Image retrieval system of mammographic masses by using local pattern matching technique

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Abstract. We proposed a concept of content-based image retrieval and demonstrated the potential usefulness in mammography. The approach incorporated a local-pattern matching method based on Nth-order autocorrelation features with KL expansion (principal components analysis) to retrieve similar mass shadows on digitized screen/film mammograms. We confirmed the tendency that similar mass images were retrieved as the initial studies by using the 75 images of mammographic masses.

1. Introduction

Comparing the previous and similar images with current case is very effective procedure in interpreting by physicians. The purpose of this work is to develop an image retrieval system that searches out the image database for the image resembling to the entered one (query image) and outputs with diagnostic information. Approaches on image retrieval technique well employ the feature-extraction method in many researches. Also in the field of a medical image, some researches are reported on retrieval of the similar image of a lesion based on segmentation technique [1, 2]. Therefore, since the retrieval results depend on the accuracy of the segmentation processing, it is not an effective approach to retrieve images that the object boundaries are difficult to determine strictly. In this research, the technique of extracting the feature from the whole image automatically and performing image retrieval without carrying out the image segmentation is proposed. The simulation experiment using the mammographic mass images was conducted to examine the validity of this technique.

2. Methods

The features were extracted from the query image and the ones within whole database. The images including mass were simply cut from original digitized images in a square form. The autocorrelation features were extracted by counting patterns defined as local patterns consisted of some pixels with various gray level distributions. The example of the local pattern used for the feature extraction is shown in Fig. 1. If the feature extraction is carried out using N pieces of local patterns on each image, the feature vector with N elements is obtained. The feature values of all of the images in database were calculated, and the feature was expressed as a vector in N dimensions. After storing the vector in each image, the KL expansion was used to decrease the number of dimension in feature space to create the retrieval feature space. Next, the Euclid distance among the feature vectors measured on retrieval feature space evaluates the similarity between the query image and the others within the database. The nearest vector from the query image was employed as the retrieval result.

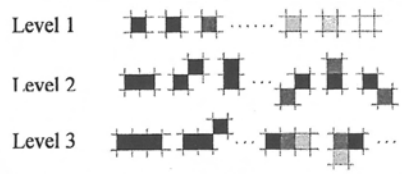

Fig. 1. Local pattern for feature extraction

3. Demonstration of image retrieval on mammographic masses

We evaluated the retrieval methods by using a database of 75 images of mammographic masses. Original images digitized from screen/film mammograms had 4096 gray levels and 100-micrometer sampling pitch. The preprocess to changes gray level into 8 and resolution into 400 micrometers was performed for the mitigation of retrieval condition. Sixty-four kinds (8 at level 1, and 56 at level 2) of local patterns were employed. KL expansion was performed to the extracted amount of the features, and one image in which the Euclid distance had the shortest feature in the retrieval feature space was determined the similar image about each image.

4. Results and Discussion

The retrieval results of the mammographic masses are shown in Fig. 2. The results indicated in the figure were chosen with degree of similar by subjective observation from 75 sets of retrieval results. Although there were many satisfied cases with the difference of density distribution between those images, there were a few results correspond to physician's opinion on the shape and the condition of margin of mass. The rate of coincidence was 29% on the shape, and was 34% on the margin. The reason of this was estimated that the signal-feature of an image is not in agreement

with a physician's subjectivity measure. However, it can expect that the system to retrieve an image quantitatively by the degree of similar based on the feature analysis, and can reduce the variation in diagnosis of physicians. Even when it was an inaccurate solution, the retrieved image has a similar impression in many cases. It is estimated that the feature vectors in the retrieval feature space were reflecting the shape of an object image well as this reason, and it may be able to use as diagnostic support.

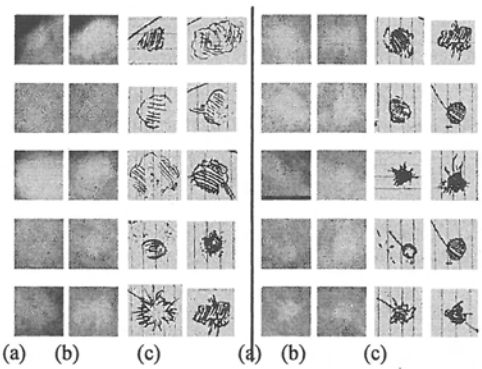

Fig. 2. 10 retrieval results of mammographic mass images. The images of four sheets are (a)a query image, (b)a retrieved one, (c)the sketch of the query image drawn by the physician, and the sketch of the retrieved image in an order from the left.

