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RESEARCH ARTICLE

Depth Video Compression Using Weighted Mode Filtering

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ABSTRACT: ***In this system, a technique has been proposed to compress a depth video by taking coding artifacts, spatial resolution, and dynamic range of the depth data into account. Due to abrupt signal changes on object boundaries, a depth video compressed by conventional video coding standards often introduces serious coding artifacts over object boundaries, which severely affect the quality of a synthesized view. The coding artifacts are suppressed by a post-processing, based on a weighted mode filtering and utilizing it as an in-loop filter. The weighted mode filtering method is attained by a joint histogram process. The weighted mode filtering is then applied to reconstruct a final solution with the original dynamic range by using the guided color information. This in addition, suppress the distortion from the dynamic range down/up scaling process by filtering the up scaling depth value based on the neighborhood information without degrading much the synthesized view quality. In addition, the proposed filter is also tailored to efficiently reconstruct the depth video from the reduced spatial resolution and the low dynamic range. The down/up sampling coding approaches for the spatial resolution and the dynamic range are used together with the proposed filter in order to further reduce the bit rate. The proposed techniques are verified by applying them to an efficient compression of multi-view-plus-depth data, which has emerged as an efficient data representation for 3-D video. Experimental results show that the proposed techniques significantly reduce the bit rate while achieving a better quality of the synthesized view in terms of both objective and subjective measures.***

Keywords: 3-D video, Depth coding, weighted mode Filtering, Depth dynamic range, Depth up/down sampling

1. INTRODUCTION

With the recent development of 3-D multimedia/display technologies and the increasing demand for realistic multimedia, 3-D video has gained more attentions as one of the most dominant video formats with a variety of applications such as 3-D TV or free view point TV (FTV). The main challenging issues of 3-D TV and FTV are depth estimation, virtual view synthesis, and 3-D video coding. The depth maps are used to synthesize the virtual view at the receiver side, so accurate depth maps should be estimated in an efficient manner.

In general, the depth map contains a per-pixel distance between camera and object, and it is usually represented by 8- bit grayscale value. The depth map has unique characteristics such that: The depth value varies smoothly except object boundaries or edges. The edges of the depth map usually coincide with those of the corresponding color image. Object boundaries should be preserved in order to provide the high-quality synthesized view. Thus, the straightforward compression of the depth video using the existing video coding standards such as H.264/AVC may cause serious coding artifacts along the depth discontinuities, which ultimately affect the synthesized view quality. The depth video coding approaches can be classified into two categories according to coding algorithms: transform based coding and post processing based coding. Although these methods have better performance than the existing image compression methods, they are difficult to be extended into video domain for exploiting temporal redundancies, and are not compatible with the conventional video coding standards such as H.264/AVC. New intraprediction in H.264/AVC was proposed to encode depth maps by designing an edge-aware intraprediction scheme that can reduce a prediction error in macro blocks. Different from the platelet or wavelet based coding methods this scheme can be easily integrated with H.264/AVC. In order to meet the compatibility to the advanced H.264/AVC standard, depth video coding algorithms have moved interest on reducing compression artifacts that may exist on depth video which is encoded by H.264/AVC

In this paper, techniques propose a novel scheme that compresses the depth video efficiently using the framework of a conventional video codec. In particular, an efficient post processing method for the compressed depth map is proposed in a generalized framework, which considers compression artifacts, spatial resolution, and dynamic range of the depth data. The proposed post processing method utilizes additional guided information from the corresponding color video to reconstruct the depth map while preserving the original depth edge. The depth video is encoded by a typical transform-based motion compensated video encoder, and compression artifacts are addressed by utilizing the post processing method as an in loop filter. In addition, we design a down/up sampling coding approach for both the spatial resolution and the dynamic range of the depth data. The basic idea is to reduce the bit rate by encoding the depth data on the reduced spatial resolution and depth dynamic range.

The proposed post processing filter is then utilized to efficiently reconstruct the depth video. For the post processing of the compressed depth map, we utilize a weighted mode filtering (WMF), which was proposed to enhance the depth video obtained from depth sensors such as time-of-flight (ToF) camera. Given an input noisy depth map, a joint histogram is generated by first calculating the weight based on spatial and range kernels and then counting each bin on the histogram of the depth map. The final solution is obtained by seeking a mode with the maximum value on the histogram. In this paper, we introduce the concept of the weighted mode filtering in generic formulation tailored to the depth image compression. I shall also describe the relation with the bilateral and trilateral filtering methods, which have been used in depth video coding, and show the effectiveness of the proposed method with a variety of experiments. The main contributions of this paper over can be summarized as follows.

1) Theoretically analyze the relation between the WMF and the existing approaches in a localized histogram framework to justify its superior performance in the perspective of robust estimation.

2) Effectively utilize the WMF in various proposed schemes for depth coding by considering important depth properties for a better synthesized view quality.

