Co-creation System

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The purpose of our research group is to realize "Co-creation System." This co-creation means co-emergence of real-time coordination by sharing subjective space between different persons. Human communication with emergent reality like this needs two kinds of processing at the same time. One is explicit communication such as the exchange of messages and the other is implicit embodied interaction such as sympathy and direct experience. By using this dual-processing complementarily, we are developing co-creative man-machine interfaces and interactive media. We think that this new technology would be effective to recover human linkage, social ethics and mutual-reliability that has been lost in IT society.

As the background of this research, we have already pointed out the serious limitation of intelligence realized in artificial systems. We think that human intelligence can be classified into two different categories: "search" and "emergence." This searching algorithm based on "completeness" of intelligence has been widely used in IT systems. This kind of intelligence is applicable to the definite situations in which every state can be previously defined (Fig.1a). However, in the indefinite situations, such as the system including human behavior and social communication, searching cannot be applicable. In such unpredictable conditions, another type of intelligence is required and intelligence with emergence is thought to be essential to overcome the limitation of the conventional approach.

In the present IT systems based on the framework of searching, the relationship between humans and artificial systems is a one-sided transfer from the system to human. As a result, size of the information space prepared in the artificial system becomes extremely large and human becomes very passive on the other side. This is the problem of design principle that is based on the intelligence with completeness. On the other hand, our Japanese culture has very different traditional background, i.e. emergence in real-time. We think that artificial systems should be incomplete, but this is a kind of active "incompleteness" to get an emergent reality with humans (Fig.1b). Due to this incompleteness, coordination between the system and the human is co-created in real-time.

In this co-creation process, embodied interaction plays an essential role to get a relevant function with real-time coordination. You can find one famous example in the stone garden of Ryoanji temple in Kyoto. There are 15 stones in this garden, however you cannot see every stone at the same time (Fig.2). Some stones are always hidden by other stones. This is a kind

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of active incompleteness. So if you want to get a whole image of the garden, you have to walk around in the garden as a part of the garden. Then you will be able to co-create the whole image including you as a part of the garden. This is the design principle of co-creation system that is based on the active incompleteness and embodiment. However, how to realize such co-creation process in IT system is still an open question.

To achieve this target, the design principle of co-creation system should be investigated. In our research group, "duality of self" was proposed as a hypothesis for realizing co-creation. This hypothesis assumes that our human intelligence is composed of two different processing modes. One is the process of "explicit self" and the other is "implicit self." This explicit self is concerned with self-consciousness and realizes the intelligence with completeness. In other words this intelligence is our causal operation in the formal logic. On the other hand, the implicit self is concerning to the embodiment with active incompleteness. This realizes the embodied interaction between the system and indefinite actual world. Here, the interface between these two processes is emerged by "mutual constraint." We regard this process as a co-creative process of intelligence.

From this hypothesis, we have already proposed a model of co-creation (Fig.3). This is called the "dual-dynamics model" and is composed of two sub-models. One is an internal model to show the explicit process and the other is a body model to represent the implicit process. Especially since the synchronization phenomenon of the body motion is widely observed as a typical dynamics of the embodied process, a nonlinear oscillator and mutual entrainment are used to show the dynamics of body model that can be embedded as a part of the indefinite world. This is a kind of mathematical expression of the active incompleteness and temporal coherence can be self-organized in such open space. On the other hand, the internal model is a coupled nonlinear oscillator as closed space to represent the process based on completeness. By the mutual constraint between these two sub-models, an emergent process of intelligence is simulated.

This model was represented as a part of the co-creation process between the machine and human. Particularly rehabilitation process of human walking was used as an example of it. This is because coordinated walking between two persons is widely observed in the rehabilitation for elderly people to redevelop their walking ability. Our dual-dynamics model is realized in a personal computer as a virtual walking robot and footsteps are exchanged between the robot and human walker (Fig.4). The footstep of the robot is transmitted to human by headphone and the footstep of human is feed backed to the robot by a touch sensor. Everyone has had this kind of experience when you walked with another person. In such situation, temporal coherence of footsteps between two persons spontaneously appears. This co-creation robot was named "Walk-Mate."

To evaluate the effectiveness of this system, interaction between Walk-Mate and a human with handicapped walking was analyzed. As a result, three characteristic properties were observed (Fig.5). The first one is mutual adaptation between human walker and Walk-Mate.

The periods of their footsteps mutually coincided with each other after the start of interaction. This is a kind of co-creation dynamics in walking motion. The second is the emergence of global stability including the both dynamics of human and the Walk-Mate. Fluctuation of the footstep period due to the handicapped walking was significantly decreased in this co-creation process. The third is the sense of togetherness emerged in this process, suggesting this process also realizes the emergence of our mind connection. These results show that our proposed framework could be effective to establish co-creation process between human and artificial systems.

In this way, we are developing co-creation systems in man-machine interface. But in the next step, this technology for co-creative interface should be extended to a network system to support co-creative communication in human linkage. On the Internet, exchange of explicit information is very easy but the implicit process cannot be shared there. This means there is no co-creation on the Internet. Recently, as the Internet has penetrated through daily life, relation-building problems, such as mutual reliability in virtual community and togetherness between remote families, becomes the main topic. We'd like to propose this co-creation technology to overcome the problems of the modern network society.

