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METADATA BASED HIGH QUALITY IMAGE/VIDEO STREAMING USING CURVELET TRANSFORM

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ABSTRACT

Today's revolution is mobile communication revolution, which enables us to connect each other worldwide. Due to the enhancement of multimedia and video surveillance services people are more sophisticated. Because of bandwidth requirements and resolution mismatch the designers still striving to provide robust coding technique. In mobile, web applications scalable video coding plays a vital role to integrate network providers with their clients. Generally, visual artifacts introduced in the existing video up/down sampling and to bridge the resolution gap between video streaming and display devices a new curvelet based architecture is introduced. Specifically, the proposed method up samples video frames by decoding the lower resolution (LR) video together with necessary features extracted from high resolution (HR). In this paper edge extraction and profile generation is provided as metadata by using curvelet transform. This proposed metadata based video streaming using curvelet transformation structure enhancing the video quality during LR to HR scheme and it provides good solution commercially.

Key words: *Curvelet Transform, Up/Down Sampler, Resolution, SVC.*

1. INTRODUCTION

The emerging home-network and broadband convergence network technologies allow people to see images and video anywhere at anytime. The display devices can be a large plasma display panel, a standard definition TV, or a very small cell-phone. Therefore, the video codec used in these devices should support various displays with different resolutions. However, the quality and resolution of the video content is currently limited because the bandwidths of wireless networks, are inadequate resources that must be shared among many users. The amount of wireless bandwidth in real situations is also far below the theoretical value due to fading, such as multi-path fading and shadowing caused by obstacles.

Due to prominent artifacts, many users find the experience on mobile devices unacceptable video quality such as blocking and blurring effects. Noticeable artifacts will significantly reduce people's eagerness to use video streaming services. However, many existing mobile devices are able to support resolutions larger than QVGA (320 X 240). Conspicuous artifacts appear when a low-resolution video is stretched to full screen on a mobile device, thereby preventing users from subscribing to mobile video services [1]. However, the bandwidth consumption to support videos with the above resolutions simultaneously in many mobile clients is still not feasible in current wireless networks. Although their computational complexity and down and up-sampling performance are appropriate for utilization with scalable video coding, further improvements must be made in terms of the rate-distortion performance [2].

This paper is organized as follows. Section 2 details an analysis of previous works. In Section 3, we describe the proposed work and its implementation. In Section 4,5 the core of the up/down sampler and curvelet transform is discussed. In Section 6, we discuss the simulation results and performance of the proposed method with existing techniques. Finally, conclusion depicted in the Section 7.

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2. PREVIOUS WORK

This section presents numerous interpretations from previous studies on user's subjective perceptions of the visual quality of video streaming on devices. Due to noticeable artifacts, the video quality is unacceptable, distorted and not well reconstructed under a large scaling factor. To support different display resolutions, discrete cosine transform (DCT) and discrete wavelet transform (DWT)-based video codecs [3],[4],[5] have incorporated. Quality scalability can be achieved in a similar way as spatial scalability, but the resolution change is lost. Then, to provide a high-quality video, we enhance the quality of high frequency or fine details, boundaries and important details of the objects in each frame/image. Metadata can be generated in real time according to the screen resolutions of devices. So Metadata based High Quality video streaming using curvelet transform method is introduced for retaining useful information is ratified in this paper.

3. PROPOSED WORK

Metadata based high Quality Video Streaming using Curvelet Transform is proposed for multimedia services. Here, for streaming high resolution video is step down as low resolution video. During full screen view the quality of video is diluted. To maintain information with the same quality, metadata is extracted from HR video that will send along with LR profile. Figure 1 depicts the transmitter section of the proposed work and receiver section is constructed symmetrically.

