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Certification

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This is to certify that the attached translation is, to the best of my knowledge and belief, a true and accurate translation from Japanese into English of the article that is entitled: Television Image Engineering Handbook, The Institute of Television Engineers of Japan, Seal of the Tokyo Metropolitan Library, Date: Jan. 17, 1981, Ohmsha, Ltd.

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Television Image Engineering Handbook

The Institute of Television Engineers of Japan

Ohmsha, Ltd.

Forward

Thirty years have passed since the Institute of Television Engineers of Japan was established in 1980. A plan was made to commemorate the event by publishing this handbook with Professor Yasuo Taki as the chief editor and the handbook has now been completed. This is truly a happy day for the Institute of Television Engineers of Japan.

The first Television Engineering Handbook was published in 1959 with professor Kenjiro Takayanagi as the chief editor, again in 1969 with Kei Mizokami as the chief editor and for the 20th anniversary the Television Engineering Handbook was completely revised and published. Television engineering has progressed remarkably in the ten years since that time. The field of television engineering has experienced innovative development in areas such as semiconductor electronics, digital circuitry and systems, image electronics and many other areas. Moreover, this handbook is more of a completely new edition than a revision to the old handbook and this is why the name was changed to the Television Image Engineering Handbook.

Television and image engineering has both a direct and indirect close relationship with our social lives. Almost 100% of the television broadcasting in Japan delivers high quality visuals related to news, education, culture and entertainment. There is increasing momentum to utilize digital technologies to provide an even wider range of teletext broadcasting and image broadcasting. On the industrial side, imaging technology is becoming increasingly more high tech and there is an increasing importance in using an industrial television system for integrated control systems at nuclear power plants, steel mills and other plants. Television and image applications are also expanding in fields such as space science, medicine, transportation, communications and information processing.

This handbook integrates all of the knowledge currently known about television and image engineering academics at this time. The writer is someone that is on the front lines of television science and he is the first of such people in the institute. The hope is that this handbook is not only a beneficial reference that can be used daily for members of the Institute of Television Engineers of Japan, but also for technicians and students that are concerned with image engineering.

The information in this handbook related to television and image engineering technology is bound to continue evolving at a rapid pace in the future. I am sure we will need to plan another revised edition later. I believe handbooks such as this are extremely valuable from the standpoint of knowing the process of how technology develops and in what direction future development will go.

In closing, I would like to offer my sincere gratitude for everyone that contributed to the editing and writing of this handbook over the last two editions including the editors, writers, publisher and everyone in the institute office that had a hand in the publication of this handbook.

Chairman of the Institute of Television Engineers of Japan, Toshio Utsunomiya

December 30, 1980

[4] Pseudocolor Image Processing

The conversion processing that has been described up to the preceding paragraph is a conversion from a black-and-white image to another black-and-white image. However, a conversion is often used in which a black-and-white image is artificially colored according to a density level of the black-and-white image to create a color image. This is called pseudocolor image processing. This is effective to clearly display a fine intensity change.

2.3 Geometrical Conversion[3), 6), 9)]

2.3.1 Geometrical Conversion of Image

The geometrical conversion of an image is a process such as conversions of magnification, reduction, rotation, parallel displacement, etc. of a given image; a correction of geometrical distortion of an image caused by the distortion of optical or electrical characteristics of the imaging system; and a production of an image in which the viewpoint or the field of view is moved. This conversion processing can be generally handled as a problem of a coordinate conversion.

[1] General Method

The image after the conversion or after the distortion of the image is corrected is represented by *f*, its coordinate is represented by (x, y), the original image is represented by *g*, and its coordinate is represented by (u, v). The coordinate conversion from (x, y) to (u, v) is shown as follows.

$$u = h_1(x, y) \qquad v = h_2(x, y)$$

If h_1 and h_2 are known, a converted image can be basically obtained from the following formula.

$$f(x, y) = g(u, v) = g(h_1(x, y),\ h_2(x, y))$$

However, for a digital image, a coordinate ($u_s \equiv h_1(x_s, y_s)$, $v_s \equiv h_2(x_s, y_s)$) on the *g* corresponding to an arbitrary sample point (x_s, y_s) of the *f* does not generally match a sample point of the *g*. Therefore, it is necessary to approximately determine a value of $f(x_s, y_s)$ from the sample point of *g* that is obtained in the vicinity of (u_s, v_s).

The basic methods for determining the value are as follows.

As the value of $f(x_s, y_s)$,

(1) a value of the sample point that is closest to the (u_s, v_s),

(2) a maximum value among four sample values in the vicinity of (u_s, v_s), or

(3) an interpolation value of four sample values in the vicinity of (u_s, v_s)

is chosen from the sample values of g. That is,

$$\begin{aligned} f(x_S, y_S) = &(1-\alpha)(1-\beta)g(u_0, v_0) \\ &+\alpha(1-\beta)g(u_0+1, v_0) \\ &+(1-\alpha)\beta g(u_0, v_0+1) \\ &+\alpha\beta g(u_0+1, v_0+1) \end{aligned}$$,

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