

**【Grant-in-Aid for Scientific Research (S)】**  
**Science and Engineering (Engineering)**



**Title of Project : Source of various behaviors of living things that understands from zombification of insects**

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Research Project Number : 17H06150 Researcher Number : 50191937

Research Area : Control Engineering, Biology

Keyword : Various Behaviors, Zombification, Implicit Control, Control Structure, Brain-Body-Field

**【Purpose and Background of the Research】**

Living things show sufficiently high adaptive behavior even if it is a species that has only a tiny central nervous system. Such behavior is thought to be generated from the interaction of the brain, the body, and the environment, but the mechanism of its emergence remains unclear. In order to understand this essence, it is necessary to pay attention to a minimalistic set of interactions of the brain, the body, and the environment, and to extract the control structure underlying it.

Therefore, in this study, we propose a novel methodology to observe the behavior after stepwise inhibiting (zombification) the upper brain function of the animal alive. Based on the control structure identified by this study, we develop a robot adaptable to the real world with a dramatically simple control scheme.

**【Research Methods】**

We got inspiration from the hunting behavior of *Ampulex compressa* and came up with a novel methodology to "zombie" without killing the crickets. It is a method to pharmacologically inhibit the brain function of crickets. If such a "zombie cricket" can be realized, it will be possible to reach the smallest cranial nervous system for the first time. And at that time we gained confidence that "a source to create diverse gaits" will come to light.

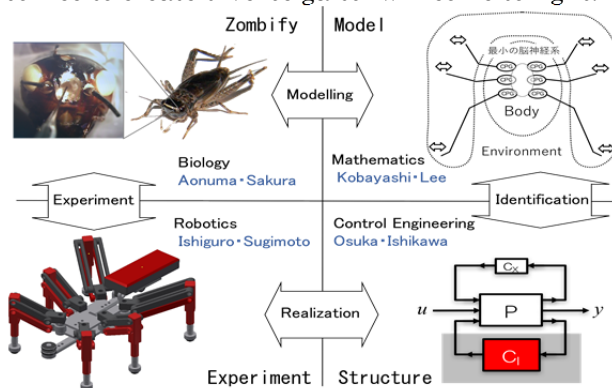


Fig.1 Research procedure

Therefore, as shown in Fig. 1, by combining biology, mathematical science, control engineering and

robot engineering, we carry out research by the following procedure.

Theme1: We establish a new method called "Zombification". Here, by properly administering a properly formulated drug to the appropriate part of the brain nerve system, the act of inhibiting the function of that part is called "Zombification".

Theme 2: "Zombie cricket" which gradually strips cranial brain system level is walked in various places by external stimulation. Then, we obtain a mathematical model of the situation, and identify the control structure generating the transformation of the gait. This is the "source of behavior" that we are seeking in this research.

Theme 3: Prove the validity of this research by prototyping a demonstration robot that realizes the identified "source".

**【Expected Research Achievements and Scientific Significance】**

The success of this trial will gain a major step towards elucidation of the mechanism of development of intellectual behavior shown by living things with simple brain nervous system only.

**【Publications Relevant to the Project】**

K.Osuka, etc.,al.: Implicit Control Law Embedded in Control System Solves Problem of Adaptive Function!?, J. of the Robotics Society of Japan, Vol.28, No.4, pp.491-502 (2012)

K.Osuka, etc.,al. :Development of Implicit Controlled Centipede Robot (i-CentiPot), Proc. of SICE Symposium on Decentralized Autonomous Systems, pp.18-23(2017)

**【Term of Project】** FY2017-2021

**【Budget Allocation】** 136,800 Thousand Yen

**【Homepage Address and Other Contact Information】**

<http://www-dsc.mech.eng.osaka-u.ac.jp/>