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Non-separable Four-Dimensional Integer Wavelet Transform with Reduced Rounding Noise

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Abstract

Since few decades ago, Discrete Cosine Transform (DCT) based digital image signal compression had been adopted as the JPEG international standard. Later, Wavelet Transform (WT) has replaced the DCT and its being applied in medical image compression. JPEG 2000, the international standardization of WT is using separable lifting structure where the multidimensional image signal is transformed separately in its horizontal and vertical direction. Besides that, each process is realized by cascading in lifting calculation. However, the necessity of waiting for previous step before calculating to the next step will make the overall delay time become longer. The delay time between input and output of WT is reduced as the proposed method reduces its lifting steps. Since the lifting step contains a rounding operation, variance of the rounding noise generated due to the rounding operation inside the transform is reduced. In this paper, unlike the conventional separable structure, the proposed non-separable structure reduces the rounding noise inside the transform, which will lead to the increasing of coding performance. The proposed wavelet transform has a merit that its output signal, apart from the rounding noise, is exactly the same as the conventional separable structure which is a cascade of 1D structure. As a result of experiments, it was observed that the proposed method reduces the rounding noise as well as increases the performance of data compression of various 4D input signals.

Key words: Wavelet, Transform, Lifting, 4D, Rounding, Coding

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