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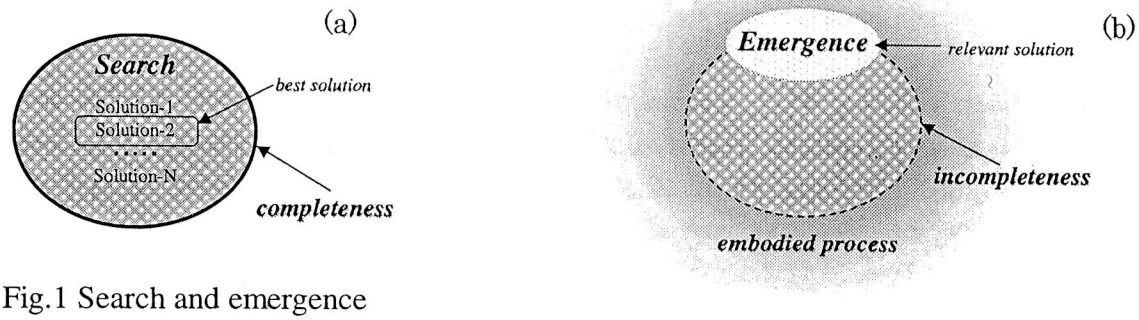


Fig.1 Search and emergence

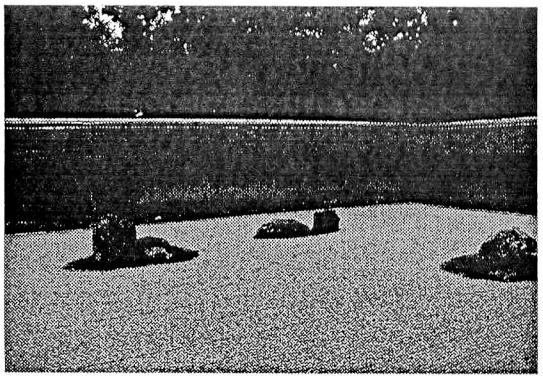


Fig.2 Japanese stone garden

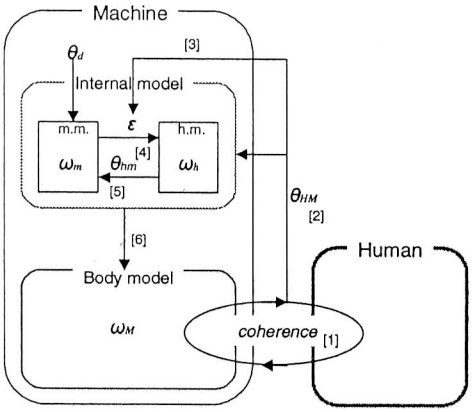
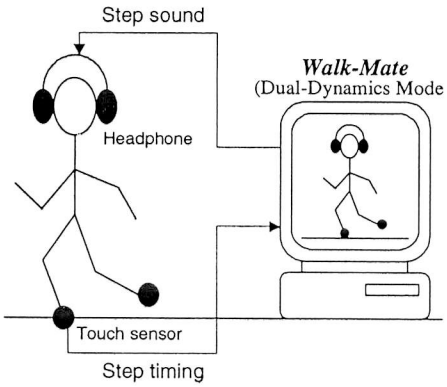
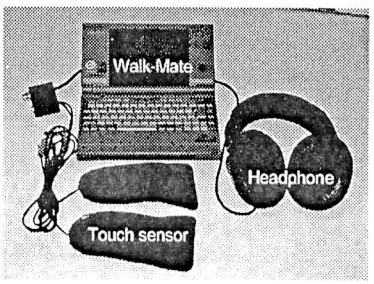


Fig.3 Dual dynamics model





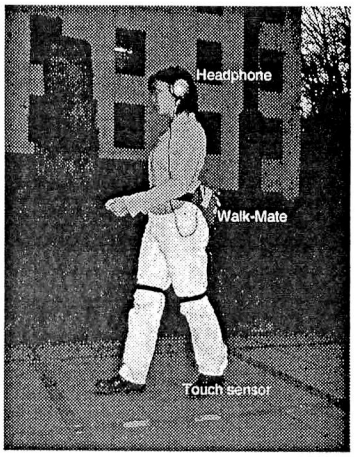


Fig.4 Walk-Mate

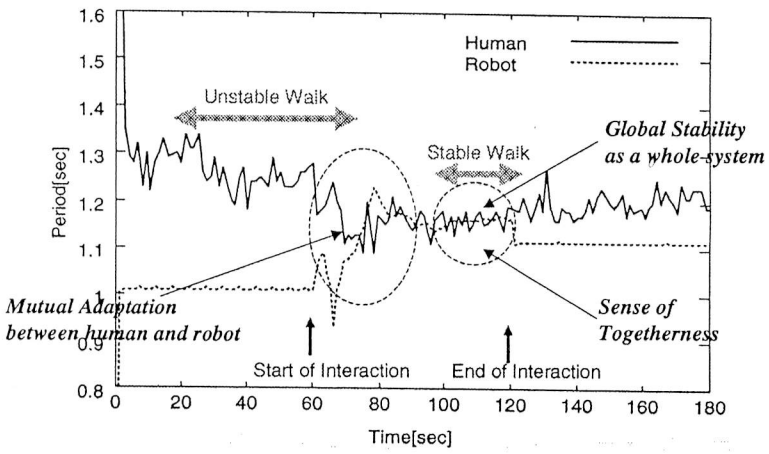


Fig.5 Co-creation process