[様式一学 5]

Abstract of Main Thesis

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Title of Thesis

Analysis of a Crawler Robot with Environmentally-adapted Mobility and its Modular Design

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Abstract on the Content of the Applicant's Thesis

To address the difficulties of the traditional wheeled, legged, and tracked robots, we have proposed a novel crawler mechanism, in which a planetary gear reducer is employed as the transmission device and provides two outputs in different forms using only one actuator. The novel proposed crawler is designed with excellent adaptability to the environment. The crawler can negotiate the encountering obstacle via the mechanism-realized three locomotion modes without any control planning. Another premier feature of the crawler mechanism is the absorption of impact energy through specifically-designed redundant mechanism when collisions inevitably occur between the crawler and the environment.

A dual-crawler-driven robot which is equipped with two crawler units can generate several configurations through cooperatively controlling the two actuators distributed in both crawler units. To figure out what postures can be generated by the introduced dual-crawler robot, quasi-static analysis of the robot is conducted while taking the rolling resistance into consideration and its realizable postures can be obtained numerically. The posture transition of the robot is also discussed subsequently. Experiments are conducted to verify the quasi-static analysis for each configuration.

To enlarge the application of the crawler mechanism in exploring and rescuing robot systems, we proposed a modular concept for the crawler mechanism, and achieved corresponding mechanical design of a modular crawler with waterproof and dust-proof qualities. Through connecting four of modularized crawler units to a robot body, a four-module-driven robot is realized via convenient assembly at the interface. Experiments are carried out to verify the proposed concept and mechanical design. A single-module crawler can well perform the proposed three locomotion modes for negotiating obstacles. The four-crawler-driven robot has good adaptability to the environment and can get over obstacles both passively and actively.