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Human-Robot KANSEI Communication Based on Emotional Synchronization

Minoru Hashimoto and Misaki Yamano
Shinshu University
Japan

1. Introduction

In an aging society it is necessary that robots work for housekeeping and elderly care at home and hospital. Such assisting robots have to communicate with humans. Then, robots purposely designed for communicating with humans have attracted our attention. These robots are indispensable for human-robot symbiosis in the near future and need to have not only intelligence but also KANSEI to make natural communication. KANSEI is cerebral activity without logical thinking such as emotion, feeling, impression, sensitivity, intuition, and so on. Although much research has been done in artificial intelligence, there has been no consideration about KANSEI in the scientific field, since KANSEI is a subjective process. It is important to consider KANSEI in the field of communication robots.

It is well known that facial expressions play a very important role in daily communication. In order to familiarize the robot with human society, it is essential to create affinity with facial expressions. From this perspective, we have developed a head robot called KAMIN-FA1 (KAnsei MINd robot) (Hashimoto & Morooka, 2006) to enhance emotional communication with humans. The robot has a facial expression function using a curved surface display. This technique provides a facial expression easily compared with other methods of mechanical facial expression.

We may change the atmosphere of interaction by adjusting our emotion to the other accordingly. For example, the interaction field becomes lively, if a robot makes a pleased reaction when the partner is pleased. On the other hand, if we do not make any reaction, the field does not swell very much. Jonsson et al. (Jonsson et al., 2005) found that matching the car voice to the drivers' emotions had enormous consequences. Drivers who interacted with voices that matched their own emotional state had less than half as many accidents on average as drivers who interacted with mismatched voices. In communications between human beings, it was found that happy facial expressions are promoted and anger and sadness expressions are weekend by the partner's reactions with synchronized emotional expressions (Ichikawa et al., 2003). Therefore, the emotional synchronization in human-robot interaction is important to swell the interaction state.

In this chapter we propose a framework of a human-robot communication system based on emotional synchronization and examine the effectiveness of the proposed method. We develop a communication system using KAMIN-FA1 to implement the proposed

framework. The robotic emotion is entrained to human emotion by using a vector field of dynamics, and then the robot makes a facial expression to express the robot emotion. In the experiments of human-robot communication with the emotional synchronization, we examine whether human feeling becomes comfortable when the robot makes the synchronized facial expression to human emotion.
The concept of the emotional synchronization is shown in Fig.1. The emotional synchronization guides human and robot to sympathy through the interaction. The ultimate purpose of this study is to find the interaction technique which makes a comfortable state through adjusting the communication field. If this study is successful, this technique will be widely utilized for human–robot communication to effect human emotional state. In this paper, we evaluate the effects of the emotional synchronization in human-robot KANSEI communications.
In the next section, we address the KANSEI communication system based on the emotional synchronization. In section III we conduct the experiment to evaluate the influence of emotional synchronization. In section IV, communication experiments using the proposed communication system with emotional synchronization are conducted to examine the effectiveness. Finally, in section V we conclude this paper.

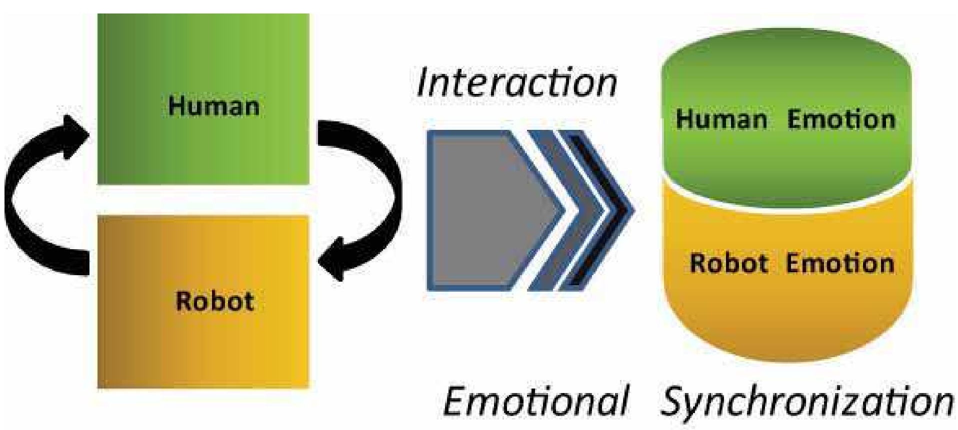


Fig. 1. Concept of Emotional Synchronization

2. Kansei Communication System

2.1Framework of the communication system based on emotional synchronization

The framework of the proposed KANSEI communication system based on emotional synchronization is shown in Fig.2. The system consists of recognition, emotion generation and expression parts. In the recognition part, the human emotion is recognized by KANSEI analysis of human. In the emotion generation part, the robotic emotion is determined by the emotional entrainment using human emotion. The emotional entrainment is performed by a vector field of dynamics according to the strength of the synchronization. The strength of the entrainment in the emotional synchronization can be changed by the parameter "S". We use an online design method of dynamics to realize the synchronization between human and robotic emotions. The robotic emotion is mapped to an emotional symbol space, and then the vector filed of an expression space is generated according to the state of the

emotional symbol space. The expression space generates the emotional expressions such as facial expression and gesture using a communication robot. These information processing systems are performed continuously by using the vector fields of dynamics, since the emotion and the expression of the robot is constantly changing.
We develop a KANSEI communication system shown in Fig.3. We use the voice analysis software, "RobEsense" made by Nemesysco Ltd. (Nemesysco), to recognize the emotions from human voice. KAMIN-FA1 is utilized as the facial expression robot. The communication system is constructed by three PC's (Usui et al., 2008) as shown in Fig.4.

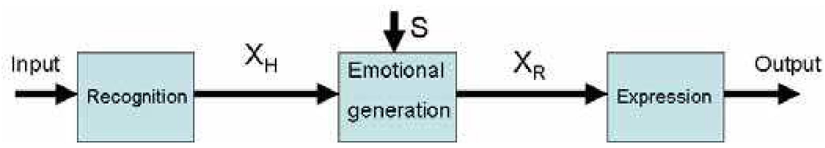


Fig. 2. Framework of the KANSEI communication system based on emotional synchronization.

