Shape Adaptive Integer Wavelet Transform based coding scheme for 2-D/3-D MR Images

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Data compression is useful in reducing the storage and/or transmission bandwidth requirements of medical images. In the medical image scenario, lossy compression schemes are not generally used. This is due to a possible loss of useful clinical information which may influence diagnosis. Hence there is a need for efficient lossless compression schemes for medical data. We propose a new Shape Adaptive Integer Wavelet Transform (SAIWT) based progressive transmission coding scheme for 2-D and 3-D brain MRI. The scheme consists of :

(a) Extraction of shape information (mask) by morphological operations. Mask is a binary image with 1's on the foregroung and 0's in the background.

(b) 2D/3D separable biorthogonal 9-7 SAIWT using the scheme given in [2].

(c) Intraband Wavelet enoding of the foreground object. Here we have modified the scheme in [1] by coding only the required object using the mask information. This object based coding greatly improves both overall progressive transmission performance and lossless compression as compared to conventional rectangular wavelet based coding scheme.

(d) Entropy coding of resulting bit stream and differential coding of the boundary of binary mask.

The above scheme is extended for 3-D MR images. The motivation is to exploit both intra and interframe correlation in the images. A common mask for a set of 2-D MR image slices (comprising 3-D MR data) is prepared by binary OR operation of individual masks of 2-D slices. After this the steps in (b), (c) and (d) are repeated for 3D case.

The performance of our shape adaptive scheme (both 2D and 3D) is superior to the conventional rectangular based schemes at all bit rates. We obtain 46% and 45% saving in bit rate for 2-D and 3-D respectively, at perfect reconstruction, using our new scheme as compared to conventional rectangular wavelet based schemes. The lossless bit rate for 3-D shape adaptive case is slightly higher than that in 2-D shape adaptive case. This is because the mask for 3-D case is obtained by mathematical or operation of the individual 2-D masks, which makes the 3-D shape information non optimal. For 2-D lossless case, our SAIWT based scheme gives considerable improvement over standard techniques like JPEG-LS and JPEG2000. We get 46.3% and 38.6% saving in bit rate for 2-D at perfect reconstruction, using our new scheme as compared to JPEG-LS and JPEG2000 standards.

References

[1] R. Srikanth and A.G. Ramakrishnan, "Wavelet-Based Coding of 2-D and 3D MR Images", Proc.IEEE Reigion 10 Conference (TENCON) 2003.

[2] Guiwei Xing, Jin Li, Shipeng Li and Ya-Qin Zhang, "Arbitrary Shaped Video Coding By Wavelet", IEEE Trans Circuits Syst. Video Technol.,vol.11, pp 1135-1139, Oct.2001.