Study of 3D Medical Image Compression Based on Motion Estimation Techniques

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ABSTRACT

3D medical image sets require considerable data capacity and as such, transfer or storage of 3D medical image sets has become a burden on a PACS system. In order to effectively reduce the required data capacity to facilitate transfer and storage, this paper has taken the redundancy in between image frames into account to propose a block matching algorithm based on motion estimation. By utilizing the trait of minimal change between frames of medical image sets, an inverse-diamond search will be performed on the images. Through the improvement in search method, we will not only be able to significantly reduce the search points needed but also achieve an ideal compression ratio to make the imaging process more efficient for motion estimation. The value of estimation deviation will be used to achieve lossless compression through simple Huffman Coding. In order to increase compression ratio, we have also taken near lossless compression into consideration by defining a threshold value during the process of block matching search to obtain the ideal balance between increased compression ratio and tolerable loss of image quality. Results of the experiment indicated that the compression ratio obtained from inverse-diamond search for MRI heart medical image set is higher than the compression ratio obtained by solely relying on intra-frame techniques such as DPCM and JPEG-LS. In addition, when compared to other algorithms that involve block matching in between frames, compression ratios obtained showed negligible differences. However, the inverse-diamond search method utilized in this paper requires merely 7% of the search points needed in a full search. As for near lossless compression, results showed that compression ratio could be increased from 2x to 7x with PSNR maintained at over 40dB. With regards to other 3D medical image sets such as MRI brain and CT brain, experiment results suggest that JPEG-LS outperformed other techniques in most areas with the exception of compression ratio; other results are similar to what has been obtained for MRI heart.

Keywords : Diamond search ; Inverse diamond search ; Lossless compression ; Near lossless compression ; 3D medical image sets

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