforts are nowadays devoted to the cooperation between the human and the robot when dealing with the execution of daily life activities in real environments, putting an emphasis on scenarios that include healthcare, elderly and disabled people assistance, home and office frameworks and industrial environments (construction, manufacturing and aerospace, among others).

*Humanoids 2014* accepted the record number of 173 scientific papers from 30 countries, 288 being submitted. They cover a wide range of topics on humanoid robotics and related technologies. These figures represent a growth of about 60% with respect to the previous conferences and demonstrate the nowadays importance of the humanoids topic. Three plenary sessions were given by top researchers in the field: Dr. Alin Albu-Schäffer from the Institute of Robotics and Mechatronics at the German Aerospace Center – DLR, with title “Humanoid Assistance Robots: Designing and Controlling Robots for Direct Interaction with Human”; Prof. Masayuki Inaba from the Department of Creative Informatics, University of Tokyo, Japan, with title “Inheriting and Evolving the Infrastructure of Systems and Devices for Humanoid Robotics”; and Dr. Jerry Pratt from IHMC – Institute for Human & Machine Cognition, Pensacola FL, USA, with title “Towards Humanoid Avatar Robots for Co-Exploration of Hazardous Environments”.

The singular single-track scheme organization of *Humanoids 2014* selected six main oral topics (sessions): Novel mechanism design; locomotion planning; learning;

grasping and manipulation; modelling and simulation and social interaction. In the first topic of design the novelty focused on aesthetic and anthropometrically correct compliant designs of legged humanoids, new variable stiffness actuators and materials, articulated talking face design, and new anthropomorphic hands design. The topic of planning was devoted to locomotion on uneven and slippery terrains, navigation through foot step planning and monitoring, whole body motion planning, and dynamically stable optimization-based planning. In the area of learning the papers focused on active learning in collaborative tasks, directed explorative learning, eye-hand and self-exploration optimization, new policy learning, and re-use of previous experiences. The fifth topic of manipulation introduced grasping taxonomy, soft hands, bi-manipulation aspects, and prediction for localization. Modelling topic centered on novel tools for dynamics and control analysis, virtual models, and bio-inspired motion. Finally, the social interaction session presented results on non-verbal face to face communication (expression, postural), use of EEG to sense human signals to engagement social interaction, robot collaboration with children with autism, and comparison of a humanoid robotic tutor with a human one.

The high number of eight interactive sessions, with an average of 18 presentations in each one, complemented these topics. During these sessions, 11 videos in long time format were also presented, introducing a new way of “only media” discussion. The high ratio of interactive presentations with respect to oral ones (more than 3:1) permitted to establish a direct and fruitful communication within the huge humanoids community.

The workshops were also an important part of the conference with the highest ever number of 17 ones organized in full- and half-day formats. Some of them were devoted to advances in traditional topics such as bipedal benchmarking, soccer humanoids, software programming tools, mechatronics design, robotic hands, and postural control. Others introduced new domains such as multimodal robotic skins, policy representations, creativity, humanoids in space programs, and exploration in complex environments. The novelty was also the workshop “Cognitive Humanoid Robotics Research”, organized by the European Union and focused on an overview of the current running EU projects related with humanoid robots.

The conference included, also for the first time, a mini-humanoid robots competition based on NAO and Darwin-OP robots, called *Humabot*. There were seven participant teams from five different countries and the competition was won by the students from Linköping University, Sweden. In the *Humabot* challenge the robot is an integral part of the house and helps its occupants to live there better. The test bed was the kitchen of the house environment.

Likewise, an exhibition of the most advanced humanoid robots and related technologies took place during the three days of the conference. There were 17 exhibitors with robots such as TEO (University Carlos III of Madrid), REEM-C (PAL Robotics), iCub (Italian Institute of Technology), Darwin (Robotics),

RoboThespian (The Engineered Arts), and products of Shadow, Schunk, Robotnik, Optoforce, IniLabs, Technaid, and Mathworks, among others. The Robo-City2030 R&D program of the Community of Madrid also participated very actively within the conference activities by organizing a presentation of undergraduate students' robots.

With over 460 attendees from more than 30 countries, *Humanoids 2014* has become the conference edition with the largest international participation, confirming the success of the event and the increasing focus on humanoid robotics all over the world.

On the other hand, it is interesting to analyze the papers' keywords and their evolution since the last *Humanoids* conferences. In 2013 the top 5 keywords were (in decreasing order): locomotion, grasping and manipulation, humanoid dynamics, trajectory planning, and visual perception. In 2014 they changed to: grasp and motion planning, modelling and simulating humans, body balancing, visual perception, and social interaction and acceptability. The topics of grasp and motion planning and visual perception were still the most important ones, but locomotion, humanoid dynamics, and trajectory planning were substituted by modelling and simulating humans (second place), body balancing, and social interaction and acceptability. It is clear that a deeper analysis is necessary but, as a general conclusion, it is possible to say that nowadays R&D in humanoid robots slightly shifted from design and locomotion to human and social interactions.

The goal of this special issue is to present a variety of the most innovative papers from *Humanoids 2014*. It was not easy to select them from 173 presented ones, some of them were published yet, but we try to cover different aspects presented in the conference. The final selection of papers has been made by the Guest Editors of this special issue taking into account the reviewers' recommendations. After the selection process, eight papers have been selected covering wide topics from development & control of humanoids to interaction & skills learning, all of them in close cooperation with humans. We hope you will enjoy this special issue.

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