

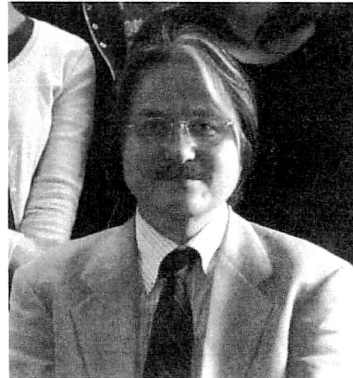
Plenary Talk III

Thursday October 1, 2009, 09:00 - 10:00 (3F Main Hall)

Chair: Yasushi Nakauchi (University of Tsukuba)

Human-Robot Interaction and Subjective Time

"Walk-Mate" Walking Assist Robot as a Co-creation System



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Abstract

The expression as a group can be improvised in realtime through human's various cooperative communications, without being limited to the fields of dance and sports. This experience is so familiar that we do not usually give thoughts to its mechanism. However, a hidden interesting problem of subjective time is found when questioning it, "Why?". It is that subjective time, unlike objective time, is not necessarily shared interpersonally in advance. For example, you cannot assume that five subjective seconds for one person corresponds to five subjective seconds for another person. However, human communications seem to have overcome this problem quite easily. Then, the question arises, by what kind of mechanism are subjective areas connected, and does cooperation as a group become possible? We call such subjective time "Ma", and search for its shared interpersonal mechanism. If we could jump to a conclusion, it is not that it connects detached subjective worlds but that it generates a subjective area together. In other words, it is a co-creation of "Ma". Necessity of co-creation in communication exists here. In order to examine this mechanism, we have focused on a very simple experiment: a synchronized tapping task. This is a task that involves pressing a button with one's finger in-sync with the rhythmic sound stimulation, such as the metronome periodically presented. See Fig.1. The horizontal axis indicates time. You can see that the time indicated by the dotted line corresponds to the time of stimulation of rhythmic sound. The vertical axis, indicating frequency of time when the button is pressed, is shown as a histogram. At this point, despite the sound stimuli and timing of button-pressing being synchronous as the subject's subjective time, the timing of pressing the button and the sound stimuli apparently differ objectively. Moreover, motion of the finger occurs before the sound. This

means a gap exists in subjective simultaneity and objective simultaneity. Moreover, it indicates that subjective time "Now" is generated to the area of future in an objective sense. We regard it as the generation of "Ma" as subjective time. We are examining the mechanism of generation of such subjective time and the mechanism of how it is shared interpersonally. We are also working on applying it to human-robot interaction. I assume everyone has experienced naturally walking at a pace synchronized with the pace of the person you are walking with. Walking paces synchronize naturally without being conscious of it. While such phenomenon of interpersonally synchronized "Ma" is observed in various phases of life, we focused on walking rehabilitation. It is a walking training where a patient tries to walk in the same pace as the pace of a therapist. We have tried establishing such cooperative walking with simultaneous "Ma" between human and robot. This system is called "Walk-Mate" [1], and it co-creates subjective time "Ma" while a human and a virtual robot mutually adapt their timing of walking. In other words, it is a walking robot that adapts "Ma". We especially aim at the co-creation of walking function recovery in cooperation with a robot as a therapist. Some characteristics of co-creation such as generation of sense of togetherness and stabilization of walking are observed in cooperative walking with synchronized "Ma". At this symposium, I introduce the potential of humanrobot interaction technology as a co-creation system, as well as recent application to a walking assist robot [2] seen in Fig.2.

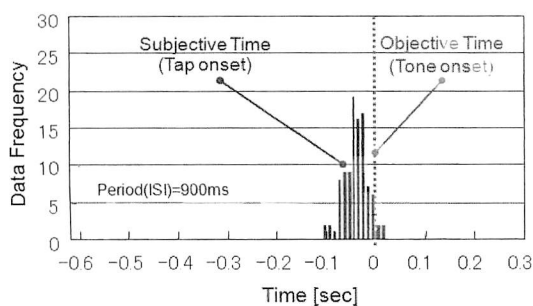


Fig.1 Subjective Timing ("Ma") in Synchronization Tapping

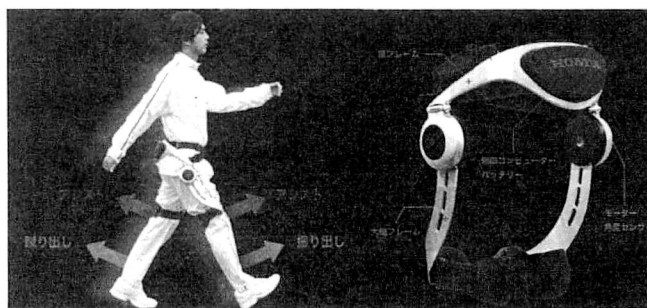


Fig.2 An Application to Walking Assist Robot (Honda Co. Ltd.)

References

- [1] Miyake, Y., "Interpersonal synchronization of body motion and the Walk-Mate walking support robot," IEEE Transactions on Robotics, 25-3, 638-644 (2009)
- [2] <http://www.honda.co.jp/ASIMO/assist/rhythm/index.html>

Biography

Yoshihiro MIYAKE has strong interest to the relationship between co-creative communication and human's subjectivity. He received the Ph.D. in 1989 from The University of Tokyo. Since 1996, he has been an associate professor in the dept. of Computational Intelligence and Systems Science at Tokyo Institute of Technology. Since 1999, he is also a guest professor in the Human Science Center at The University of Munich, Germany.