

Hierarchical Design of Dynamics Based Information Processing System for Humanoid Motion Generation

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1. Introduction

Some researchers tried to design the human brain function using a nonlinear dynamics. We proposed the dynamics-based information processing system using nonlinear dynamics that has some attractors with a polynomial configuration and realized a motion generation and transition for a humanoid robot[1]. In this paper, based on the dynamics based information processing system, (1) we propose on-line embedding method of attractor to dynamics. (2) by setting the forgetting parameter, we realize plastic property for dynamics. (3) we propose the hierarchical design method for dynamics based information processing method for the motion generation based on the input signal. The proposed method is implemented to humanoid robot and realizes the motion generation and transition based on input sensor signal.

2. Hierarchical design of the dynamics based information processing system

The dynamical system memorizes the time sequence data M as an attractor and the state vector entrained to the attractor autonomously. In this section, based on the human brain cortex model, we design the hierarchical model so that the dynamics transits the attractors using external inputs. Even if the external inputs are same, produced motions are different because of the difference of internal state of the dynamics.

The hierarchical structure means the increase of the dimension of the dynamics, which causes the increase of design parameters. Design of the large dimensional dynamics is not only difficult because of the small computer power but also causes unclearness of the structure of the system, which prevent heuristic design. On the other hand, the hierarchical structure enables the large dimensional dynamics with clear structure of the system and

appropriated design for our objective.

3. Motion generation

Figure 1 shows the upper body humanoid robot 'Robovie'. The total degree-of-freedom is 11 and



Figure 1: Humanoid robot Robovie

total number of sensor signals is 19.

Figure 2 shows the motion of the state vector in motor space. By the difference of the timing of the

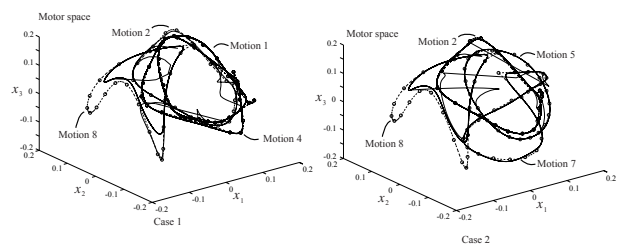


Figure 2: Motion of the dynamics in motor space

touch sensor inputs, the different motion is generated, that means the humanoid motion depends on the internal space of the humanoid robot.

References

- [1] M.Okada, K.Tatani and Y.Nakamura: Polynomial Design of the Nonlinear Dynamics for the Brain-Like Information Processing of Whole Body Motion, Proc. of IEEE International Conference on Robotics and Automation, pp1410-1415, 2002