5. Conclusion

The retrieval technique based on local patterns existing in images was proposed. The experimental results show the effectiveness to retrieve gray-level patterns such as mammographic masses.

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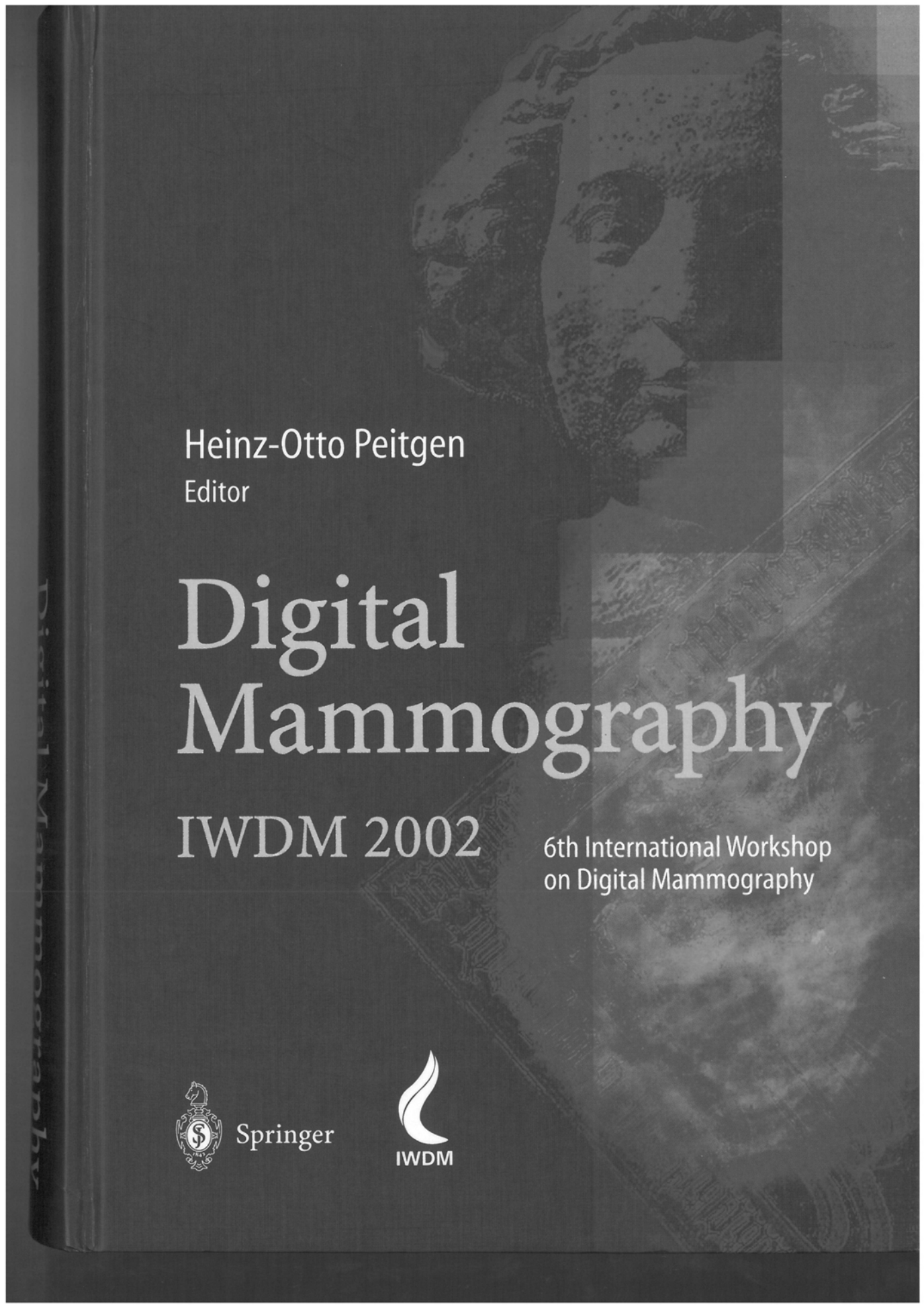
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