

The difference between the sense of touch and the sense of sight on the image of plastic texture

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Abstract:

Most of the papers discussed about human's feeling were concentrated on form or color, which is based on sense of sight; seldom were discussed about texture, which is based on sense of touch. As a result, designer usually lacked of useful principles on designing the texture of product. In order to helping designer in designing texture, in this research, based on the theory and processes of KANSEI Engineering, we tried to find out the differences and the relations on image of plastic materials between senses of sight and touch.

By constructing image space from Factor Analysis, 9 image words were selected as subjective words for evaluating the image of plastic texture. 3 types of plastic material (PP, ABS and rubber) and 6 kinds of etching pattern were selected as attributes of plastic, then 18 samples were consisted, which were well-controlled made by plastic maker for evading the inappropriate influence of other factor's. 3 experiments of evaluating the image of 18 samples were conducted, 1) by sense of touch, 2) by sense of sight, 3) by multi-sense of sight and touch simultaneously.

After analyzing and comparison the results of experiments by ANOVA, MANOVA and Quantification I Analysis, main results were concluded as fellows:

1. Material was the main influence factor on tactile sense; on the contrary, etching pattern was the main influence factor on sight and multi-sense.
2. No matter in any sensation, there were not any significant interaction between materials and etching patterns.
3. Although the results of 3 experiments were different, the results of multi-sense were similar to the sense of touch.
4. By establishing the reasoning functions from Quantification I Analysis, we had more precise knowledge about the effects of materials and patterns for different image.

Key words: *Sense perception, Sense of sight, Sense of touch, texture, KANSEI Engineering*

1. Introduction

Nowadays, due to the rapid development on technology our circumstance was filled with products, therefore in terms of increasing the awareness of product to customers, "how to make the product more attractive" became one of the most important issues that designers are really concerned with. Although the texture is less important factor than form or color in product perception, but sense of touch is considered as an indispensable factor in perceptive process for texture. On the other hands, KANSEI Engineering(KE)[1,2], advocate by Prof. Nagamachi, is considered as an effective methodology for translating human's feeling(KANSEI) into the design elements of

product, a lot of papers also based on the theory of KE and discussing about the relationships between KANSEI and design elements[3,4,5,6,7]. However, most of the papers discussed about human's feeling were concentrated on form or color, which is based on sense of sight; seldom were discussed about texture [8,9,10,11,12], which is based on sense of touch. As a result, designer usually lacked of useful principles on designing the texture of product.

In order to helping designer in designing texture, in this research we tried to find out the differences and the relations on image of plastic materials between senses of sight and touch. Plastic was used as experimental subject since it is the most common material in product. Main topics of this study were set as follows:

- (1)To explore the difference in image perception between senses.
- (2)To explore the difference in image perception between textures
- (3)To explore the relationship between image perception and texture

2. Method

2.1 experimental samplings

Even though there are many attributes concerned with plastic texture, such as material, color, degree of burnish, surface roughness, itching pattern and so on, however considering the important principles as: (1) can be evaluated by the sense of sight and touch (2) can be well-control made by plastic makers, 2 attributes – materials (include ABS, rubber, PP 3 levels) and itching pattern (includes 6 kinds of patterns, Figure 1) were selected. 18samplings were consisted from 2 factors and well-control made by plastic maker.