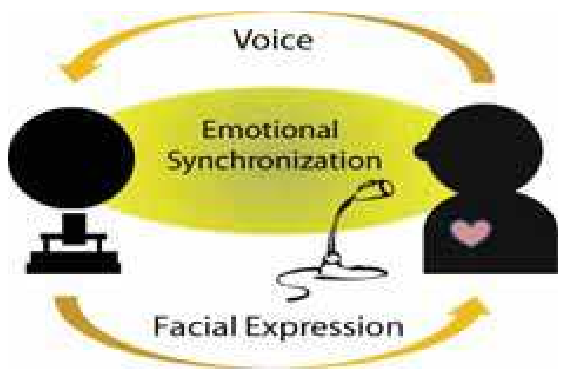


Fig. 3. Schematic drawing of human-KAMIN communication

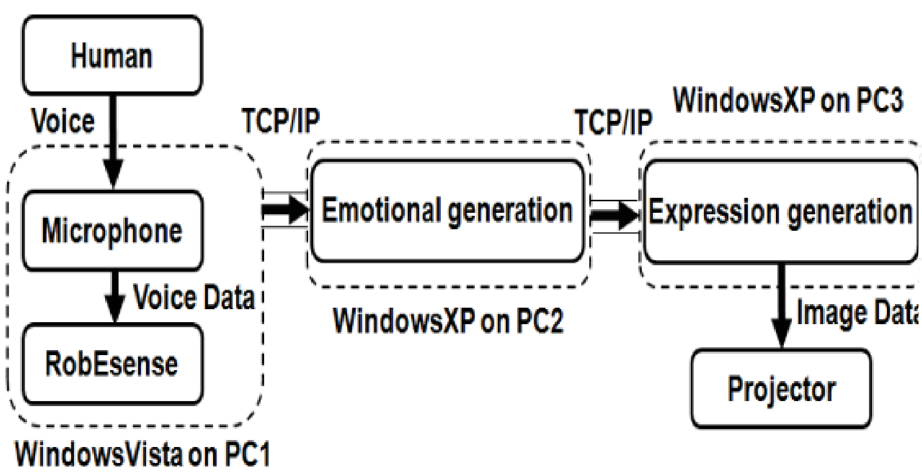


Fig. 4. Block diagram of the KANSEI communication system

2.2 Emotional recognition and generation

The voice analysis software "RobEsense" in the recognition part is a tool judging the emotional state from human voices. It is used in a call center and for a diagnosis of depression mainly. It analyses the emotion of human voice using 18 parameters which is obtained by data with high speed sampling. The result of voice analysis does not depend on language and gender.

We use two parameters, "Excited" and "Atmosphere", within 18 parameters of related emotions. Russell's circumplex model of emotion (Russell, 1980) is utilized to express human and robotic emotions in the recognition part. This model can represent the emotions based on a two dimensional space as shown in Fig.4. One of the axes in the space expresses "comfort-discomfort," and the other is "rouse-sleep". Using the numerical values of the parameters "Excited" and "Atmosphere" in "RobEsense" we express the emotional state based on Russell's model. In addition, we form a vector field of dynamics on the two dimensional space to realize the entrainment between the human and robotic emotions.

In the vector field we make a basin of attractor near the position of human emotion to entrain the robotic emotion. We call it the emotional generation space for the robot as shown in Fig.5. The human emotion obtained by "RobEsense" is plotted in the vector field, and an attractor is constructed in the vector field using the online-design method of dynamics. The attractor is updated continuously according to the result of the recognition part. In the on-line design method, the oblivion and weighted parameters explained below, as determined by the strength of the entrainment in the emotional generation space.

In the next subsection, we describe the design of vector field which is used in the emotional generation space.

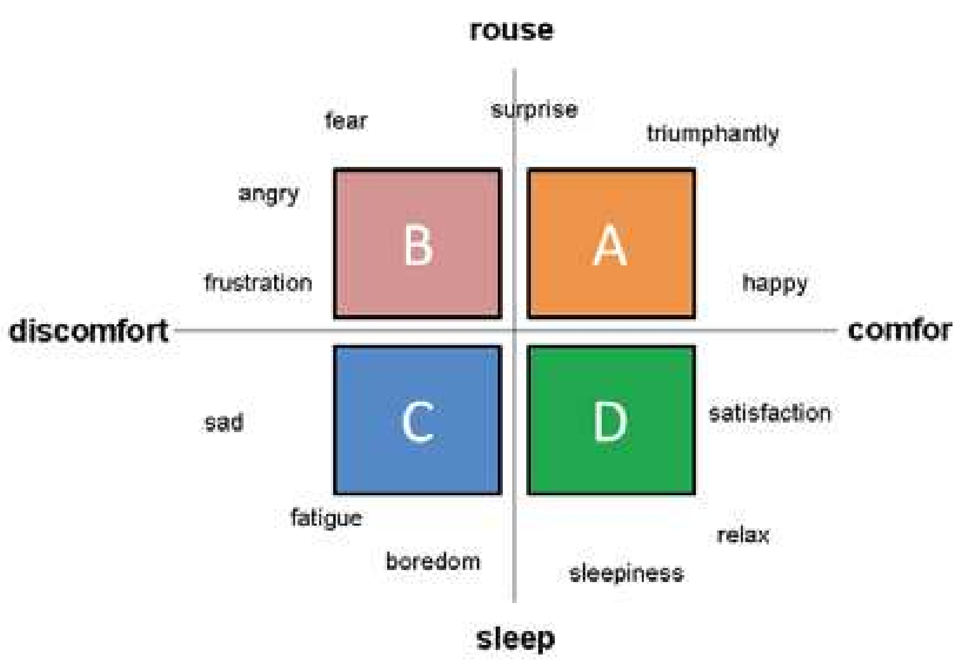


Fig. 4. Russell's circumplex model of affect

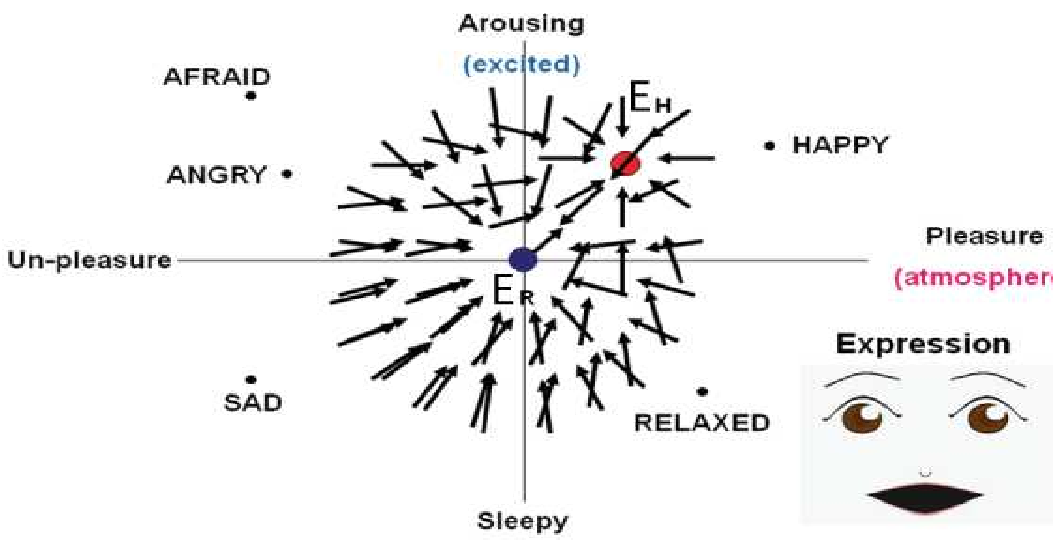


Fig. 5. Emotional generation field

2.3 Vector field design for emotion generation

We need to design dynamics to have arbitrary attractors for information processing. As one of the design methods of dynamics to have arbitrary attractors, Okada et al. (Okada & Nakamura, 2005) proposed a polynomial expression approximation of a vector field. They use dynamics to design the trajectory of the robotic motion. We apply this method to make synchronization in emotion generation. By using this method we can design a vector field around the attractor geometrically and approximate it by a polynomial expression. It is easy to design arbitrary attractors.

