

---

## Session Overview

### Humanoids

Hirohisa Hirukawa

National Institute of Advanced Industrial Science and Technology (AIST)  
1-1-1 Umezono, Tsukuba 305-8568 Japan

An epoch of humanoid robotics started from the astonishing reveal of Honda P2 in 1996, and the focus of interest in the field has been the motion control of humanoid robots as well as the development of the hardware in the beginning of the decade. A reliable hardware with the minimum level of the mobility can be a research platform of humanoid robotics as well as mobile robot platforms like Nomad. Several research platforms are available currently including HRP-2 with software platform OpenHRP and HOAP series, and the interests in humanoid robotics can spread over various topics; that is, intelligence, interactions with humans and a tool of cognitive science. The state of the art of humanoid robotics has arrived at the level of the beginning of mobile robot technologies in 1980s, and every aspect of robotics is now expected to be integrated on humanoid robots.

The paper by Satoshi Kagami et al. extends the autonomy of humanoid robots. They developed an enhanced version of humanoid robot HRP-2, called HRP2-DHRC, equipped with three d.o.f. hands, three d.o.f. wrists, one d.o.f. toes, higher resolution stereo cameras and laser range finders. The autonomy embedded on the robot includes a footstep planning with mixed reality with an online motion capture system, a vision guided footstep planning, an object localization from a depth matching, a navigation from 3D localization, and that among movable obstacles. HRP2-DHRC should be one of most advanced humanoid robots from the viewpoint of autonomy.

The paper by Hiroshi Ishiguro proposes android science as a new cross-interdisciplinary framework. He found that the appearance of the robot should have a significant influence on the impression of a humanoid robot as well as its behaviors. He developed humanoid robots that look like humans and executed a cognitive experiment in which subjects are asked to judge if a figure should be an android or a real human in two seconds. The result of the experiment told that the subjects should judge the figure is a real human in more chance when the figure has a real appearance with some human-like behavior. We had intensive discussions on his talk, especially on the significance of his work. It

was claimed out that the objective of the research may not be clarified, but Ishiguro tried to defend his approach.

The paper by Yoshihiro Nakamura et al. investigated the interaction between a human and a humanoid. They introduced a meta proto-symbol which is an abstract analogy of the proto-symbol. The meta proto-symbol is applied to recognize and generate the relationship of a human and a humanoid. They applied the proposed concept to a fight between a humanoid robot and a subject in a virtual world. The robot was able to recognize the human behaviors and generate the responses through mimetic communications with the human.

The papers contributed to the session showed the three directions in which humanoid robotics should be enriched in the coming decade, that is, autonomy, cognitive science and interaction with humans.