Autonomous Decentralized Multi-Legged Robot System

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In this research, we have developed an autonomous decentralized multi-legged robot system (ADMRS, Fig.2). This system is modeled on the walk pattern generating mechanism of walking animals (Central Pattern Generator: CPG, Fig.1). Each leg is an autonomous partial system (subsystem) and communicates with its neighbor subsystems, and then harmonious gait patterns are achieved as a total system. ADMRS can be composed of any number of legs and has the features such as high fault-tolerance and easiness of maintenance (Fig.3).

We developed a mathematical CPG model suitable for ADMRS. The model generates natural oscillating modes and makes them transit according to the oscillation energy. The modes and the energy correspond to the gait patterns and the desired walk speed, respectively. Thereby, this model can generate and transit the gait patterns according to the number of legs.

Moreover, we research the environment adaptation algorithms for ADMRS (Fig.4). They modulate the gait patterns according to the changes of the environment and the robot structure. We have proposed a fault-tolerance algorithm as one of them. This algorithm evaluates the leg failure by the energy consumption change and changes the gait patterns so as to distribute the energy change. The effectiveness of the algorithm was verified on the physical simulation (Fig.5, 6).

Keywords: Autonomous Decentralized System, Multi-Legged Robot, CPG, Gait, Fault-Tolerance

References

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2) Takanori SUZUKI, Shinkichi INAGAKI, Hideo YUASA and Tamio ARAI: "Fault-Tolerance for Autonomous Decentralized Multi-Legged Robot System," Intelligent Autonomous Systems 7, M. Gini et al. eds., IOS Press, pp. 325~332, 2002.

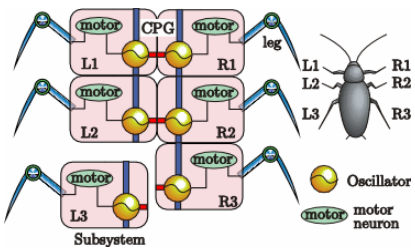

Fig. 1 CPG and Subsystem

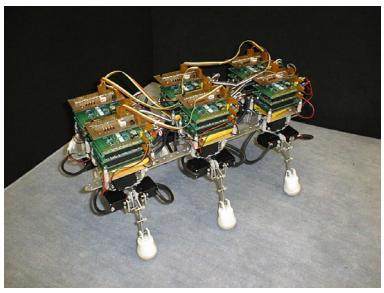

Fig. 2 Multi-Legged Robot: NEXUS

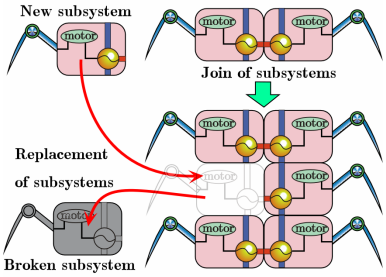

Fig. 3 Expanding of Leg-Number and Replacement

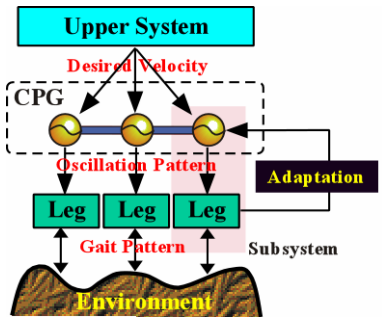

Fig. 4 CPG and Adaptation in Gait Pattern Generation

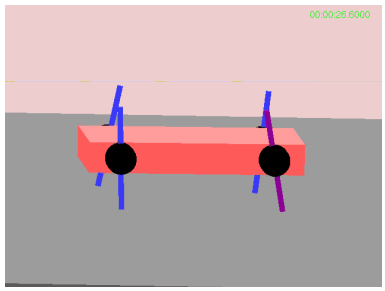

Fig. 5 Fault Tolerance Simulation for 4-Legged Robot

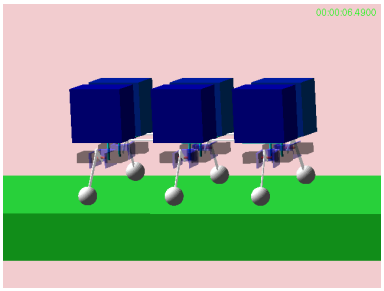

Fig. 6 Physical Simulation for 6-Legged Robot