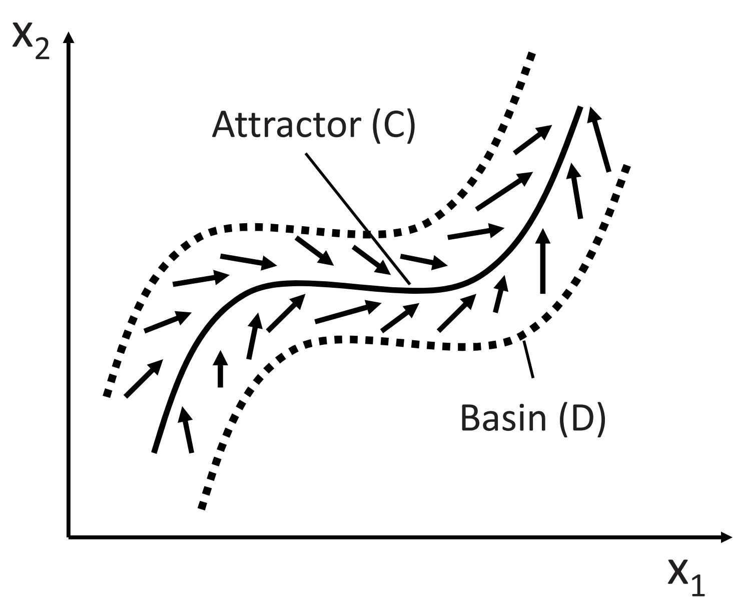


Fig. 6. Attractor and basin of a vector field

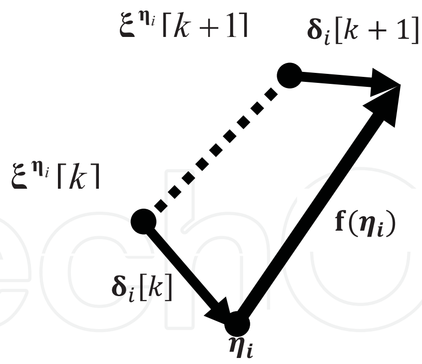


Fig. 7. Defining the vector field

An example of a vector field in the two dimensional space is shown in Fig.6. The vector filed is formed around arbitrary curve C. The curve C is assumed as an attractor, and region D is a basin of entrainment around the attractor. The curve C is a function of discrete time k and consists of $\xi[k](k=1,2,\ldots)$ as shown in Fig.7. We decided the number of sample point among the basin of entrainment around the attractor which is described as $\boldsymbol{\eta}_i(i=1,2,\ldots,m)$, where m is the number of sample points. $\boldsymbol{\xi}^{\boldsymbol{\eta}_i}[k]$ are located on the attractor is the nearest point from $\boldsymbol{\eta}_i$, and $\boldsymbol{\delta}_i[k]$ is the connection vector between $\boldsymbol{\eta}_i$ and $\boldsymbol{\xi}^{\boldsymbol{\eta}_i}[k]$. Then, $\boldsymbol{\delta}_i[k+1]$ and $\boldsymbol{\delta}_i[k]$ can be defined as follows:

$$\boldsymbol{\delta}_i[k+1] = (\boldsymbol{\eta}_i + \mathbf{f}(\boldsymbol{\eta}_i)) - \boldsymbol{\xi}^{\boldsymbol{\eta}_i}[k+1] \tag{1}$$

$$\boldsymbol{\delta}_i[k] = \boldsymbol{\eta}_i - \boldsymbol{\xi}^{\boldsymbol{\eta}_i}[k] \tag{2}$$

And, the sufficient condition for convergence is:

$$\|\boldsymbol{\delta}_i[k+1]\| < \|\boldsymbol{\delta}_i[k]\| \tag{3}$$

We make vectors $\mathbf{f}(\boldsymbol{\eta}_i)$ in the basin D by using equations (1)-(3), and approximate them by a polynomial expression. When $\boldsymbol{\eta}_i \in R^2$, the polynomial expression is as follows,

$$\begin{aligned} f_x(\boldsymbol{\eta}_i) = {} & a(50)x^5 + a(41)x^4y + a(32)x^3y^2 + a(23)x^2y^3 + a(14)xy^4 + a(05)y^5 \\ & + a(40)x^4 + a(31)x^3y + a(22)x^2y^2 + a(13)xy^3 + a(04)y^4 \\ & + a(30)x^3 + a(21)x^2y + a(12)xy^2 + a(03)y^3 \\ & + a(20)x^2 + a(11)xy + a(02)y^2 \\ & + a(10)x + a(01)y \\ & + a(00) \end{aligned} \tag{4}$$

$$\begin{aligned} f_y(\boldsymbol{\eta}_i) = {} & b(50)x^5 + b(41)x^4y + b(32)x^3y^2 + b(23)x^2y^3 + b(14)xy^4 + b(05)y^5 \\ & + b(40)x^4 + b(31)x^3y + b(22)x^2y^2 + b(13)xy^3 + b(04)y^4 \\ & + b(30)x^3 + b(21)x^2y + b(12)xy^2 + b(03)y^3 \\ & + b(20)x^2 + b(11)xy + b(02)y^2 \\ & + b(10)x + b(01)y \\ & + b(00) \end{aligned} \tag{5}$$

Where, $a(ij), b(ij)$ are the constant parameters, and by using the vector $\boldsymbol{\eta}_i$, $\mathbf{f}(\boldsymbol{\eta}_i)$ can be described as:

$$\mathbf{f}(\boldsymbol{\eta}_i) = \boldsymbol{\Phi}\boldsymbol{\theta}(\mathbf{x}) \tag{6}$$

where,

$$\boldsymbol{\Phi} = \begin{pmatrix} a(50) & a(41) & \cdots & a(00) \\ b(50) & b(41) & \cdots & b(00) \end{pmatrix} \tag{7}$$

$$\boldsymbol{\theta}(\mathbf{x}) = [x^5 \; x^4 y \;\; x^3 y^2 \cdots 1]^T \tag{8}$$

We can determine $\boldsymbol{\Phi}$ by the least-squares method. $\mathbf{F}$ and $\boldsymbol{\Theta}$ can be defined by equations (9) and (9) :

$$\mathbf{F} = [\mathbf{f}(\boldsymbol{\eta}_1)\, \mathbf{f}(\boldsymbol{\eta}_2)\, \mathbf{f}(\boldsymbol{\eta}_3) \;\cdots\; \mathbf{f}(\boldsymbol{\eta}_m)] \tag{9}$$

$$\boldsymbol{\Theta} = [\boldsymbol{\theta}(\boldsymbol{\eta}_1)\, \boldsymbol{\theta}(\boldsymbol{\eta}_2)\, \boldsymbol{\theta}(\boldsymbol{\eta}_3) \;\cdots\; \boldsymbol{\theta}(\boldsymbol{\eta}_m)] \tag{10}$$

And,

$$\boldsymbol{\Phi} = \mathbf{F}\boldsymbol{\Theta}^{\#} \tag{11}$$

where, $\boldsymbol{\Theta}^{\#}$ means a pseudo inverse matrix of $\boldsymbol{\Theta}$.

