Title of Project : Developmental Approach in Configuring Body and Behavior of Life-size Humanoids with Whole-body Passivity and Attention Inductivity

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Research Area : Comprehensive fields

Keyword : Intelligent robot, Sensation/Perception/Attention, Sensory behavior system

【Purpose and Background of the Research】

Research and development of life-size humanoids has progressed towards assistance in daily life, but it is still hard to ensure the safety to human and environment due to lack of rich capabilities to recognize and reason daily situations and enough flexibility in body structures for direct contact with human and environment.

The goal of this research is to reveal the effective configuration method of both body design hardware and motion control software for life-size humanoid with whole-body passivity and attention inductivity through developing the functions incrementally and comparing the difference between each steps of development in describable form, where a humanoid can detect human presence and safely react to any direct contact to human or environment while it is performing goal-oriented tasks and also human can interrupt and navigate the humanoid motions through attention-seeking behaviors and inductive behaviors.

【Research Methods】

In this research, we study how to configure body structures and behavior strategy with whole-body passivity and attention inductivity through changing and evaluating body hardware and perception software components in a stepwise fashion on the life-size humanoid platform with the intelligent robot-software kernels leveraging research on whole-body flesh and musculo-skeletal humanoids.

In particular, the steps of this research comprises (1) building modeling system of body and behaviors, (2) step-wise addition of passivity in flesh and joints, (3) configuring internal reaction system for whole-body passivity control, (4) building the development system for evaluation, (5) whole-body passivity evaluation in stepwise realization of mobile-manipulation, (6) attention inductivity evaluation in perceptive behaviors.

Ultimately, the developmental approach in configuring body and behavior system is summarized through evaluating the effectiveness in whole-body passivity and attention inductivity for safe and adequate reaction to dynamic interaction with human during performing tasks.
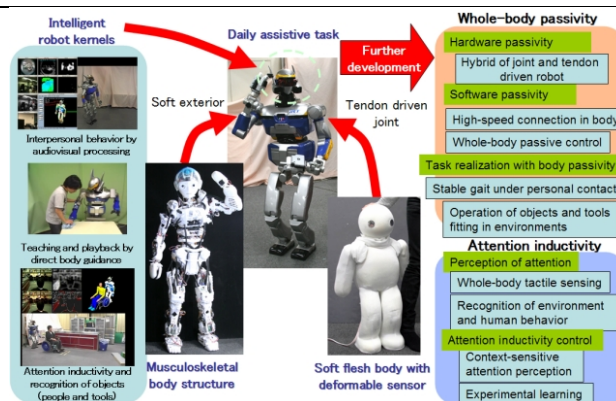
【Expected Research Achievements and Scientific Significance】

The feature of this research is to developmentally seek the body design methodology based on hybrid type of conventional joint-driven humanoids and musculoskeletal tendon-driven ones, and to reveal how to configure robot systems for various tasks in daily life from both sides of software and hardware by adding attention inductivity for human interaction.

It provides important results to describe the development steps about how the body and behavior components such as variable stiffness joint, whole-body flesh, attention-seeking reaction, and motion control to follow inductive motions contribute to enough passivity and inductivity on real platform. And also this result will be an important basis for daily assistive humanoids which can assist human and learn from human in daily environment for the future.

【Publications Relevant to the Project】

M. Inaba, K. Okada, I. Mizuuchi, T. Inamura: Humanoid Programming System in Euslisp, Computer Software, Vol. 23, No.2,pp.45-61, 2006.

T.Yoshikai,M.Hayashi,M.Inaba: Simultaneous Learning and Recalling System for Wholebody Motion of a Humanoid with Soft Sensor Flesh, Proc. 10th International Conf. on Intelligent Autonomous Systems, pp.229—237, 2008

【Term of Project】 FY2009-2013

【Budget Allocation】 189,200 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.jsk.t.u-tokyo.ac.jp