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Article

MRI Image Fusion Based on Sparse Representation with Measurement of Patch-Based Multiple Salient Features

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Abstract: Multimodal medical image fusion is a fundamental, but challenging, problem in the fields of brain science research and brain disease diagnosis, as it is challenging for sparse representation (SR)-based fusion to characterize activity levels with a single measurement and not lose effective information. In this study, the Kronecker-criterion-based SR framework was applied for medical image fusion with a patch-based activity level, integrating salient features of multiple domains. Inspired by the formation process of vision systems, the spatial saliency was characterized by textural contrast (*TC*), composed of luminance and orientation contrasts, to promote the participation of more highlighted textural information in the fusion process. As a substitute for the conventional l_1-norm-based sparse saliency, the sum of sparse salient features (*SSSF*) was used as a metric for promoting the participation of more significant coefficients in the composition of the activity level measurement. The designed activity level measurement was verified to be more conducive to maintaining the integrity and sharpness of detailed information. Various experiments on multiple groups of clinical medical images verified the effectiveness of the proposed fusion method in terms of both visual quality and objective assessment. Furthermore, this study will be helpful for the further detection and segmentation of medical images.

Keywords: multimodality medical image; image fusion; sparse representation (SR); Kronecker criterion; activity level measure

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1. Introduction

Over the past several decades, a variety of information processing technologies have led to major achievements in clinical diagnosis research [1], such as image classification [2,3], image fusion [4], and image segmentation [5]. The main purpose of medical image fusion is to combine the complementary information from various sensors to construct a new image with which to assist medical experts with diagnosis. Despite the simplicity of the idea, there are many challenges related to the theoretical background and the nature of medical images that need to be resolved. For instance, computed tomography (CT) imaging is informative regarding dense tissues, but lacks soft tissue information. In contrast, magnetic resonance imaging (MRI) is more suitable for soft tissues, but is short on dense tissue information. More crucially, single imaging tends to be ineffective at characterizing the symptoms of different diseases.

To overcome these challenges, a variety of image fusion methods have been proposed. The content of the image can be either visual (i.e., color, shape, or texture) or textual (i.e., to identify datasets appearing within an image). Some new advances in the fusion field consider these two aspects simultaneously [6,7]. To further improve fusion performance, some new features, such as different image moments [8–10], have also been used in image fusion.