Department of Management and Information Sciences	Key words	Image analysis, Feature extraction, Segmentation, Pattern recognition, Quantitative description of image information, Visualization

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Education

Kyushu Institute of Technology Graduate School of Information Engineering
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Professional Background

Specially Appointed Assistant Professor, Center for Novel Science Initiatives, National Institutes of Natural Sciences

Consultations, Lectures, and Collaborative Research Themes

Lectures and technical consultations on the basics and applications of image information analysis. Development of image processing analysis methods. Effective visualization of complex information. Machine learning, etc.

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Main research themes and their characteristics

「Development of Nonlinear Image-Processing Techniques Based on Mathematical Morphology for Biomedical Images」

Image-processing methods significantly contribute to the analysis/visualization of biomedical targets acquired from various imaging techniques, including wide-field optical and electron microscopy, X-ray computed tomography, magnetic resonance imaging, and mammography. Image-processing is a crucial step in the analysis of biomedical imaging data; therefore, it is fundamental to a wide range of biomedical imaging and clinical research fields. Image-processing derives structural features, which are then numerically quantified by image analysis. Quantitative interpretation of structural features of lesion regions plays an important role, especially in diagnostic imaging; however, it poses many research challenges.

New computational methods based on mathematical morphology for quantitative image analysis has been developed. An important purpose of image processing is to derive meaningful information that is expressed as image structural properties. Mathematical morphology is a nonlinear image-processing method based on a set theory and is useful for the extraction of the structural properties from an image, thus making it a useful tool in analyzing biomedical images. In this study, image-processing algorithms (e.g., feature extraction, image enhancement, segmentation, and region segmentation) and theories for shape description and modeling based on mathematical morphology for biomedical images have been developed.

Mathematical morphology involves the configuration of a set of nonlinear operators acting on images by using structuring elements (SEs). An SE, which indicates the shape characteristics in an image, is generally a small and simple binary image. Dilation and erosion are two basic morphological operators, from which many operations can be derived. However, because SEs move in a fixed direction across the image, some intricate images (i.e., those whose structural details contain several directional characters) may not be properly processed. This is especially a serious problem because objects in biomedical images consist of delicate structural features.

To overcome this problem, an extension of conventional mathematical morphology called rotational morphological processing (RMP) has been devised. RMP-based morphological filters have been applied to a wide variety of biomedical images.

The morphological image enhancement method was used to enhance of an abnormal region in the chest radiograph shown in Figure 1. The unwanted structures surrounding the target are suppressed in the target enhancement process using the proposed method. From the result, the nodule region (It is indicated by an arrow) was clearly distinguished from the surrounding tissues. Furthermore, by applying automatic segmentation to the enhanced lesion region, it is possible to quantify the features of the lesion.

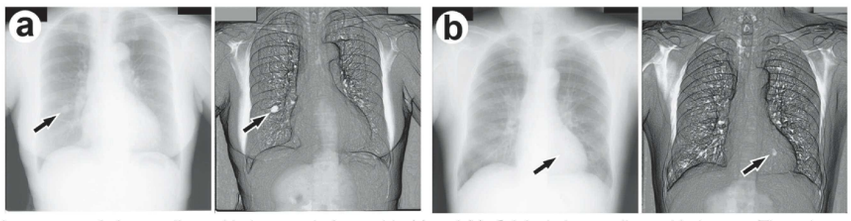

Fig.1 Enhancement of chest radiographic images. Left panel in (a) and (b): Original chest radiographic images (These images were obtained from the standard digital image database (Japanese Society of Radiological Technology)). Arrow in each image indicates the position of the abnormality (lung nodule). Right panel in (a) and (b): The images after contrast enhancement using the proposed method.

Major academic publications

Y. Kimori, “Mathematical Morphology-Based Approach to The Enhancement of Morphological Features in Medical Images,” Journal of Clinical Bioinformatics, 1 (2011) 33.

Y. Kimori, “A morphological image processing method to improve the visibility of pulmonary nodules on chest radiographic images,” Biomedical Signal Processing and Control, 57 (2020) 101744.

「Using image-based resources: databases for plant organelle dynamics and applications based on image information, Image and Video Processing: An Indroductory Guide」 S. Mano, Y. Kimori, T. Takeda, T. Miwa, S-i. Nishikawa, T. Mimura iConcept Press, pg. 83-109 (2013) ISBN 978-1477554838