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MR Compressed Sensing Reconstruction using Image Domain Learning CNN

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Abstract

Recently, a new theory called compressed sensing (CS) has been applied to MR image reconstruction with great success. CS reconstruction requires an iterative process for image reconstruction, which is computationally far more intensive than traditional inverse Fourier reconstruction. Another drawback of CS is that the obtained image tend to have artificial appearances.

In this study, we propose a high-speed CS reconstruction method using Image Domain deep learning. Our networks is based on residual learning convolutional neural network with 30 layers [1]. The reconstructed image is obtained by subtracting aliasing artifacts on the zero-filled images obtained by under-sampled MR signal. Reconstruction experiments showed that proposed method outperforms existing iterative reconstruction method (RecPF [2], sparseMRI [3]) in terms of reconstruction time and image quality.

Keywords: compressed sensing, reconstruction, deep learning

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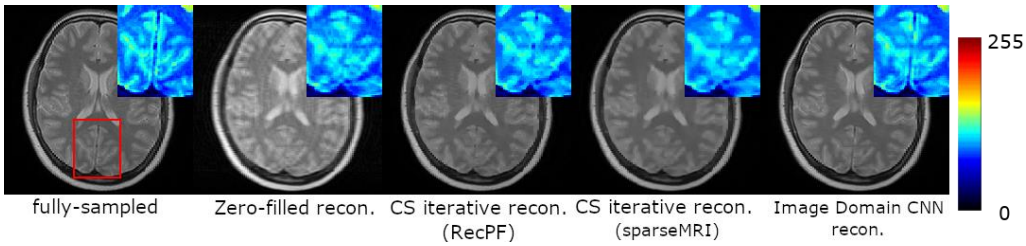

Fig. 1 Reconstructed images

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Study on initial alignment on registration between clinical CT and micro CT volumes of lungs

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Abstract

This paper presents initial alignment on registration between clinical CT and micro-focus X-ray CT (micro CT) volumes of lung. Clinical CT and MRI are 3D imaging modalities of mm-scale level resolution, and are commonly clinically used. Micro CT is a modality which enables us to observe μm-scale level of resolution images. While the micro CT cannot be used for the human body, resected specimens of lung tissues can be scanned. Registration of clinical and micro CT volumes allows us to explore macroscopic and microscopic structures. Our goal is to perform registration of pre-operative clinical CT of lung patients and micro CT volumes of those patients' resected lung cancers. Nevertheless several multi-modality registration methods have been tried, registration of those clinical and micro CT volumes have not been succeeded. In this study, we propose an initial rigid registration method between clinical CT and micro CT volumes of lung which can be performed as initial alignment of our future non-rigid registration method. Firstly, rough structures using information of surface and cutting plane of both CT volumes are aligned. Then, we segment blood vessels from both volumes, and convert the blood vessel labels into point clouds. Registration consists of two steps: 1) Rough alignment using manually selected pairs of landmark points in the point clouds, and 2) detailed alignment using ICP on the point clouds of the blood vessels. Finally, we apply the transformation matrix obtained by this method to the micro CT volume. Experiments were performed using one pair of clinical and micro CT volumes of a lung cancer patient. It was confirmed that not only blood vessels used for alignment but also structures outside them were also aligned almost properly. Quantitatively, it was confirmed that the value of NCC is closer to 1 after ICP.

Keywords: microstructural computational anatomy, scale-seamless registration, 3D histopathological diagnosis, multi-resolution images

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Role of image processing and machine learning in Carbon-ion radiotherapy

炭素線治療における画像処理と機械学習の役割

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Abstract

Carbon-ion radiotherapy is one of main treatment modalities for cancers. It has higher dose conformity and biology effect than photon therapy. Therefore, this technology has high requirement for accuracy. To achieve a more accurate irradiation, various technologies including the physical and engineering sites are applied, especially for image processing which plays an important role. Moreover, artificial intelligence including machine learning is being applied recently. I will present the role of the image processing and machine learning for carbon-ion radiotherapy and their future prospect.

Keywords: Carbon-ion radiotherapy, image processing, machine learning.

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Continuous observation of nailfold capillaroscopy through image processing

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Abstract

Routine nailfold capillaroscopy is essential for early diagnosis of rheumatic disease, but clinicians struggle to evaluate the same capillaries in every examination because the capillaries are similar in shape; therefore, difficult to differentiate. Here, we propose a method that enables us to compare previous and real-time images captured by a microscope with low- and high-power objective lenses. After selecting a target nailfold capillary using the low-power objective lens, we assessed the capillary with a high-power objective lens. The captured image of the target capillary was compared in real-time with the previously captured image, irrespective of magnification, using template matching. Our proposed algorithm detected allowable similarity for assessing the same capillary, which was helpful in evaluating the structural abnormalities of the entire area in addition to just the magnified area.

Keywords: Image stabilization, Nailfold capillary, Microscopy with low- and high-power objective lenses, Real-time similarity check.

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Composite Visco-elastic Model for Replaying Facial Expression

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Abstract

Facial expression has an important role in communication of human being. Aging and surgical scar change physical characteristics of facial tissue so that the difference of facial movement influences impression of the person. Recently, the computer-based biomechanical simulation provides an estimated result of aging and surgical scar, although most studies are limited to static movement. The goal of this study is to simulate dynamic movement of facial tissue considering visco-elastic characteristics to explain the effect of the procedure on dynamic movement. In this presentation, we report the measured visco-elastic properties of a couple of points of face and the results of dynamic deformation by using finite element method.

Keywords: finite element method, visco-elasticity, facial expression, deformation.

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Endoscopic Image Sequence Clustering using Dynamic Programming

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Abstract

Endoscopic image is an important modality for the discovery of diseases. Nowadays, it is natural to use some machine learning techniques such as neural networks and support vector machines for supporting endoscopic diagnosis by computers. However, the collection of labeled endoscopic images for a training dataset is difficult. In such case, group-based labeling is an effective strategy for collecting sufficient amount of training data. Improving the performance of endoscopic image clustering accelerates such group-based labeling.

In this study, we propose a new unsupervised learning method for clustering endoscopic images. A common property of endoscopes is that they take a sequence of images according to their camera movement. Hence, we use the temporal ordering information to cluster the endoscopic images. In the proposed method, clustering results of endoscopic image sequences are obtained by minimizing variance in each cluster using dynamic programming. Clustering is performed on each endoscopic image sequence.

In the experiments using esophagogastroduodenoscopy image datasets, we showed the validity of the proposed method for clustering endoscopic image sequence. The proposed method showed the best performance compared with conventional clustering method.

Keywords: endoscopic image, clustering, dynamic programming