§42-4 Improvement of Similarity Retrieval in Fusion Experiment Multimedia Data Archive

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Experiments of the fusion phenomena produce a lot of sequences of time-varying values which form waveforms. If the waveforms similar to a desired one can be obtained by using computer system, the burden of researchers in searching similar waveforms will extremely be decreased. We have addressed to the issue on this kind of retrieval. The method using three dimensional (3D) Fourier transformation has been developed for the similarity retrieval of movies of plasma discharges, which are called plasma movies [1]. This paper clarifies the characteristics of plasma movie retrieval.

In the plasma video retrieval, videos are transformed to gray scale in advance. Only luminosity value is used as information of frames. A plasma video is divided by every sixty-four frames, which constitute a segment, from the beginning of the plasma discharge. 3D fast Fourier transformation is applied to each segment. Dissimilarities are separately calculated for low and middle frequency bands. In the low frequency band, difference of phases at the same frequency can be recognized. In the middle frequency band, difference of frequency can be recognized, while difference of phases can not. In the high frequency band, differences of frequency and phases are hardly recognized. These characteristics are considered in calculating dissimilarity. By cutting high frequency component from frequency information obtained, the dissimilarity considering human eyes can be obtained from plasma videos.

As evaluation criteria for judging the similarity of plasma videos do not exist, plasma video evaluation criteria (PVEC) are introduced. PVEC include the following seven criteria: Cr1: Position of a light spot, Cr2: Amount of the movement of a light spot, Cr3: Expansion and contraction of a light spot, Cr4: Speed of brightness transition, Cr5: Amount of brightness transition, Cr6: Color, and Cr7: Amount of color transition. These evaluation criteria are significant in plasma emission phenomenon.

We prepared five plasma videos (KEY1-KEY5) as key videos, and fifteen videos as database videos, which include the key videos. Subjects see key videos and database videos, and answer the similarity between key and database videos along the seven evaluation criteria of PVEC in three steps: 0: dissimilar, 1: a little similar, and 2: similar. Five male university students in early twenties majoring information technology joined the experiment. The average values of similarity are used in the evaluation. Here, we evaluate the dissimilarity calculated through the existing method by using the correlation coefficients between an evaluation criterion and the dissimilarity calculated, and the correlation coefficients between combinations of evaluation criteria and dissimilarity calculated.

Table I shows the correlation coefficients between the similarities obtained in the experiments and the dissimilarity calculated. Here, Cr6 and Cr7 are not included in Table I because these criteria relating to color information, and the dissimilarity calculated does not consider them. In Table I, "Min. of Abs." means the minimum value of absolute values of coefficients, and "Mean" stands for average values of coefficients. According to Table I, "Min. of Abs." and "Mean" indicate that the correlation between Cr5 and the dissimilarity calculated is the strongest.

Table II shows the correlation coefficients between the combinations of evaluation criteria containing Cr5 and the dissimilarity calculated. Here, Cr3 is not included in the combinations because it is correlated to Cr5. In Table II, the numbers put in parenthesis at the first line represent the combinations of evaluation criteria. For example, the expression (1,2,3) represents the combination formed by Cr1, Cr2, and Cr3. According to "Mean" in Table II, it is shown Cr5 has stronger correlation than the other combinations containing Cr5.

It was clarified the dissimilarity calculated by the existing method is strongly related to the criterion Cr5, the amount of brightness transition.

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 Table I: Correlation Coefficients between Evaluation Criteria and Dissimilarity Calculated

key video	Cr1	Cr2	Cr3	Cr4	Cr5
KEY1	-0.48	-0.44	-0.33	-0.29	-0.74
KEY2	-0.62	-0.51	-0.69	-0.80	-0.72
KEY3	-0.65	-0.83	-0.74	-0.76	-0.80
KEY4	-0.44	-0.46	-0.54	-0.45	-0.52
KEY5	-0.65	-0.48	-0.40	-0.35	-0.56
Min. of Abs.	-0.44	-0.44	-0.33	-0.29	-0.52
Mean	-0.57	-0.55	-0.54	-0.53	-0.67

 Table II: Correlation Coefficients between the Combinations of Evaluation Criteria and Dissimilarity Calculated

key video	(1,5)	(2,5)	(4,5)	(1,4,5)	(2,4,5)
KEY1	-0.70	-0.67	-0.60	-0.63	-0.60
KEY2	-0.74	-0.67	-0.80	-0.78	-0.74
KEY3	-0.77	-0.82	-0.81	-0.79	-0.83
KEY4	-0.51	-0.53	-0.53	-0.51	-0.53
KEY5	-0.63	-0.56	-0.48	-0.56	-0.52
Min. of Abs.	-0.44	-0.44	-0.33	-0.29	-0.52
Mean	-0.67	-0.65	-0.65	-0.65	-0.64