After designing a vector field consists of *m* sample points, by adding one sample point, the sample points become to *m+1*. Appealing to *m+1* sample point, online design can be described as equations (12)-(17) (Okada & Nakamura, 2005). If we know the values of $\mathbf{P}_m$, $\boldsymbol{\Phi}_m$, $\xi[k+1]$ and $\xi[k]$, and by determining a certain point in vector $\boldsymbol{\eta}_{m+i}(i=1,2,\cdots,l)$ which nears to $\xi[k]$, $\boldsymbol{\eta}_{m+i}$ we can define $\mathbf{f}(\boldsymbol{\eta}_{m+i})$ based on equation (1). By this way, the input signal is given as a new sample point, and the output signal is computed by the dynamics.

$$\hat{\mathbf{F}} = [\mathbf{F} \quad \mathbf{f}(\eta_{m+1})] \tag{12}$$

$$\hat{\boldsymbol{\Theta}} = [\boldsymbol{\Theta} \quad \boldsymbol{\theta}(\eta_{m+1})] \tag{13}$$

$$\boldsymbol{\Phi} = \hat{\mathbf{F}}\hat{\boldsymbol{\Theta}}^{\#} \tag{14}$$

$$\mathbf{P}_{m+1} = \mathbf{P}_m - \frac{\mathbf{P}_m \boldsymbol{\theta}(\eta_{m+1})\boldsymbol{\theta}^T(\eta_{m+1})\mathbf{P}_m}{1 + \boldsymbol{\theta}^T(\eta_{m+1})\mathbf{P}_m \boldsymbol{\theta}(\eta_{m+1})} \tag{15}$$

$$\boldsymbol{\Phi}_{m+1} = \boldsymbol{\Phi}_m - \{\boldsymbol{\Phi}_m \boldsymbol{\theta}(\eta_{m+1}) - \mathbf{f}(\eta_{m+1})\}\boldsymbol{\theta}^T(\eta_{m+1})\mathbf{P}_{m+1} \tag{16}$$

where,

$$\mathbf{P}_m = \{\sum_{i=1}^{m} \boldsymbol{\theta}(\boldsymbol{\eta}_i)\boldsymbol{\theta}^T(\boldsymbol{\eta}_i)\}^{-1} \tag{17}$$

An oblivion parameter of online method is defined as α, and a weighted parameter for a new sample signal is defined as β. By using these two parameters equations (12)-(14) can be described as follows:

$$\hat{\mathbf{F}} = \left[a\mathbf{F} \quad \beta\mathbf{f}(\eta_{m+1}) \right] \tag{18}$$

$$\hat{\mathbf{\Theta}} = \left[a\mathbf{\Theta} \quad \beta\mathbf{\theta}(\eta_{m+1}) \right] \tag{19}$$

$$\mathbf{\Phi} = \hat{\mathbf{F}}\hat{\mathbf{\Theta}}^{\#} \tag{20}$$

When $0 \le \alpha \le 1,\ 0 \le \beta \le 1$, we can get the following equation:

$$\mathbf{\Phi}_{m+1} = \left[a\mathbf{F} \quad \beta\mathbf{f}(\mathbf{\eta}_{m+1}) \right] \left[a\mathbf{\Theta} \quad \beta\mathbf{\theta}(\mathbf{\eta}_{m+1}) \right]^{\#} \tag{21}$$

2.4 Evaluation of voice analysis

We conducted an evaluation experiment of emotional recognition using voice analysis. 16 voice samples which are obtained in every day life are utilized to evaluate the emotion. We compared the emotional state which was declared by the speaker with the atmosphere and excited parameters of RobEsense in the Russell's model plane. Figure 8 shows the result of the evaluation experiment. The numbers are sample numbers of the voice data. The speaker's emotions and RobEsense parameters of the same sample number are located in the same area in the plane except area (B). Therefore, we can evaluate the speaker's emotion using the atmosphere and excited parameters of RobEsense.

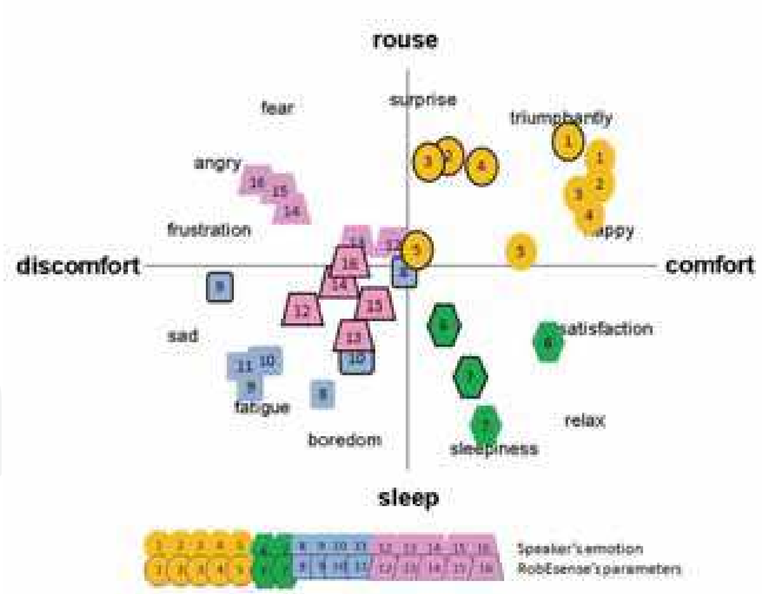


Fig. 8. Results of the evaluation experiments for emotional analysis.

2.5 Facial expression

Yamada (Yamada, 2000) found the relationship between the basic emotional category and the structural variables of facial expression based on the displacement structure of the characteristics points in the facial expression. Yamada reported that there are two kinds of the facial structural variables called "Inclination" and "Bend". "Inclination" means the displacement of the characteristic points concerning the degree of the slant of eyes and eyebrows. In the case of the mouth, it means the strength forming the shape of V and reverse V characters. "Bend" means the curvature of eyebrows, or the strength of the opening of the eyes and the mouth. In this study, we referred to this facial expression model in order to make the robotic facial expression of KAMIN-FA1. The facial image is made up of the line drawing, and it is determined numerically. The facial image consists of straight lines, bezier curves, and circles. A straight line can be created from specifying two points. Similarly a bezier curve is four points, and a circle is the center point and a radius. That is, the state of facial expression is specified with the parameter vector of the points and the radiuses. Figure 9 shows the examples of the facial expression with the characteristic points.

We make a two dimensional space whose axes indicate "Inclination" and "Bend" to express the facial image. And then we build a vector field of dynamics on the two dimensional space to make the facial expression dynamically. In this study we assume that the facial expression is not static, it is a dynamic process. The facial expression is modeled by an attractor on this vector filed. We designed the attractors of the basic six emotions based on Yamada's facial expression model. We symbolized the facial expression space and make a symbol space. In the symbol space a point expresses an emotional state and a vector filed of the facial expression space. Therefore, we can change the vector field of the facial expression by the state of the symbol space as shown in Fig.10.

