International Journal of Social Robotics (2020) 12:613–616
https://doi.org/10.1007/s12369-020-00655-8

EDITORIAL

Special Issue on Behavior Adaptation, Interaction, and Artificial Perception for Assistive Robotics

Mariacarla Staffa[1] · Silvia Rossi[1] · Adriana Tapus[2] · Mehdi Khamassi[3]

Published online: 4 June 2020

This special issue aims at examining and promoting recent developments in the Assistive/Social Robotics field and future directions including the related challenges and how these can be overcome with particular focus on computational intelligence methodologies. With robots being integrated more and more in our environments and daily activities, the effectiveness of robotics applications has to rely on robots' ability to perceive, reason, and adapt on-the-fly to the users' behavior and needs. In particular, the development of personal robots, as assistive technological tools, challenges researchers to develop socially intelligent and adaptive robots that can collaborate with people in real environment.

This special issue is comprised of 14 papers, fostering discussions and investigations in robot behavior adaptation and learning, in socially assistive robotics, and in developing reliable systems for natural interactions between humans and robots. Several aspects and perspectives are taken into consideration by the authors covering various topics such as adaptability during real-world human–robot interactions; new reinforcement learning and learning by teaching techniques especially used in the context of child-robot interaction; social robot responses, perception and adaptation by means of a semantic representation; robots acceptability and security. Furthermore, several assistive applications for the elderly, children, and people are presented.

✉ Mariacarla Staffa
mariacarla.staffa@unina.it

Silvia Rossi
silvia.rossi@unina.it

Adriana Tapus
adriana.tapus@ensta-paris.fr

Mehdi Khamassi
mehdi.khamassi@upmc.fr

[1] University of Naples Federico II, Naples, Italy

[2] ENSTA Paris, Institut Polytechique de Paris, Palaiseau, France

[3] Sorbonne Université, CNRS, ISIR, Paris, France

In the field of assistive robotics, adaptation to the specific needs of patients was considered in "A Holistic Approach to Behavior Adaptation for Socially Assistive Robots" (by A. Umbrico, A. Cesta, G. Cortellessa, and A. Orlandini) with a semantic-based cognitive architecture to generate robotic assistive objectives. The approach is based on ontologies for characterizing the internal knowledge and the self-awareness of a social robot and specifying its capabilities to support users during its assistive services in adaptive and personalized scenarios.

Adaptation to the user is also considered in "Short-Term Human–Robot Interaction Adaptability in Real-World Environments" (by A. Andriella, C. Torras, and G. Alenya), where an assistive robotic platform relying on planning techniques extended with adaptive social capabilities, is used to assist people during short-term interactions. The robot adapts itself according to the stage of the game and provide assistance to the user.

Conceiving robot control architectures to be applied to a variety of experimental situations is the central issue addressed in "The RHIZOME Architecture: An Adaptive Neurobehavioral Control Architecture for Cognitive Robots Application in a Vision-Based Indoor Robot Navigation Context" (by D. M. Rojas Castro, A. Revel, and M. Ménard). The approach consists in exploiting the synergy of different state-of-the-art control paradigms by merging them into a neural structure that evolves and adapts its behavior learning from the dynamic interaction of the robot with its environment and with other cognitive agents.

The development of a strategy for robot-assisted navigation is investigated in "Reinforcement Learning Aided Robot-Assisted Navigation: A Utility and RRT Two-Stage Approach" (by L. Garrote, J. Paulo, and U. Nunes) that is based on user intent adjustments. Such adjustments are learned by reinforcement learning (RL) and supported on a rapidly exploring random tree (RRT) inspired algorithm. The proposed framework relies on local environment perception and layers for avoiding collisions and following social norms, so to effectively guiding the user.

Human-like obstacle avoidance is also addressed in "A hybrid Joint/Cartesian DMP-based approach for obstacle avoidance of anthropomorphic assistive robots"[1] (by C. Lauretti, F. Cordella, L. Zollo) that proposes an approach based on joint-space dynamic movement primitives (DMP) to perform goal reaching with a robotic arm. The approach integrates two DMPs in the task and joint space that are merged together using a scheme that gives priority to the task space position.

In the field of social assistive robotics applications, "A Novel Reinforcement-Based Paradigm for Children to Teach the Humanoid Kaspar Robot" (by A. Zaraki, M. Khamassi, L. J. Wood, G. Lakatos, C. Tzafestas, F. Amirabdollahian, B. Robins, K. Dautenhahn) presents a novel child-robot learning by teaching scheme tested with a group of typically developing children and a small group of children with autism. The objective is to stimulate interaction and collaboration between a group of children while teaching the robot simple object-name associations.