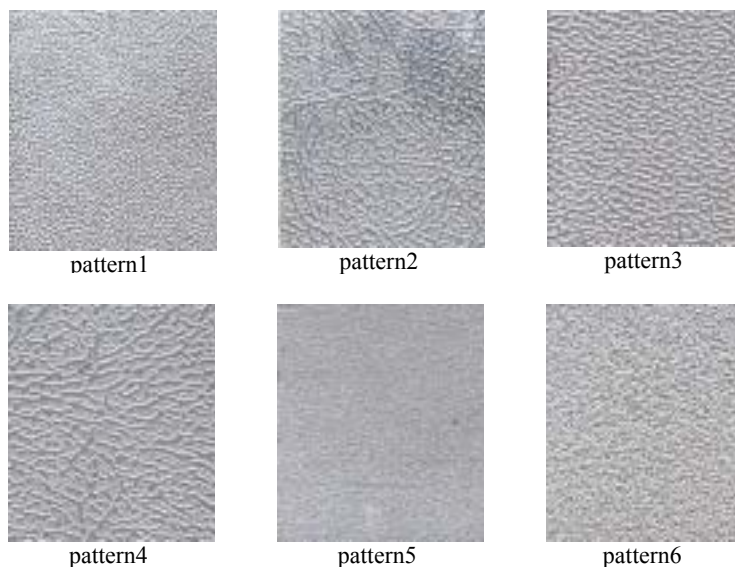


Figure1. 6 kinds of itching patterns

2.2 Image words (subjective evaluating words)

182 image words which were appropriate in describing the feeling of touch or sight were collected from catalogs, magazines, CM, journals, and so on. After deleting the words that have similar meaning, 93 words were used for the questionnaire of suitability, then 44 words was selected by the sequence of amount of selection.

By Factor analysis and cluster analysis, 9 image words were picked up as subjective words for evaluating the image of plastic texture: decorative, harmony, rough, cozy, leisure, light, fashionable, relaxed, firm.

2.3 Main experiment of sense perception

3 tasks were conducted in this main experiment for evaluating the image of plastic texture: 1) by sense of

touch, 2) by sense of sight, 3) by multi-sense of sight and touch simultaneously. The follows are the detail of 3 tasks:

Samplings : 18 plastic samples as described in 2.1, size: 30mm×25mm.

In the evaluating task by the sense of sight, in order to avoiding the touch of material, each sampling was stuck into a thick white paper of 90mm×55mm(Figure) which was only to be allowed holding by fingers in the evaluating process.(Figure 2)

Subjective image words: 9 image words as described in 2.2, which was gave the point of 1 to 9 according to its image performance.

Evaluating method: 3 steps grouping: (1)first divided all the 18 samplings into 3 groups which means [high, middle, low] level of image, (2)then divided the samplings of each group into 3 groups which means [high, middle, low] level among its group, (3)final confirm and adjust by Subject. After these 3 steps, 18 samplings were divided into 9 groups, [high-high, middle-high, low-high, high-middle, middle-middle, low-middle, high-low, middle-low, low-low], which will be gave the point of 9 to 1.

Subjects: 30 students (including undergraduate and graduate students).

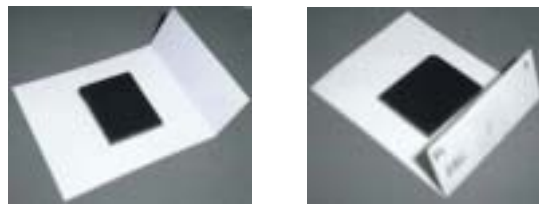


Figure2. Sampling for the evaluation of sense of sight

3. Results and Discussions

3.1 The difference between senses

In order to examine the difference of perception between each sense, one-way-ANOVA was applied in analyzing the results (Table 1). Image words of [decorative] and [rough] had the highest amount of significant mean difference (13 and 11 samples); on the contrary, image words of [leisure] and [firm] had the lowest number of significant mean difference (1 and 0 sample). About the difference among 18 samplings, except that Sample03, Sample08, Sample09 had the least amount of significant mean difference, the else samples almost had the same amount of significant mean difference. Therefore it was confirmed that there certainly had difference between different senses, but the patterns were depended on image words.

By Post-Hoc-Multiple-Comparisons (LSD method), the detail mean difference between senses were also examined (summarized in Table2, refer to Appendix TableA-1 to TableA-3 for detail), the total amount of significant difference were as: 1) between sense of touch and sense of sight: 63; 2) between sense of touch and multi-sense:34; 3) between sense of sight and multi-sense:20. The results revealed that there are comparatively high differences of perception between sense of touch and sight, especially on the image words of [decorative, rough, cozy, light]; on the contrary, there are comparatively low differences of perception between sense of sight and multi-sense.