An emotional state is expressed within the parameters of six basic emotions: happiness, sad, anger, fear, surprise, and disgust. The parameter vector of the facial image is computed from this emotional state. The state of the face model in six emotions is set up beforehand.

Using this method, the subtle expression between emotional states is possible by using the parameter vector. We modeled the parameter vector based on "Inclination" and "Bend". Then we can determine the parameter vector by the coordinate in the facial expression space. Figure 11 shows an example of facial expressions using the simbole space.

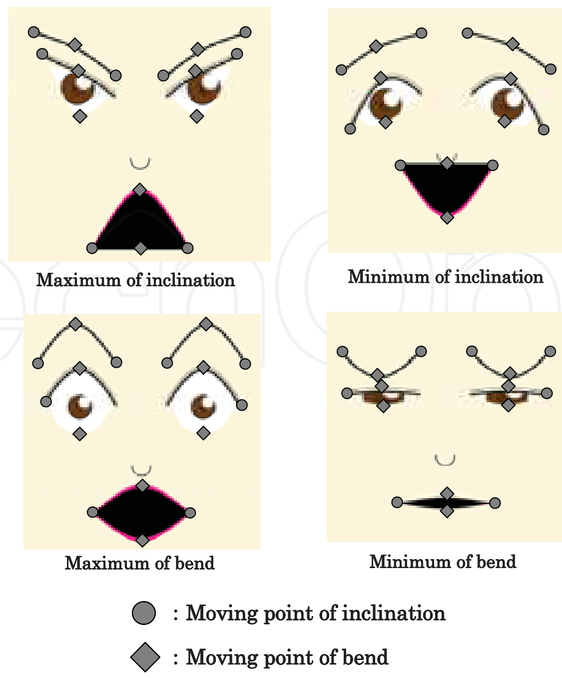


Fig. 9. Facial expressions based on Yamada's model.

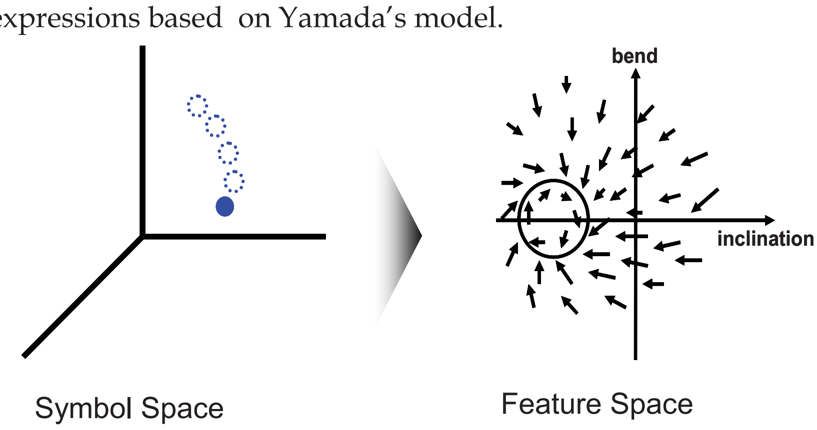


Fig. 10. Symbol space and Facial expression space.

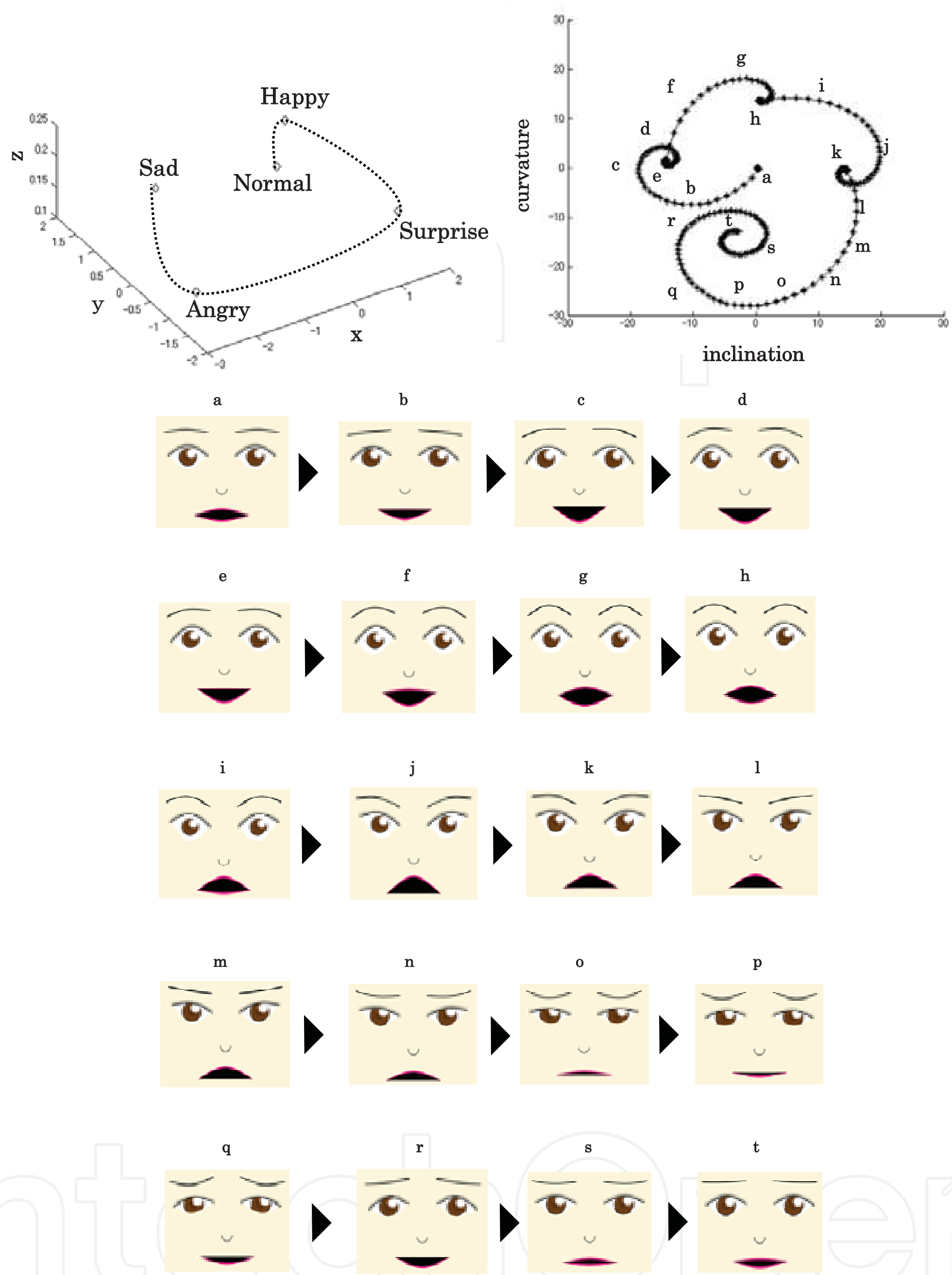
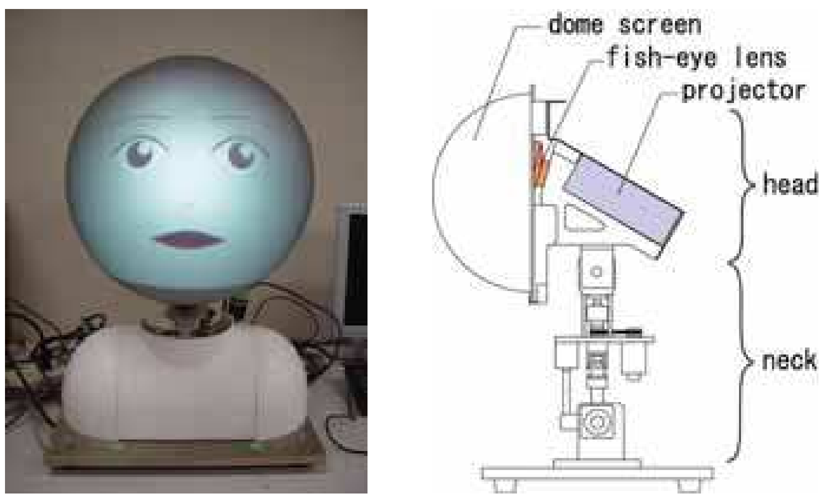


