Efficient Seismic Volume Compression Using The Lifting Scheme

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Summary

An advanced seismic compression technique is proposed to manage seismic data in a world of ever increasing data volumes in order to maintain productivity without compromising interpretation results. A separable 3-D discrete wavelet transform (DWT) using long biorthogonal filters is used. The computation efficiency of the DWT is improved by factoring the wavelet filters using the lifting scheme. In addition, the lifting scheme offers: 1) a dramatic reduction of the required auxiliary memory, 2) an efficient combination with parallel rendering algorithms to perform arbitrary surface and volume rendering for interactive visualization, and 3) an easy integration in the parallel I/O seismic data loading routines. The proposed technique is tested on a seismic volume from the Stratton field in South Texas. The resulting 3-level multiresolution decomposition yields 21 detail sub-volumes and a unique low-resolution sub-volume. The detail wavelet coefficients are quantized with an adaptive threshold uniform scalar quantizer (TUSQ). The scale-dependent thresholds are determined with the Stein unbiased risk estimate (SURE) principle. As the approximation coefficients represent a smooth low-resolution version of the input data they are only quantized using a uniform scalar quantizer (USQ). Finally a runlength plus a Huffman encoding are applied for binary coding of the quantized coefficients.

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