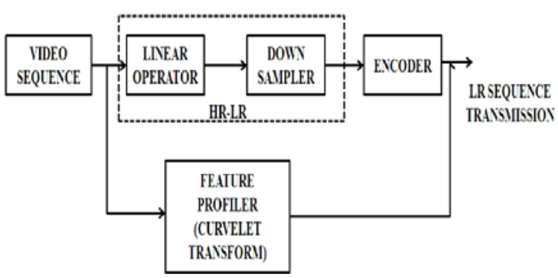

Figure 1 : Transmitter Section For The Proposed System

A video sequence is sliced into number of frames then passed through linear operator; basically it is a linear filter which reduces the dynamic range of the image pixels. Down sampling scheme is also introduced for high-low resolution trade off. Subsequently LR video sequence is compressed and coded using third party encoding scheme. During down sampling process we lose a lot of information and then the edge position of the up sampled frames are not identical to the original HR frames that creates visual artifacts. To resolve these visual artifacts, we extract the edge information from HD videos to find the boundaries and important details of objects at the client side. This paper deals with the proposed curvelet transform as feature profiler for optimal edge detection and other detailed feature extraction.

4. UP/DOWN SAMPLER

SVC method achieves adaptation of the bit-rate with useful features such as temporal and spatial scalabilities [6], [7], [8]. The down sampler has characteristics for strong antialiasing, where aliasing is inevitable in down-sampling [9], [10]. The performance of spatial scalability depends on the adopted down/up-sampling method. When spatial scalability is required in image or video coding, a high degree of compression is required at different scale. Moreover, in practical applications, the content of lower spatial resolution is used as it guarantees lower bit-rate than the original resolution content [11]. Therefore the highest compression is usually needed at lower scales, where the sequences correspond to the downsampled original sequence. Since, the compression has to be done in an efficient manner, a good balance should be found between the compression performance of the downsampler and the ability to downsample an input sequence. However, to improve dyadic scalability, up-sampling method is proposed in spatial domain [1], [12]. The down/up-sampled coordinates have a half-pel shifted result shown in Figure 2.

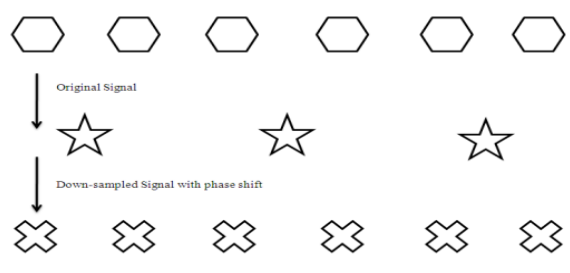

Figure 2: SVC Pixel Coordinates In Down/Up-Sampling

5. CURVELET TRANSFORM

The Curvelet transform is a higher dimensional generalization of the Wavelet transform designed to represent images and video sequences at different scales and different angles. The special characteristic of the curvelet transforms is very important for curvelet applications involving feature profiler like edge detection, denoising, and

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numerical simulation. Most natural images/video signals reveal line-like edges, i.e., discontinuities across curves. Although applications of wavelets and other popular edge detection operators have become gradually more popular in scientific and engineering fields, but do not exploit the regularity of edges [13]. Therefore, curvelet-based compression becomes computationally efficient for geometric features with line and surface singularities, and it supply good direction selectivity [14], [15]. Curvelets enjoy two unique mathematical properties, namely: Curved singularities can be well approximated with very few coefficients and in a non-adaptive manner - hence the name "curvelets". Curvelets remain coherent waveforms under the action of the wave equation in a smooth medium [16], [17]. The curvelet decomposition is the sequence of the following steps: Sub band Decomposition, Smooth Partitioning & Renormalization and Ridgelet Analysis as shown in Figure 3.

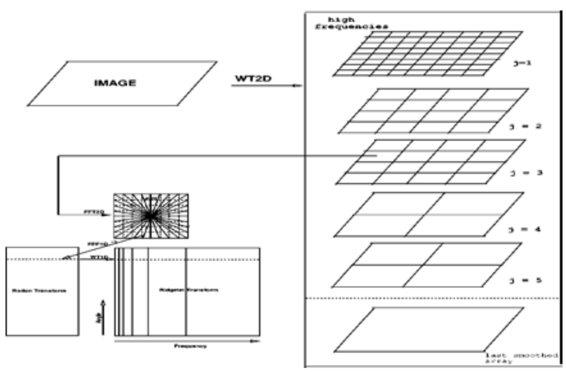

Figure 3: Flowgraph of curvelet transform

Basically, curvelet transform extends the ridgelet transform to multiple scale analysis. Therefore, lets start from the definition of ridgelet transform [6], [18]. Given an image function f(x,y), the continuous ridgelet transform is given as:

$$R_f(a,b,\theta) = \iint \psi_{a,b,\theta}(x,y) f(x,y) dxdy$$

Where a>0 is the scale, b Є R is the translation and Θ Є [0,2π] is the orientation. The ridgelet is defined as:

$$\psi_{a,b,\theta}(x,y) = a^{-\frac{1}{2}} \psi\left(\frac{x\cos\theta + y\sin\theta - b}{a}\right)$$

The digital curvelet transform is taken on a 2-D Cartesian grid f[m,n], 0≤m<M, 0≤n<N

$$C^D{}_{a,b,\theta}(x,y) = \sum_{\substack{0\le m<M \\ 0\le n<N}} f[m,n]\psi^D{}_{a,b,\theta}(m,n)$$

Let the Input N × N image f(x,y),

Step 1: Apply WT2D with J scales,
Step 2: Set B1 = Bmin,
Step 3: for j = 1, . . . , J do
Step 4: Partition the sub-band Wj with a block size Bj
apply the DRT to each block,
Step 5: if j modulo(2) = 1 then
Step 6: Bj+1 = 2Bj ,
Step 7: else
Bj+1 = Bj .
end if
end for.

6. SIMULATION RESULTS

Based on the experiments conducted, to study the performances of proposed metadata based high quality video streaming using curvelet transform, different kinds of benchmarks have been identified. Summarized experimental results with necessary parametric analysis and comments are revealed as follows. Simulation is performed using MATLAB with the parameters provided in Table 1. Three different video test sequences are employed to examine and analyze the proposed algorithm as shown in Table 1. The step by step process involved in the proposed method is experimented, also depicted in the figure 4. Here statistical features like, contrast, energy, correlation, homogeneity and entropy are calculated to rove the robustness of the proposed method.

Table 1: Table of test sequences

Test Number	Sequences	Resolution	Number of frames
1	Mother and daughter	352x288	96
2	Hall monitor	352x288	96
3	News reader	352x288	96

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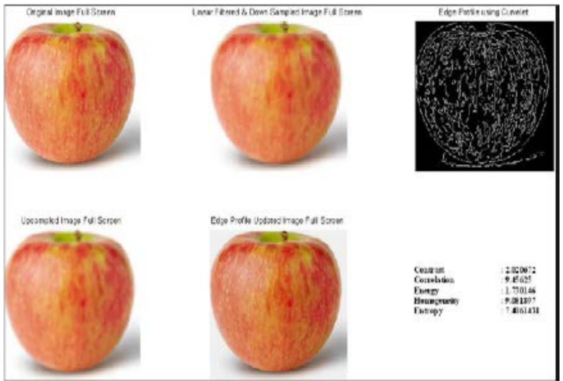

Figure 4: Image streaming using proposed method

Hall monitors video sequence with the frame rate of 25fps, resolution of 352x288 and totally of 96 frames have been analyzed and statistical features are extracted as shown in figure 5.

(a)

(b)

(c)

Figure 5: (a) Hall Monitor original video sequence (b) Edge profile using curvelet (c) Reconstructed sequence

Contrast : 0.4034
Correlation : 0.9453
Energy : 0.1084
Homogeneity : 0.9057
Entropy : 7.7381

7. CONCLUSION

We have proposed metadata based high quality video streaming using curvelet transformation in this paper. The effectiveness of the proposed method is measured by observation and error variance, is completely optimized to assure visual quality. The metadata generated by proposed technique considering less than the total transmitted data, but it reduces prominent artifacts very much compared with the existing approaches. Thus, the proposed metadata based video streaming using curvelet transformation structure enhancing the video quality during LR to HR scheme and it provides good solution commercially. Currently, a fast message passing interface-based parallel implementation can somewhat reduce the cost. How to build a fast orthogonal curvelet transform is still open.

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