These results also were summarized into 8 situations in order to find out the possibility of replacement among senses (Table 2). [Situation1] means 3 senses differed significantly from each other, therefore not any sense can be replaced with other senses; [situation2] means the sense of touch differed from sight and multi-sense, but the sense of sight had not significant difference with the multi-sense, therefore sense of touch can not be replaced with sight or multi-sense; [situation3] means the sense of touch differed from sight, but the multi-sense had not significant difference with the sight and touch, therefore multi-sense can be replaced with sight or touch sense; [situation4] means the sense of sight differed from touch and multi-sense, but the sense of touch had not significant difference with the multi-sense, therefore sense of sight can not be replaced with sight or multi-sense; [situation5] means the sense of multi-sense differed from touch and sight, but the sense of touch had not significant difference with the sight sense, therefore multi-sense can not be replaced with sight or multi-sense; [situation6] means the sense of touch differed from multi-sense, but the sense of sight had not significant difference with the multi-sense and touch, therefore sense of sight can be replaced with multi-sense or touch sense; [situation7] means the sense of sight differed from multi-sense, but the sense of touch had not significant difference with the multi-sense and sight, therefore sense of touch can be replaced with multi-sense or sight sense; the last situation, [Situation8] means 3 senses did not differ significantly from each other, therefore they can be replaced with other senses.

From Table2, since the situation2 (total=23) and situation3 (total=22) had the largest amount of difference, it was reasoned that there are comparatively high differences of perception between sense of touch and sight, next is observed in the sense of sight (situation4, total=11). From the aspects of image words, [leisure (total=3), firm (total=1)] can be presented by any sense since they had the least amount of difference between senses; on the contrary, [decorative (total=14)] can not be replaced with each other since they had the highest amount of difference between senses, especially on the sense of touch. Although the image of [harmony (total=10), rough (total=10), cozy (total=10)] also had higher difference between senses, the image difference was due to the sense of touch on [rough], the image difference was due to the sense of sight on [harmony, cozy].

Table 1 : the difference significance between senses by ANOVA

	decorative	harmony	rough	cozy	leisure	light	fashionable	relaxed	firm
Sample01	* 0.00	0.32	* 0.03	0.07	0.73	0.55	* 0.04	0.67	0.07
Sample02	* 0.00	* 0.00	* 0.02	* 0.00	0.24	0.06	0.60	* 0.01	0.58
Sample03	0.27	0.35	0.67	0.52	0.17	0.28	0.45	0.69	0.17
Sample04	* 0.00	* 0.04	0.09	* 0.02	0.70	0.57	* 0.01	0.75	0.68
Sample05	0.13	0.09	0.24	0.31	0.68	0.37	0.20	* 0.02	0.55
Sample06	* 0.00	* 0.00	* 0.01	0.06	0.49	0.56	0.50	0.99	0.37
Sample07	0.11	0.23	* 0.00	* 0.00	0.70	* 0.00	0.64	* 0.01	0.92
Sample08	* 0.00	0.64	0.94	0.21	0.08	0.66	0.33	0.91	0.57
Sample09	0.11	0.87	0.94	0.24	0.08	0.12	* 0.03	0.31	0.77
Sample10	* 0.00	0.10	0.26	0.11	0.17	0.30	* 0.00	0.39	0.69
Sample11	* 0.00	0.42	* 0.00	* 0.02	0.54	* 0.00	0.49	0.14	0.58
Sample12	* 0.00	0.46	* 0.00	0.45	0.33	* 0.00	0.83	0.31	0.60
Sample13	0.13	0.10	0.12	0.43	0.58	* 0.02	0.54	0.26	0.33
Sample14	* 0.00	* 0.00	* 0.00	* 0.00	* 0.02	* 0.00	0.33	0.12	0.69
Sample15	* 0.05	* 0.01	* 0.00	* 0.01	0.44	* 0.01	0.67	* 0.02	0.39
Sample16	* 0.00	* 0.00	* 0.00	0.22	0.35	* 0.00	* 0.02	0.31	0.40
Sample17	* 0.01	0.44	* 0.03	0.37	0.68	0.96	* 0.04	0.14	0.48
Sample18	* 0.00	0.12	* 0.04	* 0.04	0.43	0.80	0.10	0.72	0.85