On the same topic of learning in child-robot interaction the article "Children Teach Handwriting to a Social Robot with Different Learning Competencies" (by S. Chandra, P. Dillenbourg and A. Paiva) presents an autonomous educational system incorporating a social robot able to enhance children's handwriting skills. The system provides a one-tone learning scenario based on the learning-by-teaching approach where a tutor-child assesses the handwriting skills of a learner-robot.

Dealing with neural networks for artificial perception and control of robot-prothesis is the contribution "A WiSARD Network approach for a BCI-based Robotic Prosthetic Control" (by M. Staffa, M. Giordano, and F. Ficuciello). The manuscript presents a method relying on the use of a WiSARD weightless neural network-based classifier, a robotic hand and a brain-computer interface (BCI) controller interface to realize a portable and easy of use solution in the area of automatic robotic-prosthesis control.

Neural networks to detect human internal state is also considered in "On-the-fly Detection of User Engagement Decrease in Spontaneous Human–Robot Interaction using Recurrent and Deep Neural Networks"[2] (by A. Ben Youssef, G. Varni, S. Essid, and Ch. Clavel), where a recurrent and deep neural networks is proposed to detect engagement decrease of users spontaneously interacting with a socially assistive robot in a public space. The user behaviour is here analyzed focusing on proxemics, gaze, head motion, facial expressions and speech during interactions with the robot.

Application of social robots in pediatric health-care is the topic of "Emotional and Behavioral Distraction by a Social Robot for Children Anxiety Reduction During Vaccination" (by S. Rossi, M. Larafa, and M. Ruocco), where a social robot is used to interact with children during the vaccination process with the aim to reduce stress and anxiety through distraction techniques that integrate different emotional states very similar to those used by health professionals.

Also dealing with health-care applications targeting Elderly population, the paper "ENRICHME: Perception and Interaction of an Assistive Robot for the Elderly at Home" (by S. Cosar, M. Fernandez-Carmona, R. Agrigoroaie, J. Pages, F. Ferland, F. Zhao, S. Yue, N. Bellotto, and A. Tapus) introduces the robotic platform developed in the ENRICHME project, whose main goal is to enrich the day-to-day experience of elderly people at home with technologies that enable health monitoring, complementary care, and social support.

Dealing with the use of ontologies to model human activities in real world with a particular focus on assistive robotics applications, "Culture as a Sensor? A Novel Perspective on Human Activity Recognition"[3] (by T.-C. Chiang, B. Bruno, R. Menicatti, C. T. Recchiuto, and A. Sgorbissa) presents a culture-aware human activity recognition system which aims to include culture-specific information about where and when activities are most likely performed in different cultures.

Also dealing with ontologies for modeling real world objects in human–robot assistive scenarios, "Multimodal object-based environment representation for assistive robotics" (by Y. Breux, S. Druon, and J. Triboulet) proposes a global architecture bridging the gap between perception and semantic modalities allowing the automatic generation of object-related ontology for a practical formalization of the ill-defined notion of context.

Finally, cybersecurity issues during robot deployment within human societies is presented in "TROS: Protecting Humanoids ROS from Attackers with Physical Access" (by G. Mazzeo and M. Staffa). Humanoids typically reside in untrusted environments where physical access to the robot is allowed and expected by opening the risk of violating the privacy of people's data and threaten human integrity from physical and emotional/social point of views. The work presents a patched Robot Operating System (ROS) solution called TROS (Trusted ROS) leveraging hardware-assisted trusted computing to shield data managed by ROS, which otherwise would reside in robot's unencrypted memory.

We thank the Editors-in-Chief (Prof. Shuzhi S. Ge and Prof. Agnieszka Wykowska), the Co-Editor-in-Chief (Prof. Oussama Khatib), the Springer Executive Editor for Engineering (Nathalie Jacobs), and staff at Springer, for their

[1] This contribution, that belongs to the special issue, was already published in a regular issue by mistake and can be found here (https://link.springer.com/article/10.1007/s12369-019-00597-w).

[2] This contribution, that belongs to the special issue, was already published in a regular issue by mistake and can be found here (https://link.springer.com/article/10.1007/s12369-019-00591-2).

[3] This contribution, that belongs to the special issue, was already published in a regular issue by mistake and can be found here (https://link.springer.com/article/10.1007/s12369-019-00590-3).

support and effort in producing this special issue. It is our hope that this special issue will generate interest and research endeavors, resulting in better understanding of robot behavior adaptation, human–robot interaction, and perception for assistive social robots and their many potential applications for improving the quality of human lives.