Fig. 11. Example of facail expression using the facial expression space.

2.4 KAMIN-FA1

We used the head robot KAMIN_FA1 (Hashimoto & Morooka, 2006) as shown in Fig.12. The head mechanism is a facial image display, and it consists of a dome screen, a fish-eye lens, and a projector. The face image is projected to the dome screen from the inside. The fish-eye lens is installed on the front of the projector, and it projects the picture on the dome screen.

This communication robot has several advantages. First, the ease with which the image is changed enables a wide variety of expressions. A robot having the same expressions as users may prove less advantageous than one having a standardized, predictable "robot" expression because, at the "gut" level, most human users dislike resemblance to the point of mimicry. A curved surface image has a dependable direction of observation and presence in actual space.
Additionally, this robot has the neck mechanism with 4-DOF to make head movement. In communication, head movement affects the impression of facial expression. More impressive facial expressions are possible when a facial image display and head movement are integrated.



(a) (b)

Fig. 12. KAMIN_FA1. (a)Overview, (b)Structure

4. Influence of Emotional Synchronization

4.1 Experimental design

In order to examine the influence of the emotional synchronization to human emotional state, we conducted an experiment. It was necessary to have the subjects be a comfortable or uncomfortable state at the time of experiment. Therefore, either a comfortable or uncomfortable state was induced in each subject at the beginning of the experiment. This was accomplished by showing the subjects 10 six-slides of picture. Each subject observed two kinds of the pictures to induce comfortable and uncomfortable states. For comfortable sate, all of the pictures reflected happy themes; for uncomfortable state, all of the pictures reflected disturbing themes.
After the subjects were led to comfortable and uncomfortable state, the subjects communicated with KAMIN_FA1. The robot expressed the emotional state of comfort or discomfort for each subject with each emotional state. The overview of the communication experiment is shown in Fig.13. The subject sat on the position where was 100[cm] away from KAMIN-FA1 and talked to the robot. The subject talked while watching a face of KAMIN-FA1. In addition, we did not address the contents of communication to the subjects, they talked freely and free time. Each subject took the communication experiment four times; two

times (emotions of the subject) and two times (emotions of the robot). We assumed that if the subject's emotion is comfortable or uncomfortable, then the robot's emotion is comfortable or uncomfortable, respectively, in the case of synchronization. In the non-synchronization case, if the subject's emotion is comfortable or uncomfortable, then the robot's emotion is uncomfortable or comfortable, respectively. The subjects filled in a questionnaire based on a semantic differential (SD) method (Inoue & Kobayashi, 1985) after the communication to examine the impression of the subject to KAMIN-FA1. Subjects answered in 7-point scoring scale. In addition, the subjects were asked which communication case you liked better to evaluate change of subject's emotion by the communication.

4.2 Results of voice analysis and subject's feeling

We compared the change of the subject's emotion with the strength of synchronization of robot using atmosphere parameter of voice analysis. The value of the atmosphere parameter indicates the strength of comfortable state. Figure14 shows the average values of the atmosphere parameter for each communication method, synchronization or non-synchronization case. In the case of synchronization, the average value of the atmosphere parameter is larger than that of the non-synchronization case. Therefore, the subjects feel better in the emotional synchronization of KAMIN-FA1.

The results of the question about the human feeling in each communication case are as follows. When the subject's emotion was comfortable, all subjects answered that the comfortable response of KAMIN-FA1 was better than uncomfortable one. On the other hand, when the subject's emotion was uncomfortable, 6 subjects answered that the uncomfortable response of KAMIN-FA1 was better than comfortable one. Consequently, the synchronized response of KAMIN-FA1 induced the human comfortable state than the unsynchronized response. That is, the human emotional state becomes more comfortable in the case of high synchronization.

4.3 Evaluation of impression to KAMIN

We examined the difference of the impression to KAMIN, when KAMIN_FA1 expresses the synchronized and non-synchronized responses. The average rated values answered in the questionnaires are shown in Fig.15. It was found that in the case of comfortable response of KAMIN the subjects had positive impressions in terms of active, happy, friendly and so on comparing with the uncomfortable case.

