Title of Project : Research on Active Coordination Technology for Human Symbiotic Robot

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Research Area : Human informatics, Intelligent robotics
Keyword : Intelligent robot, Intelligent information processing

【Purpose and Background of the Research】

Labor shortages caused by aging society have become a severe problem in developed countries. Because symbiotic robots can work with humans or support them in daily life, public and medical and welfare services, interest in human symbiotic robots has increased in these countries. These robots are expected to share a place at the same time with humans. Safety and work-efficiency are key issues for these robots. In the conventional framework of human symbiotic robots, it has been thought for long time that robots must avoid physical interactions with humans to ensure safety.

We consider this concept a major hurdle to enable robots to work efficiently with humans. Thus, we propose a shift of paradigm from: robots must avoid physical interactions with humans, to *robots should actively coordinate with humans*. We believe this paradigm shift can be a breakthrough to develop human symbiotic robots that are both safe and efficient. The purpose of this study is to establish a methodology to design mechanical structures and intelligent human symbiotic robots that coordinate actively with humans (Fig. 1).

Figure 1 Research purpose

【Research Methods】

This study can be divided into two major subjects. One is modeling the interaction between humans and robots both from a psychological and physiological (statics and dynamics) viewpoint. The second is to develop novel control theory and intelligence based on these models. We will validate experimentally these models using robots such as upper body humanoids with flexible manipulators and bipedal humanoid robot (Fig. 2). These investigations will be conducted in three major situations where interaction between humans and robots occurs:

(A) Weak contacts to teach one's direction.
(B) Dynamic contacts for coordination
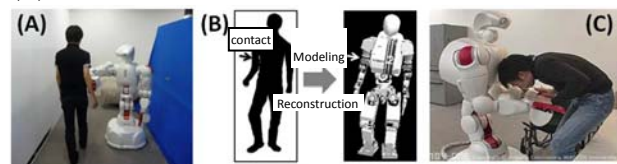(C) Actions to make a human to move

Figure 2 Research method

【Expected Research Achievements and Scientific Significance】

There are a few studies on physical interactions between humans and robots, especially active coordination between them. This study aims to establish a general methodology that can be used in various situations, whereas conventional studies in this field focus on a specific situation.

Once the methodology is established, it can be used in the design of various kinds of human symbiotic robots such as humanoid robots, human assisting devices, rehabilitation equipment and personal mobility systems.

【Publications Relevant to the Project】

- H. Iwata and S. Sugano, "Design of human symbiotic robot TWENDY-ONE," in Proc. IEEE Int. Conf. Robotics and Automation (ICRA), pp. 580-586, 2009.
- Yo Kobayashi, Masakatsu G. Fujie, et al. , "Soft interaction between body weight support system and human using fractional impedance Control", Advanced Robotics, 26, pp. 1253-1269, 2012.

【Term of Project】 FY2013-2017

【Budget Allocation】 167,800 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.sugano.mech.waseda.ac.jp/
http://www.twendyone.com/
http://www.takanishi.mech.waseda.ac.jp/
http://www.fujie.mech.waseda.ac.jp/