MR Image Compression by Haar Wavelet Transform

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Image compression and coding form substantial problems in many engineering and biomedical applications. This paper is devoted to the study of the multi-resolution approach to this problem employing the Haar wavelet transform. In the initial part of the paper, the computation algorithm of the Haar transform (HT) for signals and images is proposed. Then we focus on the orthonormality property of discrete transforms in general. This property fulfilled also by the HT implies preserving the total amount of signal or image energy in its transform coefficients, as formulated by Parseval's theorem. According to this principle, we may calculate the proportion between the energies conveyed in each coefficients set and the energy of the original image. These percentual proportions suggest the extent of possible image compression, as depicted in Fig. 1 in which the HT is applied to a biomedical magnetic resonance (MR) image. Apart from energy preservation, the orthogonality property also guarantees reconstruction of a signal or an image from its transform coefficients without any distortion. In the final part of the paper, the two perfect reconstruction (PR) conditions for both the decomposition and reconstruction filters are derived employing the z-transform theory. It is shown, that the Haar filters satisfy the PR conditions.

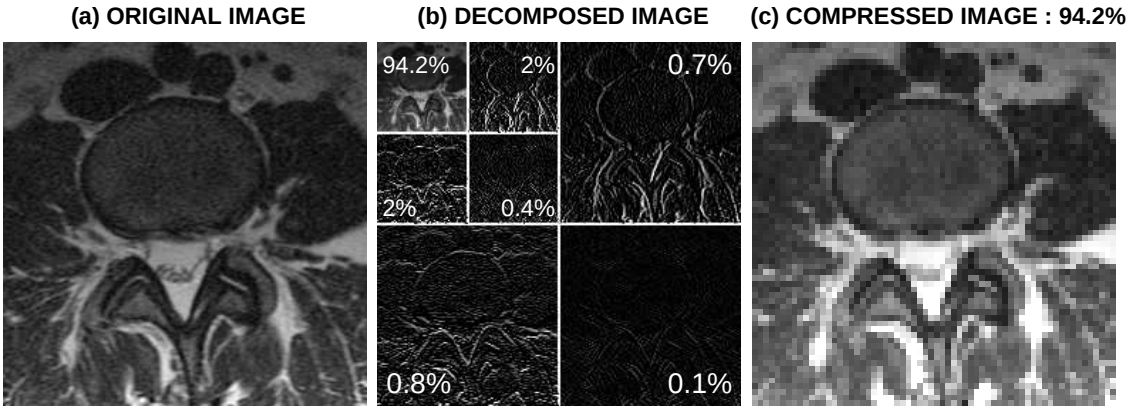

Figure 1: MR image compression using the Haar transform presenting **(a)** an axial MR image of the spine, **(b)** image decomposition up to the second level displaying the proportions of energy conveyed in each subimage, and **(c)** the compressed image