Fig. 13. Overview of a communication experiment

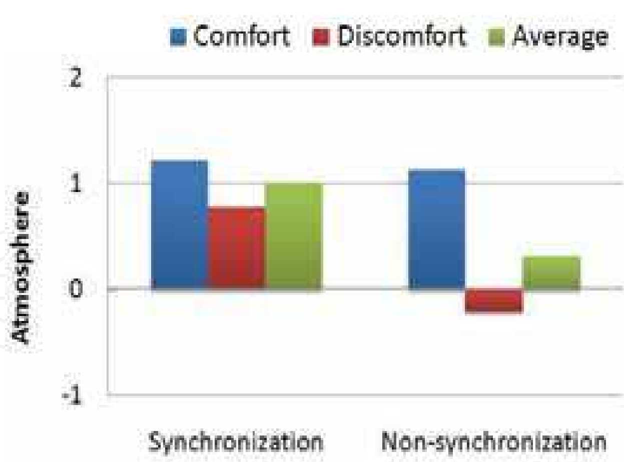
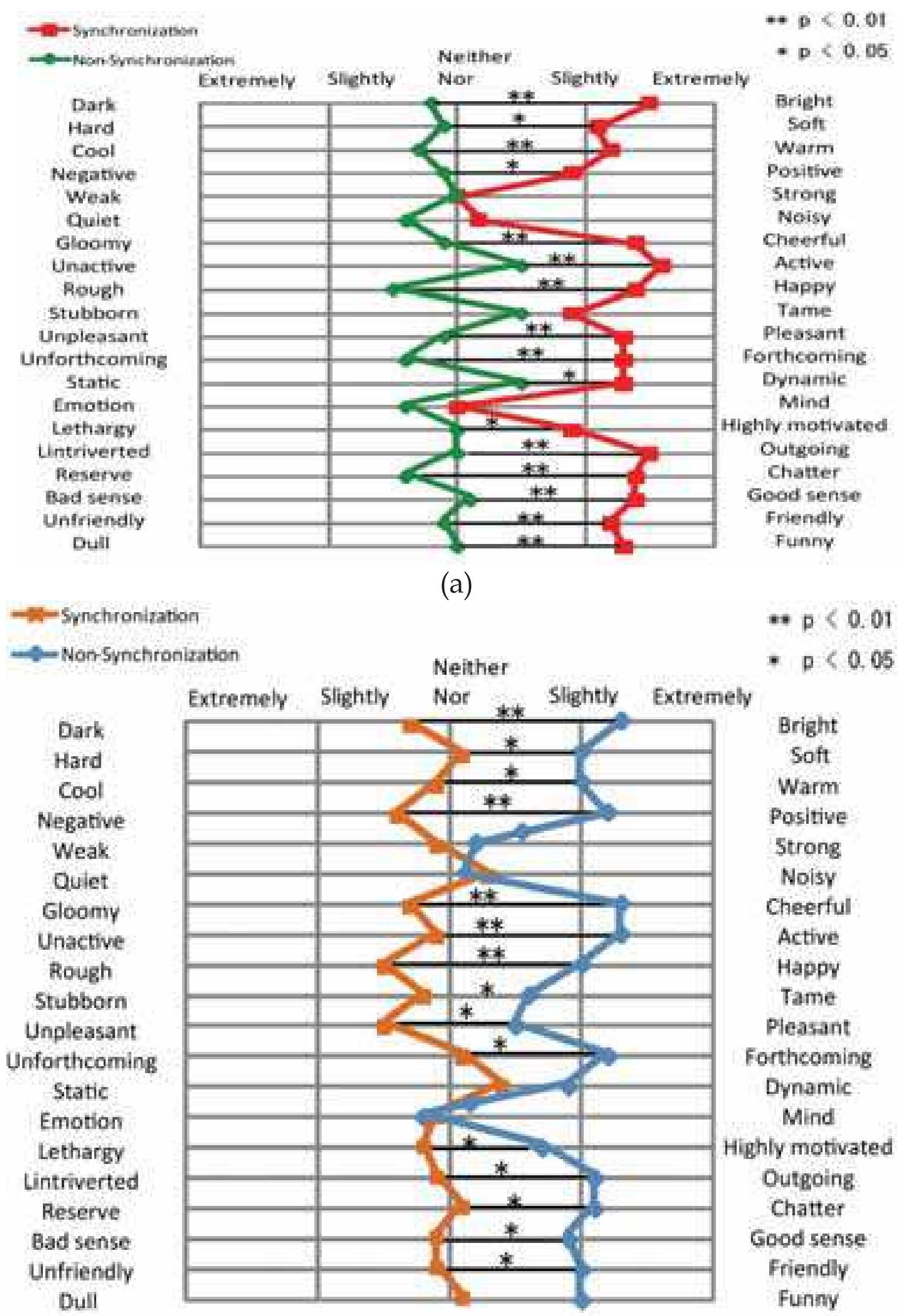


Fig. 14. Result of atmosphere parameters in voice analysis



(a)

(b)

Fig. 15. Impression of KAMIN with synchronized and non-synchronized expressions. (a) Comfort (b) Discomfort

5. Communication Experiment

5.1 Experimental design

In order to examine the effectiveness of the proposed KANSEI communication system, we conducted some experiments using the communication system of KAMIN_FA1. The subject sat on the position where was 100[cm] away from KAMIN_FA1 and talked to the robot. The number of subjects was ten. The facial expression of KAMIN_FA1 changed according to the subject's emotional state. The subject talked while watching a face of KAMIN_FA1. In addition, we did not address the contents of communication to the subjects, they talked freely and free time. Each subject took the communication experiment four times. One of the experiments was conducted by using the strong emotional entrainment, the others were the non entrainment cases, normal, happy, discomfort. In the case of the high entrainment, the facial expression of KAMIN_FA1 changed much by reacting the subject's emotional state. Figures 16 and 17 show the examples of synchronized and non-synchronized normal responses, respectively. In the case of the non entrainment, the facial expression did not change so much. In addition, the subjects filled in a questionnaire based on a semantic differential (SD) method after the communication to examine the impression of the subject. Subjects answered in 7-point scoring scale.

