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AN EFFICIENT ARCHITECTURE FOR 3-D LIFTING-BASED DISCRETE WAVELET TRANSFORM

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ABSTRACT

This paper proposes an improved version of lifting based 3D Discrete Wavelet Transform (DWT) VLSI architecture which uses bi-orthogonal 9/7 filter processing. The whole architecture was optimized in efficient pipeline and parallel design way to speed up and achieve higher hardware utilization. The Discrete Wavelet Transform (DWT) was based on time-scale representation, which provides efficient multi-resolution. The lifting based DWT architecture has the advantage of lower computational complexities transforming signals with extension and regular data flow. This is suitable for VLSI implementation. It uses a cascade combination of three 1-D wavelet transform along with a set of in-chip memory buffers between the stages. The discrete wavelet transform (DWT) is being increasingly used for image coding. This is due to the fact that DWT supports features like progressive image transmission (by quality, by resolution), ease of compressed image manipulation, region of interest coding, etc. DWT has traditionally been implemented by convolution. Such an implementation demands both a large number of computations and a large storage features that are not desirable for either high-speed or low-power applications. Recently, a lifting-based scheme that often requires far fewer computations has been proposed for the DWT. The main feature of the lifting based DWT scheme is to break up the high pass and low pass filters into a sequence of upper and lower triangular matrices and convert the filter implementation into banded matrix multiplications. Such a scheme has several advantages, including "in-place" computation of the DWT, integer-to-integer wavelet transform (IWT), symmetric forward and inverse transform, etc. Therefore, it comes as no surprise that lifting has been chosen in the upcoming.

Keywords— Descrete wavelet transform, image compression, lifting, video, VLSI architecture.

I. INTRODUCTION

The fundamental idea behind wavelets is to analyze according to scale. Indeed, some researchers in the wavelet field feel that, by using wavelets, one is adopting a perspective in processing data. Wavelets are functions that satisfy certain mathematical requirements and are used in representing data or other functions. Wavelet algorithms process data at different scales or resolutions. Fourier Transform (FT) with its fast algorithms (FFT) is an important tool for analysis and processing of many natural signals. FT has certain limitations to characterize many natural signals, which are non-stationary (e.g. speech). Though a time varying, overlapping window based FT namely STFT (Short Time FT) is well known for speech processing applications, a time-scale based Wavelet Transform is a powerful mathematical tool for non-stationary signals.

1.1 Introduction to Wavelet Transform:

The wavelet transform is computed separately for different segments of the time-domain signal at different frequencies. Multi-resolution analysis: analyzes the signal at different frequencies giving different resolutions. Multi-resolution analysis is designed to give good time resolution and poor frequency resolution at high frequencies and good frequency resolution and poor time resolution at low frequencies. Good for signal having high frequency components for short durations and low frequency components for long duration, e.g. Images and video frames.

1.1.1 Wavelet Definition

A 'wavelet' is a small wave which has its energy concentrated in time. It has an oscillating wavelike characteristic but also has the ability to allow simultaneous time and frequency analysis and it is a suitable tool for transient, non-stationary or time-varying phenomena.