Chapter 18
Cluster Based Medical Image Registration Using Optimized Neural Network

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ABSTRACT

Registration of medical images like CT-MR, MR-MR etc. are challenging area for researchers. This chapter introduces a new cluster based registration technique with help of the supervised optimized neural network. Features are extracted from different cluster of an image obtained from clustering algorithms. To overcome the drawback regarding convergence rate of neural network, an optimized neural network is proposed in this chapter. The weights are optimized to increase the convergence rate as well as to avoid stuck in local minima. Different clustering algorithms are explored to minimize the clustering error of an image and extract features from suitable one. The supervised learning method applied to train the neural network. During this training process an optimization algorithm named Genetic Algorithm (GA) is used to update the weights of a neural network. To demonstrate the effectiveness of the proposed method, investigation is carried out on MR T1, T2 data sets. The proposed method shows convincing results in comparison with other existing techniques.

INTRODUCTION

Image registration or alignment and matching of two or more images, establishes a one-to-one spatial correspondence of a single 2-D/3-D scene or several similar scenes captured at different time instants or from various viewpoints or by different sensors. In image processing this is one of the important steps

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used in a variety of applications including remote sensing and cartography, autonomous navigation, robot vision, and medical imaging to mention a few. It is a powerful tool for integrating or fusing image data collected from different sensors (mono-modal or multi-modality), tracking the temporal evolution (changes in images taken at different times), making inter-patient comparisons, reconstructing 3-D (volumetric) images from multiple 2-D (planar) images, etc. When one image is registered to another image, the latter is typically referred to as a reference image, and the former is called a target or sensed image. Medical images are very important for diagnosis, treatment, and supervising disease progression. The term 'medical image' spreads over a vast area of different types of images. Now-a-days medical researchers used medical images to investigate disease processes and to understand different developments like a tumor. Multiple images are acquired of common subjects at different times, or from different imaging modalities. Comparing two or more unregistered images can lead to incorrect diagnostic conclusions. Medical image registration generally deals with the technique to align two or more images of different modalities like inter-modality or intra-modality. Different topographic medical images like computed tomography (CT), magnetic resonance imaging (MRI), single photon emission computed tomography (SPECT), and positron emission tomography (PET) are generally used for research in image registration. Computer-aided diagnosis (CAD) systems use image registration to investigate how human anatomy is altered by disease, age, gender, handedness, and other clinical or genetic factors. Over the last decade, researches on automatic rigid registration methods of medical images have been widely developed. Rigid registration generally deals with some popular global geometric transformations include similarity, affine transformation, perspective projection, and polynomial models etc. Affine geometric transformation was used by Scale-invariant feature transform (SIFT) introduced by Lowe (Lowe, 2004). Multiple point-wise correspondences between local areas in two images determine the transformation parameters. Different retinal images collected with the 1-day time difference is analyzed using this method to estimation transformation parameters. Affine transformation deals with translation, rotation, scaling, and skewness of a target with respect to a reference. For negligible deformation in the image the affine transformations are sufficient. To address the deformable nature of a medical image like different organs, tissues etc. nonrigid registration methods have been developed. However, the global mapping is unable to capture intrinsically local large deformations of anatomical structures. Thus, frequently more flexible elastic transformations that locally warp a target to align with a reference image are needed. Most popular such transformations include large deformation models (diffeomorphisms), radial basis functions (RBF), physical continuum models (viscous fluids). Soft Computing techniques like GA (Genetic Algorithm), ANN (Artificial Neural network) etc. are also used in medical image registration. A powerful advantage of soft computing is the complementary nature rather than competitive. For this reason more than one soft computing technique is used collectively named hybrid technique. Hybrid soft computing models have been applied to a large number of classification and prediction. In this chapter a hybrid technique is described to register images of same modality. Here weight optimization of neural network is done by GA.

BACKGROUND

Image Registration is a technique to align two images, with one being referenced (fixed) image whiles the other being sensed (transformed) image of the same scene taken over different times or from different viewpoints. Over the years, research on image registration has offered a lot of methods. Typical examples include methods like image correlation functions, principal axis method, Fourier transform based