*5% significance

Table2 The results of Post-Hoc-Multiple-Comparisons between different senses

	decorative	harmony	rough	cozy	leisure	light	fashionable	relaxed	firm
situation1 T≠S≠M	3	1				1			
situation2 T≠(S=M)	8	1	6			3	2	3	
situation3 T≠S	3	4	2	4		4	2	2	1
situation4 S≠(T=M)		2	1	5		1	1	1	
situation5 M≠(S=T)									
situation6 T≠M			1	1	1		1	1	
situation7 S≠M		2			2				
Situation8 S=T=M	4	8	8	8	15	9	12	11	17

Data means the total number of samples in each situations
S: sense of sight T: sense of touch M: Multi-sense
≠:not equal(significant difference) =:equal(no significant difference)

3.2 The interaction between material and itching pattern on sense perception

Before discussing the effect of material or itching pattern on sense perception, the interaction between material and itching pattern on each sense perception was analyzed by 2-way-ANOVA. The interaction was not existent since there was not any significant difference was observed, in another words, there have not any interactions between material and itching pattern on the sense perception.

3.3 The effect by material on sense perception

By one-way-ANOVA and Post-Hoc-Multiple-Comparisons (LSD method), the difference of effect by materials was analyzed.

3.3.1 On the sense of touch (summarized in Table3, refer to Appendix Table B for detail)

On the image of [rough, cozy, leisure], there were not any significant difference between 3 kinds of texture (ABS, Rubber and PP), means any texture has similar image, can be chosen in these image. On the contrary, on the image of [light], significant difference was observed between 3 kinds of texture, means different texture had its own image, must be chosen according to the level light image. The same pattern was observed on the image of [decorative, fashionable, relaxed, firm], rubber had significant difference with ABS and PP, means rubber had different image, can not be replaced with PP or ABS. PP had a significant difference with ABS and rubber on the image of [harmony].

3.3.2 On the sense of sight (summarized in Table3, refer to Appendix Table B for detail)

On the image of [fashionable, relaxed], there were not any significant difference between 3 kinds of material (ABS, Rubber and PP), means any material has similar image, can be chosen in these image. On the contrary, on the image of [rough], significant difference was observed between 3 kinds of material, means different material had its own image, must be chosen according to the level light image. The same pattern was observed on the image of [decorative, cozy], rubber had significant difference with ABS and PP, means rubber had different image, can not be replaced with PP or ABS. PP had a significant difference with ABS and rubber on the image of [harmony], ABS had a significant difference with PP and rubber on the image of [leisure]. The image of PP was not the same as ABS on [light], but was not the same as rubber on [firm].

3.3.3 On the multi-sense (summarized in Table3, refer to Appendix Table B for detail)

Compare to the results of sense of touch and sense of sight, the perception of multi-sense had the most similar results on each image. On the image of [fashionable, leisure], there were not any significant difference between 3 kinds of material (ABS, Rubber and PP), means any material has similar image, can be chosen in these image. The same pattern was observed on the image of [decorative, rough, light, relaxed, firm], rubber had significant difference with ABS and PP, means rubber had different image, can not be replaced with PP or ABS. The image of PP was not the same as rubber on [cozy].

