Synthesis of Dynamics Based Information Processing System of Robot Using Synchronization in the Coupled Arnold Equations

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1. Introduction

In biological brains and nervous systems, many nonlinear dynamical phenomena like chaos are observed. It is considered that such nonlinear dynamical phenomena play important roles in the information processing in brains and nervous systems[1]. In this paper, we try to develop an information processing system of robot using such nonlinear dynamical phenomena. We design a dynamics based information processing system by which periodic motions of robot are controlled, using synchronization in the coupled Arnold equations.

2. Information Processing Using the Coupled Arnold Equations

As a nonlinear dynamics used for information processing, we employ the Arnold equation which is known to show the chaotic behaviors of non-compressive perfect fluid[2]. We designed mutual connections between two Arnold equations so that synchronization would occur. Considering one of the Arnold flow as a sensor system and the other as a motor system, we designed a dynamics based information processing system of robot, by cutting the connection from the motor system to the sensor system, and then re-connecting it through the environment as shown in Fig.1.

In order to apply the proposed method to robots with many DOF, we also designed interactions between two pairs of the sensor-motor system (in the proposed method, the coupled Arnold flows). By the interactions, motions of the two pairs are synchronized.

3. Experimental Results

We have applied the proposed method to a robot called Robovie, and conducted some experiments. We designed two pairs of the sensor-motor system,

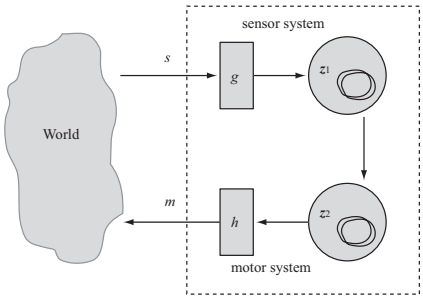

Figure 1: Behavior control using dynamical synchronization

one for controlling the right arm, and the other for controlling the left arm and the head. Periodic motions of the robot were successfully controlled by using synchronizations in the sensor-motor systems, and applying the interactions between the two systems.

4. Conclusion

In this paper, we designed a dynamics based information processing system using the coupled Arnold equations. In the proposed method, we can separately design synchronized patterns of the dynamical sensor-motor system and motion patterns of the robot. We consider that such dynamics based information processing provides a framework such that the dynamics of body and the dynamics of information processing can be merged, and it would be a basis for a robot intelligence.

References

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