A High-power and Flexible Humanoid Robot Driven by Artificial Muscles of Back-drivable Spiral Motors

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【Outline of survey】

This survey aims at developing a high-power and flexible humanoid robot driven by novel direct-drive type spiral motors, and at realizing a high-power, wide-band, and high-dynamic-range motion control system. Conventionally, combination of servo motors and high-ratio gears such as harmonic gears is widely used in robotic applications. Loss of torque and output power occurs during their transmission by the gears. Therefore, the joint of robots has a non-backdrivable characteristic that causes lack of adaptability and safety. Various models of joint structure that recovers the backdrivability were reported in the past works. However, size of these actuators is unsatisfactory for autonomous humanoid robots. In this survey, novel direct-type spiral motors are applied to a humanoid robot to overcome this drawback. The spiral motor consists of a spiral stator and a spiral mover, which moves spirally in the stator. The motor is compact and easy to control, and gains high-thrust. These characteristics are suitable for a high-power and flexible humanoid robot.

【Expected results】

The target performances of this survey are as follows; the frequency response of the force control system is 1kHz or more, the dynamic range of the force control system is 40dB, and the frequency response of the position control system is 100Hz. Based on the high-speed force response with gearless direct-drive spiral motors, the humanoid robot will achieve very quick motion control including fully active collision impact control between the robot and the environment.

【References】

• Hyuk-jin Kwon, Yasutaka Fujimoto, "Thrust Characteristic of High-Thrust Spiral Motor Using FEM Analysis", IEEJ Trans. on Industry Applications, vol. 127-D, no. 6, pp. 653-662, 2007
• Hyuk-jin Kwon and Yasutaka Fujimoto, "Thrust Characteristic of Spiral Motor Using FEM Analysis and Compensation for Thrust Fluctuation", Proc. IEEE Int. Workshop on Advanced Motion Control, pp. 535-540, 2006

【Term of project】 FY2007－2011	**【Budget allocation】 12,800,000 yen** (2007 direct cost)

【Homepage address】 http://www.fujilab.dnj.ynu.ac.jp/