Table3 The effect by material on sense perception

	Sense of touch	Sense of sight	Multi-sense
decorative	rubber	rubber	rubber
harmony	PP	PP	ABS=rubber=PP
rough	ABS=rubber=PP	ABS≠rubber≠PP	rubber
cozy	ABS=rubber=PP	rubber	rubber≠PP
leisure	ABS=rubber=PP	ABS	ABS=rubber=PP
light	ABS≠rubber≠PP	ABS≠PP	rubber
fashionable	rubber	ABS=rubber=PP	ABS=rubber=PP
relaxed	rubber	ABS=rubber=PP	rubber
firm	rubber	rubber≠PP	rubber

3.4 The effect by itching pattern on sense perception

By one-way-ANOVA and Post-Hoc-Multiple-Comparisons (LSD method), the difference of effect by itching patterns was analyzed.

3.4.1 On the sense of touch (summarized in Table4, refer to Appendix Table C for detail)

On the image of [leisure, fashionable, firm], there were not any significant mean difference between 6 kinds of itching pattern (pattern1~pattern6), means 6 pattern had similar image on these words. On the image of [decorative, rough, light], pattern1, pattern 3 and pattern 4 had similar image; then pattern2, pattern 5 and pattern 6 was different from the others. On the image of [harmony, cozy, relaxed], pattern1, pattern 2, pattern 3 and pattern 4 had similar image; then pattern5 and pattern 6 was different from the others.

Therefore, it was concluded that pattern5 and pattern6 were comparatively easy to distinguish from the others.

3.4.2 On the sense of sight (summarized in Table4, refer to Appendix Table C for detail)

Compare to the results of the sense of touch, the total number of significant difference between 6 itching patterns was more than the sense of touch, therefore itching pattern can be clear distinguished, no matter what in any 1 of 9 image words, by the sense of sight.

On the image of [leisure, relaxed], there were less significant difference between 6 kinds of itching pattern (pattern1~pattern6), means 6 pattern has similar image on [leisure, relaxed]. Generally speaking, except that pattern2 and pattern3 had similar image, others 4 patterns can be distinguished easily with one another.

3.4.3 On the multi-sense (summarized in Table4, refer to Appendix Table C for detail)

The results of the multi-sense were similar to the sense of sight, significant differences were observed between 6 itching pattern, no matter what in any 1 of 9 image words, on the multi-sense.

On the image of [relaxed], pattern5 was differed from others 5 patterns, means 5 pattern has similar image on [relaxed]. Generally speaking, except that pattern2 and pattern3 had similar image, others 4 patterns can be distinguished easily with one another.

Table4 The effect by itching pattern on sense perception

	Sense of touch	Sense of sight	Multi-sense
decorative	pattern2 pattern5 pattern6	pattern2 pattern3 pattern4 pattern5	pattern1 pattern4 pattern5 pattern6
harmony	pattern5 pattern6	pattern5	pattern5
rough	pattern5 pattern6	pattern1 pattern4 pattern5 pattern6	pattern1 pattern4 pattern5
cozy	pattern5	pattern1 pattern5 pattern6	pattern5
leisure			
light	pattern5 pattern6	pattern1 pattern5	pattern1 pattern5
fashionable		pattern4	
relaxed	pattern6		pattern5
firm			

3.5 The analysis of relationship between image and texture

In order to find out the quantitative relationships between image and texture factors (of material and itching pattern), then constructing a function for reasoning the image of different texture, Quantification I analysis were applied in analysis.

3.5.1 On the sense of touch (Table5)

In general, the effects by itching pattern on image appearance are stronger than by material, especially on the image of [decorative, harmony, rough, cozy], but both had similar effect on the [light] image. In detail, among 6 kinds of itching pattern, the influence of pattern5 are just contrary to pattern6; for example, pattern5 had a strong image of [harmony, cozy, light, relaxed], but pattern6 gave a strong image of [decorative, rough]. Among 3 kinds of material, rubber reduced the image of [decorative, rough], PP increased the image of [rough].

