

## Report for the Triennial Review

### TC Co-Chairs:

- Cynthia Breazeal, MIT, Cambridge, USA
- Yasushi Nakauchi, University of Tsukuba, Japan
- Cecilia Laschi, Scuola Superiore Sant'Anna, Pisa, Italy

### Assessment of TC over the past 3 years, goals for next 3 years, and the feasibility of retiring the TC

#### *Activities in the past three years (Spring 2006 – Spring 2009)*

The TC on Human-Robot Interaction and Communication was funded in 1999, and the TC Co-Chairs were periodically changed as summarized below.

1999	Shigeki Sugano, Waseda University, Tokyo, Japan Kasuhito Kosuge, Tohoku University, Sendai, Japan Maria Chiara Carrozza, Scuola Superiore Sant'Anna, Pisa, Italy
2001	Shigeki Sugano, Waseda University, Tokyo, Japan Kasuhito Kosuge, Tohoku University, Sendai, Japan Cecilia Laschi, Scuola Superiore Sant'Anna, Pisa, Italy
2005	Cynthia Breazeal, MIT, Cambridge, USA Yasushi Nakauchi, University of Tsukuba, Japan Cecilia Laschi, Scuola Superiore Sant'Anna, Pisa, Italy

In line with the strategies and the policies of the IEEE RAS for TCs, the mission of the TC on HRIC has always been to create and consolidate the community of researchers in human-robot interaction and coordination, by providing a framework for discussion for the variety of issues related to the development of robots intended to interact with human beings.

The activities of the TC in the last three years mainly concerned the organization of events and publications, representing concrete opportunities for the community to meet and share experiences, methods, and perspectives. Examples of such events are a *Special Issue* of the Transactions on Robotics, as well as *Workshops* at the main IEEE-RAS Conferences, as specified in the following, in the section devoted to the "List of activities during the past three years".

Such activities have greatly served the purpose of consolidating the community of robotics researchers and researchers in different fields, addressing the problems related to the interaction between human beings and robots.

#### *Goals for the next three years (Spring 2009 – Spring 2012)*

The TC aims at coordinating the activities of the young scientific community of human-robot interaction inside the IEEE RAS. In the next three years, the TC aims at achieving measurable results in this sense, like at least one focused workshop, one Summer school, one special issue of a robotics journal.

The field of human-robot interaction includes diverse areas of investigation, which range from the development of control techniques managing the physical interaction of the robot with a person, to the study of the communication and cooperation in task execution, to the emotional exchange between the robot and its user. The goals for the next three years will focus more on this latter younger area of investigation.

It is worth mentioning that in the current period there is an increasing number of examples of robotics systems that are reaching a status of development mature enough to be experimented and demonstrated in real-world scenarios, in contacts with common people. This is the case of some European projects

funded in the last call of FP6 (“Advanced Robotics”) which are aimed at demonstrating service robots in urban environments, during 2009. Japan has pioneered real-world demonstrations of robot with common people and has now examples of semi-permanent installations of robots and networks, like the one at the Universal City of Osaka.

The goals and the role of the TC in the next three years are assuming a stronger impact in these terms.

### ***Feasibility of retiring the TC on HRIC***

The community of human-robot interaction is steadily growing worldwide. As mentioned, there is an increasing number of applications of service robots in human environments and of extensive experimental trials in real-world scenarios. For this reason, the community would still greatly benefit from the coordination given by the TC, especially within the IEEE.

An option that can help increase the capability of the TC to offer services to the human-robot interaction community is to nominate new co-chairs, chosen according to these goals of the TC for the next period.

### **List of activities during the past three years**

The major activities of the TC in the last three years are summarized below:

- **Workshop WF-1** “Collaborative Human-Robot Teamwork”, at the IEEE-RAS International Conference on Robotics and Automation, **ICRA 2006**, Orlando, FL, USA, 19 May 2006 - Organizers: Cynthia Breazeal, Cecilia Laschi, Yasushi Nakauchi

The workshop had a good success in terms of participants (more than 40 people) and discussion. The speakers were well-known scientists in the field of human-robot interaction, presenting different experiences in the development of human-robot interaction techniques, in humanoid robotics and in rescue robotics:

1. Cynthia Breazeal
2. Raja Chatila
3. Sylvain Colinon
4. Terry Fong
5. Takayuki Kanda
6. Kazuhiro Kosuge
7. Robin Murphy
8. Jean Scholtz
9. Alan Schultz
10. Kazuhito Yokoi

The contributions from the speakers were collected in the forms of short papers, distributed to the workshop participants.

