복합 이미지에 대한 Perceptibility와 Acceptability 측정

Perceptibility and Acceptability Tests for the Quality Changes of Complex Images

김동호*, 박승옥**, 김홍석**, 김연진**
*앞선 사람들, **대진대학교 물리학과 색채과학연구실,
sopark@daejin.ac.kr

The psychophysical experiments were carried out by a panel of eleven observers on the image difference pairs displayed on the LCD (liquid crystal display)to quantify the quality changes of complex images imparted by the typical image processing operations. There were six different kinds of pairs according to their original image. The three types of visual tests performed were: (1) pair-to-pair comparison of image differences for ordering the differences between images introduced by single or combination of image lightness change, contrast change, blurring, and sharpening, (2) perceptibility and acceptability tests using ascending or descending series of image difference pairs ordered according to the size of their visual differences.

Six standard colour image data (SCID) images selected : musicians (MUS), cafeteria (CAF), bicycle (BIC), fishing goods (FIS), wine & tableware (WIN), and business graph (BUS). These selected images contain complicated geometric shapes, low lightness and shadow detail (low key), highlight tones and neutral colours, fine image detail, different skin tones, and synthetic charts in primary and secondary colours. These characteristics are suitable for evaluating the results of image processing (e.g., sharpness change) or reproduction. Global image colourfulness (or chroma) and lightness information were also considered in the selection of test images.

The images were processed on a windows operating PC equipped with an NVidia GeForce series video graphics adapter. A Samsung liquid crystal display (LCD) monitor of model number CX195T-CZ was used for displaying the images. The monitor resolution was set to 1280 x 1024 pixels at 60Hz frequency, and 24 colour bits per pixel. Using monitor on screen display (OSD) controls, the brightness and contrast were initially set to 80 and 50, respectively. The monitor was calibrated daily and the white point was set to 6500K. Other monitor characteristics were controlled following the sRGB reference conditions. The surround of the images on the monitor screen was filled with neutral grey having the RGB DAC count of (127,127,127). All of the visual tests were made in a darkened room. More than two hours were taken for warming up and stabilizing the monitor. For the colorimetric specification of each pixel in each image, the 8-bit RGB values of each pixel in an image were converted to CIE 1931 XYZ values according to the equations provided in the sRGB standard. The XYZ values were further translated to CIELAB values for the calculation

of mean difference of images in a pair.

Table 1 shows the results of Phases 1 and 2 experiments. In Phase 1, the raw data of observer judgments were analysed by invoking the Thurstone's law of comparative judgment for paired-comparison experiment. First, the 17 x 17 frequency matrix (FMAT) was constructed by summarizing the observers' judgment. FMAT was then converted to the proportion matrix (PMAT) and the z-score matrix (ZMAT) was obtained by transforming each proportion in PMAT. Finally, the scale matrix (SMAT) was obtained by summing up each column in ZMAT. Each element of the one dimensional ZMAT is regarded as the final arbitrary image difference scale value. the pair of the original and the blurred and consecutively sharpened image (E*ab = 2.06, order no. 4) represents perceptibility threshold, and the pair the original with the lightness increased by six steps, contrast decreased by five steps, and sharpened image (E*ab = 7.13, order no. 13) represent acceptability tolerance. This result did coincide well with the previous studies[1,2].

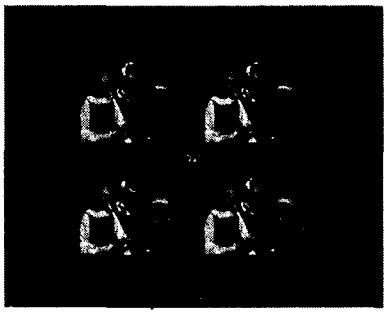

그림 1 1st experiment

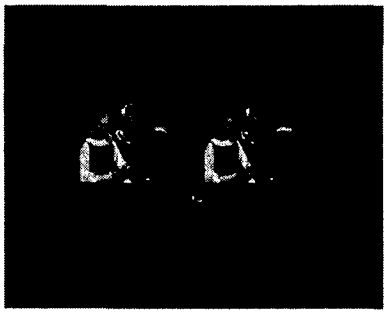

그림 2 2nd experiment

Table 1. Results of Phases I and 2 experiments.

Order	Scale	Function for variation	CIE LAB	Percept.		Accept	
				Asc.	Des	Asc.	Des
1	-17.4	(T+4)	1.66	0	0	0	0
2	-12.4	(L-3)	1.29	5	2	0	0
3	-11.7	(T-6)	2.45	4	9	0	0
4	**-8.2**	**(BLR) (SPE)**	**2.06**	**15**	**11**	**1**	**0**
5	-7.2	(SPE)	3.17	13	13	1	0
6	-5.5	(L+5)	3.92	3	6	1	1
7	-4.0	(L+5) (T+2)	3.52	11	3	7	8
8	-3.9	(L-5) (SPE)	4.28	8	6	5	3
9	0.2	(T+5) (L+4) (SPE)	5.10	3	3	4	1
10	0.6	(L+5) (T-4) (SPE)	6.28	1	1	2	6
11	1.0	(BLR) (L+5) (SPE)	4.68	1	0	6	12
12	4.5	(L+5) (T-5) (SPE) (BLR)	5.91	1	1	2	10
13	**5.6**	**(L+6) (T-5) (SPE)**	**7.13**	**0**	**0**	**24**	**9**
14	12.0	(BLR)	2.85	0	0	1	0
15	13.2	(T-6) (L+7) (SPE) (BLR)	7.53	0	0	1	5
16	17.0	(L+5) (BLR)	5.47	0	0	0	0
17	19.2	(L+5) (T-5) (BLR)	6.72	0	0	0	0

References

1. STOKES, M. Precision requirements for digital color reproduction. ACM Transactions on Graphics. 1992, 11, 406-422.

2. SONG T. Testing color-difference formulae on complex images using a CRT monitor. Proc. IS&T/SID 8th Color Imaging Conf. 2000, 8, 44-48.