Table5 sense of touch The results of multi-sense by Quantification I analysis

		decorative	harmony	rough	cozy	leisure	light	fashionable	relaxed	firm
Itching pattern	pattern 1	0.20	0.35	0.11	-0.06	0.05	0.14	0.03	-0.12	-0.03
	pattern 2	-0.56	0.21	-0.50	-0.30	-0.01	0.30	0.36	0.26	-0.14
	pattern 3	0.33	-0.65	0.51	-0.50	-0.33	-0.41	-0.03	-0.21	0.36
	pattern 4	0.58	-0.24	0.73	-0.60	0.21	-0.79	-0.20	-0.32	0.33
	pattern 5	-1.52	1.18	-1.87	1.34	0.13	1.24	0.12	1.07	-0.54
	pattern 6	1.47	-1.30	1.66	-0.89	0.03	-0.97	-0.33	-1.04	0.13
material	ABS	0.56	-0.19	0.08	0.00	-0.03	0.42	0.32	0.40	0.52
	rubber	-0.83	-0.32	0.14	-0.19	0.01	-1.61	-0.57	-1.22	-0.60
	PP	0.27	0.51	-0.21	0.19	0.02	1.19	0.25	0.81	0.09

1st column of each image means the coefficient of partial correlation
2nd column of each image means the category score of each pattern

3.5.2 On the sense of sight (Table6)

In general, except on the image of [relaxed, firm], the effects by itching pattern on image appearance are similar to the effects by material. In detail, among 6 kinds of itching pattern, the influence of pattern4 are just contrary to pattern5; for example, pattern4 had a strong image of [decorative, rough, leisure, fashionable], but pattern6 gave a strong image of [harmony, cozy, light]. Among 3 kinds of material, ABS increased the image of [harmony, leisure], rubber increased the image of [cozy] but reduced the image of [decorative, rough,], PP

increased the image of [rough].

Table6 : sense of sight The results of multi-sense by Quantification I analysis

		decorative	harmony	rough	cozy	leisure	light	fashionable	relaxed	firm
itching pattern	pattern1	0.99	0.97	0.98	0.96	0.91	0.99	0.99	0.95	0.96
	pattern 2	-1.15	0.80	-1.13	1.09	0.20	0.67	-0.79	0.27	-0.51
	pattern 3	2.11	-0.99	1.00	-1.05	-0.53	-0.87	1.00	-0.29	0.33
	pattern 4	1.40	-1.07	1.44	-1.19	0.17	-1.00	0.62	-0.01	0.34
	pattern 5	3.07	-1.86	2.58	-1.77	0.37	-1.58	1.72	-0.31	1.01
	pattern 6	-3.02	2.23	-2.73	2.22	-0.19	2.12	-1.30	0.69	-0.98
material	ABS	0.96	0.71	0.86	0.75	0.92	0.76	0.80	0.30	0.72
	rubber	-0.70	0.07	-0.75	0.67	-0.27	0.11	-0.32	0.03	-0.15
	PP	0.42	-0.48	0.72	-0.49	-0.13	-0.31	0.10	-0.07	0.28

1st column of each image means the coefficient of partial correlation
2nd column of each image means the category score of each pattern

3.5.3 On the multi-sense (Table7)

Totally speaking, the results of multi-sense were almost the same as the sense of touch; in other words, the perceptions between these 2 senses are similar. In general, except on the image of [fashionable], the effects by itching pattern on image appearance are similar to the effects by material. In detail, among 6 kinds of itching pattern, the influence of pattern4 are just contrary to pattern5; for example, pattern4 had a strong image of [decorative, rough, leisure, fashionable], but pattern6 gave a strong image of [harmony, cozy, light]. Among 3 kinds of material, ABS increased the image of [light], rubber reduced the image of [light], PP increased the image of [decorative, firm].