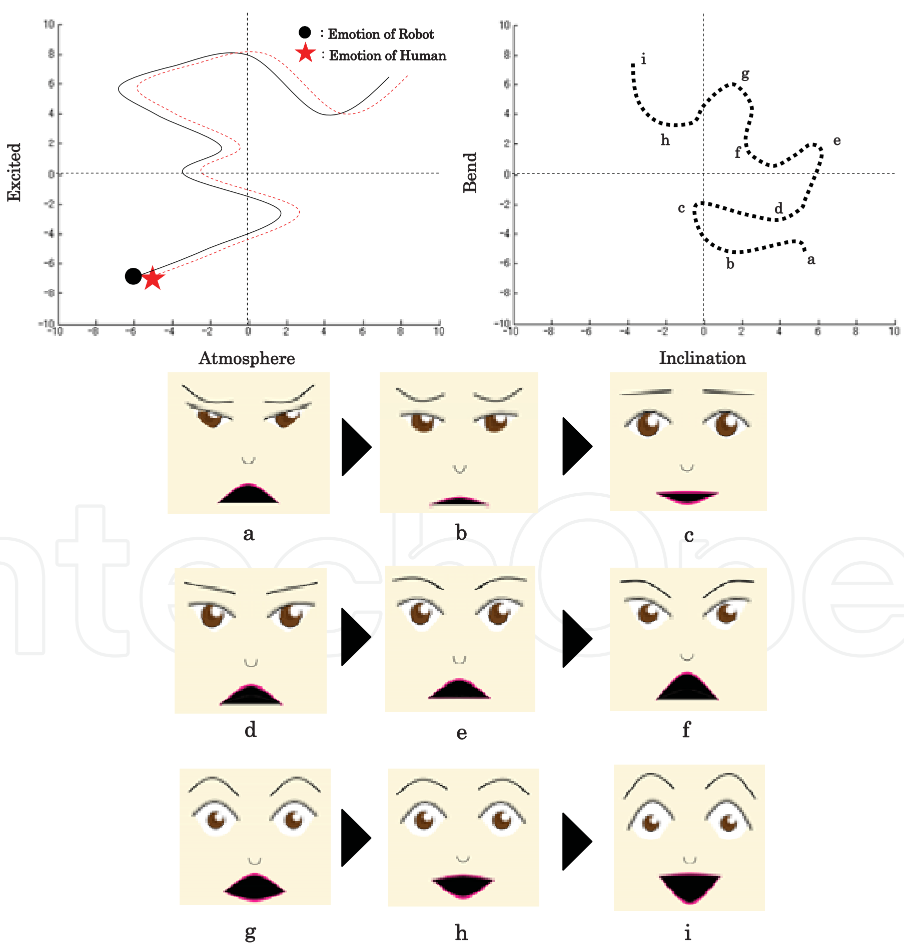


Fig. 16. Example of synchronization reaction

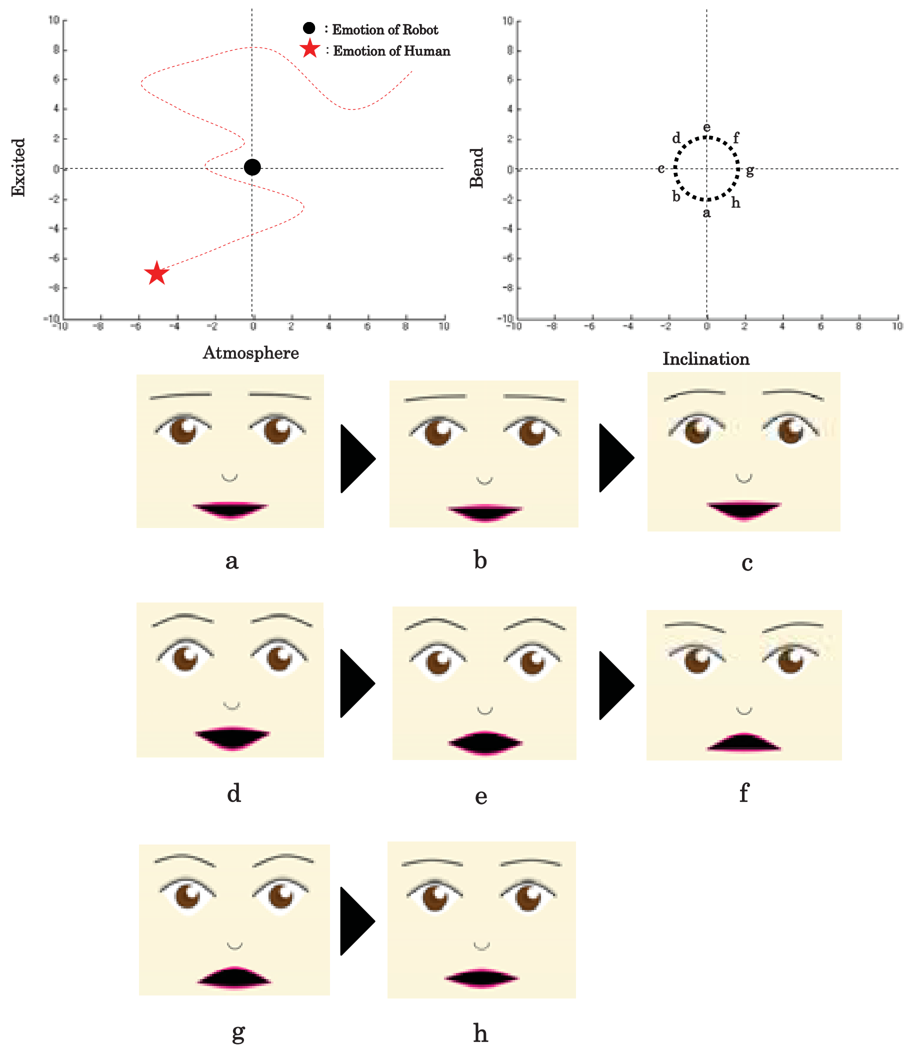


Fig. 17. Example of non-synchronization reaction

5.2 Experimental Results

The average rated values answered in the questionnaires are shown in Fig.18. Four kinds of average values are shown in the figure, a synchronization case and non-synchronization cases, normal, happy, discomfort. It was found that in the case of synchronization case the subjects felt better comparing with all the non-synchronization cases.

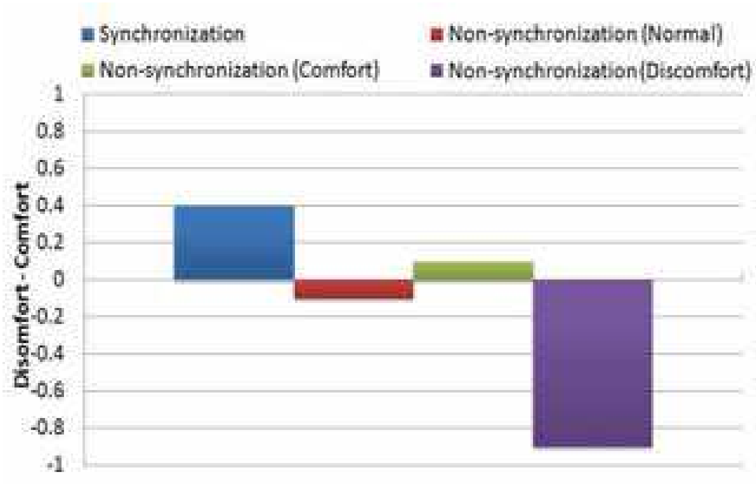


Fig. 18. Result of subject's comfortableness in communication experiments

6. Coclusions

We developed a KANSEI communication system based on emotional expressions, and its effectiveness was verified by experiments in human-robot communication. The robotic emotion was determined by an entrainment to human emotion. The entrainment was accomplished using a vector field of dynamics. The robotic facial expression using a communication robot was realized dynamically based on the emotional space.

Additionally, we investigated the influence of the emotional synchronization in human-robot KANSEI communications. We conducted experiments to evaluate the effects of the proposed system based on emotional synchronization. In the experiments of human-robot interaction using the emotional synchronization, we found that human feeling became comfortable when the robot made the synchronized facial expression to human emotion. Then it was confirmed that emotional synchronization in human-robot interaction could be effective to keep a comfortable state.

As the future work, we are planning to investigate the effect of the emotional synchronization in long-term experiments.

7. Acknowledgent

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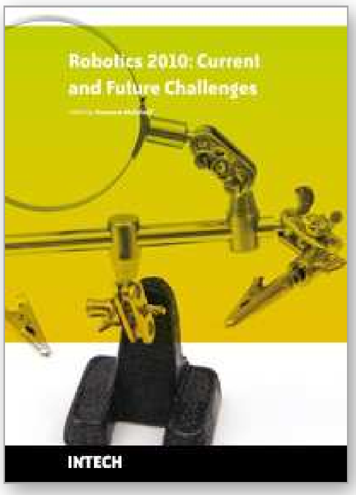

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Without a doubt, robotics has made an incredible progress over the last decades. The vision of developing, designing and creating technical systems that help humans to achieve hard and complex tasks, has intelligently led to an incredible variety of solutions. There are barely technical fields that could exhibit more interdisciplinary interconnections like robotics. This fact is generated by highly complex challenges imposed by robotic systems, especially the requirement on intelligent and autonomous operation. This book tries to give an insight into the evolutionary process that takes place in robotics. It provides articles covering a wide range of this exciting area. The progress of technical challenges and concepts may illuminate the relationship between developments that seem to be completely different at first sight. The robotics remains an exciting scientific and engineering field. The community looks optimistically ahead and also looks forward for the future challenges and new development.