

【Grant-in-Aid for Scientific Research(S)】

Integrated Science and Innovative Science (Comprehensive fields)



Title of Project : High-speed Intelligent Robot Using Ultra High-speed Vision

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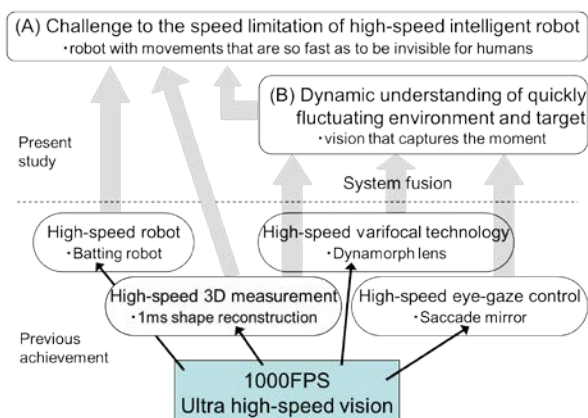
Research Area : Informatics, Intelligent Robotics

Keyword : Intelligent Robot, Image Information Processing

【Purpose and Background of the Research】

General intelligent robots are designed with a primary goal of the emulation of human capabilities and cannot achieve fast and dexterous movement such as human motion. On the other hand, industrial robots can repeat preplanned motion quickly. However its variation of motion is limited only to a certain specific task. That is, almost all robots cannot quickly respond to environmental change due to insufficient motor performance and recognition performance.

In this research, we aim at the speed limitation of mechanical systems themselves integrating high-speed 3D shape measurement, high-speed eye-gaze control and high-speed varifocal technology into an intelligent robot. In concrete terms, the purposes of this research are (A) development of a high-speed intelligent robot whose movements are so fast as to be invisible to a human being, and (B) realization of the dynamic understanding of environment and target with motions that are too fast for humans to clearly observe.



【Research Methods】

(A) Challenge to the speed limitation of high-speed intelligent robot: We systematically establish motion principle, necessary condition, and design guide for making a high-speed intelligent robot, and implement them. First, we develop the technology (B) described below to detect the fluctuating environment, and achieve intelligent sensory feedback based on the understanding of all

information in behavioral space. Next, our high-speed actuation technology is applied to various body parts including not only the upper limb and also the lower limb, and our high-speed movement theory based on the phase synchronization of body motion is also implemented into the high-speed intelligent robot.

(B) Dynamic understanding of quickly fluctuating environment and target: We develop the following three terms as the environment recognition technology: B-1) high-speed 3D shape measurement with 1kHz temporal precision and sub mm spatial precision, B-2) high-speed eye-gaze control using high-speed mirror with the velocity of 17,000 deg/s, and B-3) high-speed varifocal technology optimized for the usage of robotic vision.

【Expected Research Achievements and Scientific Significance】

This research delivers drastic improvement regarding the methodology of both sensing and actuation, and breakthrough of real-time sensory feedback robots. In concrete terms, the development of various applications can be expected such as speeding up and high accuracy on FA/manufacturing line, high-speed position control, non-stop visual control, flexible object control, human-machine cooperation, human motion assist, and human-robot interface.

【Publications Relevant to the Project】

Masatoshi Ishikawa, “High speed vision and its applications”, Applied Physics, Vol.81, No.2, pp.115-120, 2012.

Taku Senoo, Akio Namiki and Masatoshi Ishikawa, “Hybrid Trajectory Generation of an Articulated Manipulator for High-speed Batting”, Journal of the Robotics Society of Japan, Vol.24, No.4, pp.515-522, 2006.

【Term of Project】 FY2012-2016

【Budget Allocation】 167,100 Thousand Yen

【Homepage Address and Other Contact Information】

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