Table7 : The results of multi-sense by Quantification I analysis

		decorative	harmony	rough	cozy	leisure	light	fashionable	relaxed	firm
itching pattern	pattern1	0.99	0.98	0.99	0.94	0.98	0.97	0.99	0.95	0.98
	pattern 2	-0.97	0.29	-0.93	0.31	-0.46	0.44	-0.57	-0.19	-0.33
	pattern 3	0.94	-0.18	0.54	-0.36	0.66	-0.22	0.42	-0.22	-0.04
	pattern 4	1.32	-0.58	1.18	-0.73	0.56	-0.76	0.74	-0.08	0.66
	pattern 5	2.01	-1.11	2.27	-1.13	0.82	-1.08	1.47	-0.04	0.50
	pattern 6	-2.31	1.40	-2.52	1.82	-0.72	1.93	-0.98	1.00	-0.78
material	ABS	0.89	0.63	0.68	0.57	0.55	0.90	0.38	0.83	0.98
	rubber	-0.70	-0.18	-0.36	-0.32	-0.10	-0.83	0.06	-0.39	-0.65
	PP	0.41	0.05	0.21	0.29	-0.01	0.25	-0.08	0.15	0.33

1st column of each image means the coefficient of partial correlation
2nd column of each image means the category score of each pattern

4. Conclusions

The results of this study clearly showed that, in addition to the form and color, texture also could play an important role in sense perception. However, According to the analysis throughout this study, main points were concluded as follows:

1. Material was the main influence factor on sense of touch, rubber had the greatest influence among 3 materials; on the contrary, etching pattern was the main influence factor on sense of sight and multi-sense.
2. No matter in any sensation, there were not any significant interaction between materials and etching patterns. Therefore it was possible to reason the image of texture by summing up the influence of material and itching pattern.
3. Although the results of 3 tasks were little different, the results of multi-sense were similar to the sense of sight, that is to say, the perception by sense of touch can not be totally replaced by the sense of sight. It was better way in wanting express the image of texture by the sense of touch.
4. By establishing the reasoning functions from Quantification I Analysis, we had more precise knowledge

about the effects of materials and patterns for different image. Moreover, the estimation of the image of texture was possible from the results of analysis.

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References

1. Nagamachi M.,1995,"Kansei Engineering: A new ergonomic consumer-oriented technology for product development", International Journal of Industrial Ergonomics,
2. Matsubara Y., Nagamachi M.,1997,"Hybrid Kansei Engineering System and design support", International Journal of Industrial Ergonomics,
3. Tanoue C., Ishizaka K., Nagamachi M.,1997,"Kansei Engineering: A study on perception of vehicle interior image", International Journal of Industrial Ergonomics,
4. Terauchi F.,Kubo M. ,Aoki H.,1999,"Development of the Synthetic Vibration Model of Human", Report of Modeling the Evaluation Structure of Kansei
5. Harada A.,1998,"The Parallel Design Methodology in the KANSEI Engineering", Report of Modeling the Evaluation Structure of Kansei
6. Muneo K., Kim Don-Han,1998,"Communicating Kansei Design Concept via Artifacts-A Cognitive Scientific Approach",Report of Modeling the Evaluation Structure of Kansei
7. Hirohiko A.,1999,"An Hierarchical Representation of the Consumer Value Structure using Qualitative Data", Report of Modeling the Evaluation Structure of Kansei
8. Chen Tsai-Ching, "A Study on the Creation of the Symbolic Imagery of Texture within Visual Communication Design", master thesis, 2001
9. Ke, Chao-Ming, "A Study on the Visual and Tactile Image of Materials", master thesis, 1997
10. Li-Ju,Chien, " The Research of Material Image on Cognitions of Feelings", master thesis, 2003
11. Hung-Liang Lee, "The Transformation of Texture Projected Images and its Applications to The Development in Product Design Originality", master thesis, 2003
12. Lin P.L., "A Study on the Visual and Tactile Image of Form— Taking the Shape of Plastic Bottles as Examples", master thesis, 2002