LOW-COMPLEXITY SCALABLE MULTIDIMENSIONAL IMAGE CODING WITH RANDOM ACCESSIBILITY

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An Abstract of a Thesis Submitted to the Graduate

Faculty of Rensselaer Polytechnic Institute

in Partial Fulfillment of the

Requirements for the Degree of

DOCTOR OF PHILOSOPHY

Major Subject: Electrical Engineering

The original of the complete thesis is on file
in the Rensselaer Polytechnic Institute Library

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July 2008
(For Graduation August 2008)

ABSTRACT

Multi-dimensional data set, such as hyperspectral images and medical volumetric data generated by computer tomography (CT) or magnetic resonance (MR) typically contains many image slices that requires huge amount of storage and transmission bandwidth. To compress those huge size image data, it is highly desirable to have a low-complexity and efficient image coding algorithm. Furthermore, in the Internet environment, to make interactive viewing more efficient, we need a compression scheme which is inherently scalable and that supports a high degree of random accessibility.

The first aspect of this work proposes a fast coding method that supports both SNR and resolution scalabilities and decoding of a region of interest by random access to the bitstream. In order to achieve minimal complexity, we use fixed-symbol Huffman coding instead of context-based arithmetic coding. Multi-dimensional subband/wavelet coding is applied to exploit the dependencies and multi-resolution in all dimensions. We adopt wavelet bitplane coding to give full SNR scalability. The hierarchical coding and block based structure enables spatial accessibility and resolution scalable representation of wavelet transform coefficients. The framework is designed and implemented for both 3D and 4D image sources. We demonstrate through extensive experiments that our coding scheme performed comparable in compression to other algorithms while yielding very high coding speeds, and supporting all features planned for JPEG 2000.

The second aspect of this thesis proposes a coding method for wavelet coefficients of 3D image sources using vector quantization. In the proposed algorithm, multistage lattice vector quantization (MLVQ) is used to exploit correlations between image slices, while offering successive refinement with low coding complexity and computation. Different LVQs including cubic Z_4 and D_4 lattices are implemented with SPIHT. The experimental results show that MLVQ-based-schemes provide better rate-distortion performance at low bit rate than 2DSPIHT and those algorithms that employ 3D wavelet transforms.