On Recent Bio-mimetic Studies of Legged Locomotion

--- Diversity, Adaptability and Energy Consumption for Hexapod, Quadruped and Biped

Z.W.Luo, T. Odashima, F. Asano and S. Hosoe

Environment Adaptive Robotic Systems Laboratory, Bio-mimetic Control Research Center, RIKEN

463-0003 Moriyama-ku, Shimoshidami 2271-130, Nagoya, Japan, E-mail: luo@bmc.riken.go.jp

1. Introduction

During these several years, active researches have been performed within RIKEN BMC on the bio-mimetic studies of legged locomotion range from hexapod, quadruped to biped. The main objective is to clarify the *diversity*, *adaptability* as well as *efficiency* and *simplicity* of the basic control mechanism inherent in animals' locomotion control and its application in robotics.

2. Diversity of Hexapod Locomotion

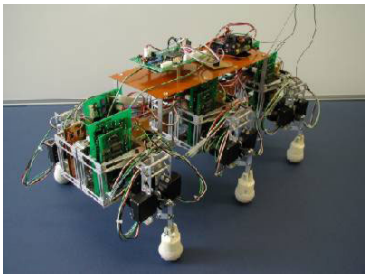

Fig.1. Modular hexapod robot with two layered hierarchical control system developed in BMC

Unlike the critical problems of balance and stability in dynamic biped locomotion, the central point in hexapod is rather to solve coordination for multi-legs with redundant D.O.F. to realize in real time the *diversity* of locomotion with respect to environmental changes. We show that, the primitive modular vector field interpolation, which was investigated in the spinally dissected frogs by Mussa-Ivaldi et al., can effectively be applied in the hierarchical control of a hexapod robot to realize diversity of locomotion. This control structure makes it easier for the robot to treat directly the logical symbolic information from sound and visual cognition in performing the dynamic locomotion.

3. Adaptive Locomotion of Quadruped

We extended the framework of autonomous decentralized system control to mathematically formulate the adaptive behavior of a decerebrate cat walking on a changing treadmill and its practical application by a quadruped robot

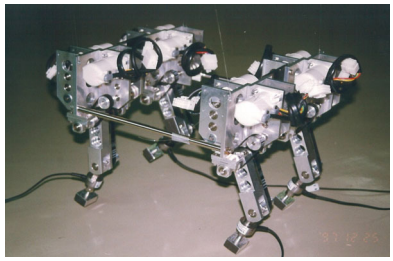

Fig.2 Quadruped Robot Developed in BMC

4. Energy Efficient Biped Locomotion

We introduced our original motion capture system for measuring, analyzing and dynamic simulating of human motions with high precision by integrating accelerometers. It is proposed that the biped robot can realize locomotion easier and energetically more efficient if we integrate both the characteristics of human locomotion as well as recent hot passive dynamic walking researches of a biped robot.

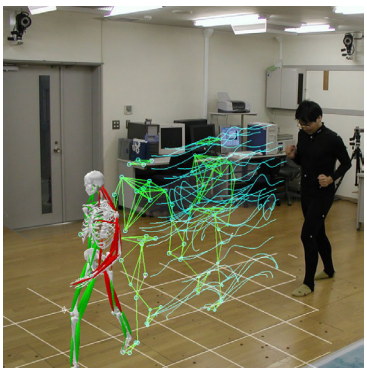

Fig.3 Dynamicon Capture System of BMC

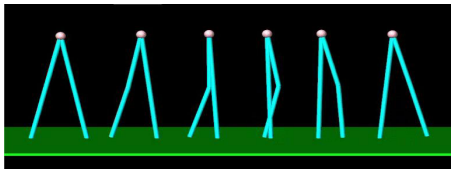

Fig.4 Stick Diagram of Virtual Passive Dynamic Biped Walking on a level

References

[1] http://www.bmc.riken.go.jp/~robot/index-e.html