- **Special Issue** on Human-Robot Interaction of the IEEE **Transactions of Robotics** (Vol.23, Issue 5, October 2007). This special issue had a great success in terms of submissions, which reached the **record** number of 83, and which required the publication of a double issue of 25 papers.
- **Workshop WW-H3** “Human Robot Interaction: Cognitive factors and their applications” at the IEEE-RAS International Conference on Robotics and Automation, **ICRA 2009**, Kobe, Japan, 13 May 2009 – Organizers: Hiroshi Ishiguro, Cecilia Laschi, Cynthia Breazeal, Yasushi Nakauchi, Yuichiro Yoshikawa.

The speakers scheduled in the workshop are:

1. Hiroshi Ishiguro
2. Kazuhiro Kosuge
3. Shigeki Sugano
4. Gerhard Sagerer, Britta Wrede, and Katharina J. Rohlfing
5. Nikolaos Mavridis
6. Kevin Gold
7. Yuichiro Yoshikawa

### **List of outreach activities outside the RAS**

- Special session "Human-Robot Interaction", "KUKANCHI (Intelligent Environments)", and "Co-creation Systems" at The Annual Conference of System Integration Division, SICE, Dec., 2006 at Sapporo, Dec., 2007 at Hiroshima, and Dec. 2008 at Gifu, Japan. (Co-organizer: Yasushi Nakauchi)
- JSSST 16th Workshop on Interactive Systems and Software (WISS 2008), Dec., 2008 at Kobe, Japan. (General Co-Chair: Yasushi Nakauchi)
- HRI Conference
- Growing number of papers on human-robot interaction in the HRI and HCI conferences

### **List of important publications over past 3 years in TC area.**

- T. Kanda, R. Sato, N. Saiwaki, H. Ishiguro, "A two-month Field Trial in an Elementary School for Long-term Human-robot Interaction", *IEEE Transactions on Robotics (Special Issue on Human-Robot Interaction)*, 23(5), pp. 962-971, 2007
- A. Billard, B. Robins, K. Dautenhahn, J. Nadel, "Building Robota, a Mini-Humanoid Robot for the Rehabilitation of Children with Autism", *the RESNA Assistive Technology Journal*, 19 (2006)
- H. Ishiguro, "Scientific issues concerning androids", *International Journal of Robotics Research* (IF 2005: 1.127), Vol. 26, No. 1, pp. 105-117, 2007
- J.G. Trafton, N.L. Cassimatis, M.D. Bugajska, D.P. Brock, F.E. Mintz, A.C. Schultz, "Enabling effective human-robot interaction using perspective-taking in robots", *IEEE Transactions on Systems, Man and Cybernetics, Part A: Systems and Humans*, Vol.35, Issue 4, pp.460-470 (2005)
- R. Kelley, C. King, A. Tavakkoli, M. Nicolescu, M. Nicolescu, G. Bebis, "An Architecture for Understanding Intent Using a Novel Hidden Markov Formulation", *International Journal of Humanoid Robotics, Special Issue on Cognitive Humanoid Robots*, vol. 5, no. 2, pages 1-22, 2008.

### **Summary of top three technical innovations in the area during the past three years**

- Development of the "Geminoid" robot and in general of the "android" approach proposed by Hiroshi Ishiguro;
- extensive user trials conducted by the group at ATR (Kyoto), including Norihito Hagita, Takayuki Kanda, Hiroshi Ishiguro, with the Robovie humanoid robots, interacting with common people and with children in schools, for several weeks;
- deployment of rescue robots in real scenarios in the US (by Robin Murphy et al.);
- application of robots in the diagnosis and treatment of autism (Scassellati in the US, Billard in Europe);
- development of interactive robots like ENON by Fujitsu, Emu2 by Hitachi, Wakamaru by MHI, ASHIMO by Honda, which are being actively used.

### **Number of members of each year in the past three years**

- 2006: 20
- 2007: 25
- 2008: 30

### **Recommendations (and alternatives) for new co-chairs:**

- Hiroshi Ishiguro, University of Osaka, Japan
- Monica Nicolescu, University of Nevada, Reno, USA
- Pericle Salvini, Scuola Superiore Sant'Anna, Pisa, Italy