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# WAVELET-BASED MULTIRESOLUTION MEDICAL IMAGE REGISTRATION STRATEGY COMBINING MUTUAL INFORMATION WITH SPATIAL INFORMATION

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Abstract. *Mutual information is a widely-used metric in medical image registration, which achieves good results; however it can lead to misregistration because of the absence of spatial information. One of the works to overcome this problem is proposed by [10] in which a gradient-based term is combined with mutual information. In this paper, we improve the method in [10] and propose a registration strategy which is more suitable when multiresolution scheme is adopted. Different from [10], the calculations of both the images with different resolutions and their corresponding gradient-like images are integrated under the wavelet transform. Mutual information (MI) and spatial information (SI) are respectively calculated from the low-frequency coefficients and high-frequency coefficients of wavelet transform on each resolution layer; and a hybrid metric is adopted to combine MI and SI together. The proposed registration strategy can run faster than the method in [10] when multiresolution scheme is used. Additionally, compared to the other existing works where wavelet transform is adopted for registration, we apply wavelet transform to the problem of 3D image registration and make use of both of the high frequency coefficients and low frequency coefficients. Experiments show that the proposed method behaves well in MR-MR and CT-MR registration problems.*

**Keywords:** Medical image registration, Mutual information, Spatial information, Wavelet transform, Multiresolution

1. **Introduction.** Medical image registration addresses the problem of finding a geometric transformation which is able to align two given medical images (volumes) together [1,2]. It is crucial to define a metric which can measure the similarities of two images. In the past few years, mutual information (MI) has been an intensively researched metric [3] in image registration because of its reported favorable characteristics and good results. This information-theoretic metric is fully automatic, and needs no predefined landmarks. In addition, unlike other intensity-based metrics, it is suitable to be applied on both mono-modality and multi-modality registration. Many independent researches show that mutual information performs very well [4,5,7,20]. However, MI has its own problem, since it lacks spatial information [3]. Its definition is based on Shannon's Entropy, which assumes each pixel is independent of its neighbors; however, sometimes such independency