Guest Editors

Mariacarla Staffa*, University of Naples Federico II, Italy
Silvia Rossi, University of Naples Federico II, Italy
Adriana Tapus, ENSTA Paris, France
Mehdi Khamassi, Sorbonne Université/CNRS, France

Mariacarla Staffa is Assistant Professor in Artificial Intelligence and Cognitive Robotics and Computer Science at the University of Naples Federico II, Italy. She received the M.Sc. degree in Computer Science from the University of Naples Federico II with honors, in 2008. She got a Ph.D. in Computer Science and Automation Engineering from the University of Napoli in 2011. She was visiting researcher at the "Institute de Système Intelligentes et de Robotique" of the University of Paris "Pierre et Marie Curie". She is member of the Institute of Electrical and Electronics Engineers (IEEE) and of the EUCognition - European Society for Cognitive Systems (ID: 2037). She is also part of the IEEE RAS Technical Committee for Cognitive Robotics. She serves as Expert Reviewer for European Commission Framework Programme for Research and Innovation (Area: AI and Robotics). She is member of the PRISCA (Projects of intelligent robotics and advanced cognitive systems) Laboratory, making research in the fields of Cognitive Robotics, Artificial Intelligence and Social and Assistive Robotics and of the ICAROS center (Interdepartmental Center for Advances in Robotic Surgery) of the University of Naples Federico II, aiming at creating synergies between clinical and surgical practice and research on new technologies for computer/robot assisted surgery. She is mainly interested in exploring computational neuroscience and cognitive robotics to generate innovative strategies and solutions for scientific problems and technological limitations. She authored several works on Social Assistive Robots, Adaptive Human Robot Interaction, Human Behavior and Emotion interpretation, etc.

Silvia Rossi received the M.Sc. degree in Physics in 2001, and the Ph.D. degree in Information and Communication Technologies in 2006. She has been an Assistant Professor with the Department of Electrical Engineering and Information Technologies, University of Naples Federico II, since 2009, where she is currently co-chief of the PRISCA (Intelligent Robotics and Advanced Cognitive System Projects) Laboratory. Her research interests include Multi-agent Systems, Human- Robot Interaction, Socially Assistive Robotics, and Recommender Systems. She is involved in the committee/organization of several International conferences on human-robot interaction and multi-agent systems. She is Associate Editor for IEEE Robotics and Automation Letters (RA-L), International Journal of Social Robotics, Pattern Recognition Letters, and for Intelligent Service Robotics journal.

Adriana Tapus is Full Professor in the Autonomous Systems and Robotics Lab in the Computer Science and System Engineering Department (U2IS), at ENSTA-ParisTech, France. In 2011, she obtained the French Habilitation (HDR) for her thesis entitled "Towards Personalized Human-Robot Interaction". She received her PhD in Computer Science from Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland in 2005 and her degree of Engineer in Computer Science and Engineering from Politehnica University of Bucharest, Romania in 2001. She worked as an Associate Researcher at the University of Southern California (USC), where she was among the pioneers on the development of socially assistive robotics, also participating to activity in machine learning, human sensing, and human-robot interaction. Her main interests are on long-term learning (i.e. in particular in interaction with humans), human modeling, and on-line robot behavior adaptation to external environmental factors. Prof. Tapus is an Associate Editor for International Journal of Social Robotics (IJSR), ACM Transactions on Human-Robot Interaction (THRI), and IEEE Transactions on Cognitive and Developmental Systems (TCDS) and in the steering committee of several major robotics conferences (General Chair 2019 of HRI, Program Chair 2018 of HRI, General Chair 2017 of ECMR). She has more than 150 research publications and she received the Romanian Academy Award for her contributions in assistive robotics in 2010. She was elected in 2016 as one of the 25 women in robotics you need to know about. She's also the PI of various EU and French National research grants.

Mehdi Khamassi has a double background in Computer Science (Engineering diploma in 2003 from Ecole Nationale Supérieure d'Informatique pour l'Industrie et l'Entreprise, Evry with specialization in Artificial Intelligence and Statistical Modeling) and Computational Neuroscience (CogMaster in 2003 from Université Pierre et Marie Curie, Paris). Then he obtained a PhD at Université Pierre et Marie Curie in 2007. Since 2010, he has been a tenured research scientist employed by the French National Center for Scientific Research (CNRS), and working at the Institute of Intelligent Systems and Robotics, Sorbonne Université. His main topics of research include decision-making and reinforcement learning in robots and humans, and the role of social and non-social rewards in learning. He serves as co-director of studies for the CogMaster program at Ecole Normale Supérieure, Paris, and as Associate Editor for the journals Intellectica, Frontiers in Neurorobotics, Frontiers in Decision Neuroscience, and Neurons, Behavior, Data analysis and Theory.