3) Thoroughly evaluate the effectiveness of the WMF in the depth characteristics and the objective measures are different.

2. RELATED WORK

2.1 IMAGE PROCESSING

Image Processing is a technique to enhance raw images received from cameras/sensors placed on satellites, space probes and aircrafts or pictures taken in normal day-to-day life for various applications. Various techniques have been developed in Image Processing during the last four to five decades. Most of the techniques are developed for enhancing images obtained from unmanned space crafts, space probes and military reconnaissance flights. Image Processing systems are becoming popular due to easy availability of powerful personnel computers, large size memory devices, graphics software etc.

2.2 VIDEO COMPRESSION

Video requires a large amount of storage space and transmission bandwidth. To reduce the amount of data, several strategies are employed that compress the information without negatively affecting the quality of the image. The proposed post processing technique follows the lossy compression.

2.3 DEPTH MAP

Depth map is an image or image channel that contains information relating to the distance of the surfaces of scene objects from a viewpoint. It is also called as depth images can be represented by grayscale image, where dark and bright pixels correspond to far and near pixels. Weighted mode filtering introduced in to enhance the depth map.

(a) (b)

(a) – Image
(b) -Depth Map

2.4 WEIGHTED MODE FILTERING

WMF-based method is utilized to up sample the spatial resolution and the dynamic range of the decoded depth map, and also to design an in-loop edge-preserving denoising filter. WMF proposes the post-processing method which utilizes additional guided information from the corresponding color video to reconstruct the depth map while preserving the original depth edge.

3. EXISTING SYSTEM

3.1 EXISTING SYSTEM

- Morvan *et al.* proposed a platelet-based method that models depth maps by estimating piecewise-linear functions in the subdivisions of quad tree with variable sizes under a global rate distortion constraint.
- Maitre and Do proposed a depth compression method based on a shape-adaptive wavelet transform by generating small wavelet coefficients along depth edges.
- Kim et al. proposed a new distortion metric that considers camera parameters and global video characteristics, and then used the metric in the rate-distortion optimized mode selection to quantify the effects of depth video compression on the synthesized view quality.
- Lai et al. showed that a rendering error in the synthesized view is a monotonic function of the coding error, and presented a method to suppress compression artifacts using a sparsity-based de-artifacting filter.
- Oh *et al.* proposed a new coding scheme based on a depth boundary reconstruction filter which considers occurrence frequency, similarity, and closeness of pixels.
- Liu *et al.* utilized a trilateral filter, which is a variant of bilateral filter, as an in-loop filter in H.264/AVC and a sparse dyadic mode as an intra-mode to reconstruct depth map with sparse representations.

3.2 DRAWBACK

- Difficult to be extended into video domain for exploiting temporal redundancies
- Not compatible with the conventional video coding standards.
- The performance of the coding algorithm was evaluated by measuring the depth map itself, not the synthesized view.

3.3 PROPOSED SYSTEM

In this project propose a novel scheme that compresses the depth video efficiently using the framework of a conventional video codec.

In particular, an efficient post processing method for the compressed depth map is proposed in a generalized framework, which considers compression artifacts, spatial resolution, and dynamic range of the depth data.

The proposed post-processing method utilizes additional guided information from the corresponding color video to reconstruct the depth map while preserving the original depth edge. The depth video is encoded by a typical transform-based motion compensated video encoder, and compression artifacts are addressed by utilizing the post-processing method as an in loop filter. In addition, we design a down/up sampling coding approach for both the spatial resolution and the dynamic range of the depth data. The basic idea is to reduce the bit rate by encoding the depth data on the reduced spatial resolution and depth dynamic range. The proposed post processing filter is then utilized to efficiently reconstruct the depth video.

3.3.1 FRAME EXTRACTION

In this technique read the input video and extract the number of frames with sequence number from that video.

3.3.2 IN LOOP FILTER

In this filter weighted mode filtering concept is employed to design


(a)


(b)


(b)


(d)


(e) (f)


(g) (h)

a,c,e,g –Extracted imags from video
b,d,f,h-Predecting edge from images

An in-loop edge-preserving denoising filter. The in loop filter is used to suppress the compression artifacts, especially on object boundaries, by taking the depth characteristics into account.

3.3.3 DOWN SAMPLING

During the compression down sampling reduces resolution of frames and also it consists of a low-pass filter and interpolation filter will smooth the sharp edges.

3.3.4 UP SAMPLING

Up sampling method increase resolution during decompression. Without proper down/ up sampling schema, important depth information in the boundary regions will be distorted and affect the visual quality of synthesized view. The proposed weighted mode filtering is tailored to up sample the decoded depth video.

3.3.5 RANGE REDUCTION

This module designs a similar approach to the spatial down/up sampling method to further reduce the encoding bit rate. The depth map consists of less texture details compared with the color video, enabling us to reconstruct efficiently the original dynamic range of the depth map from the lower dynamic range data.

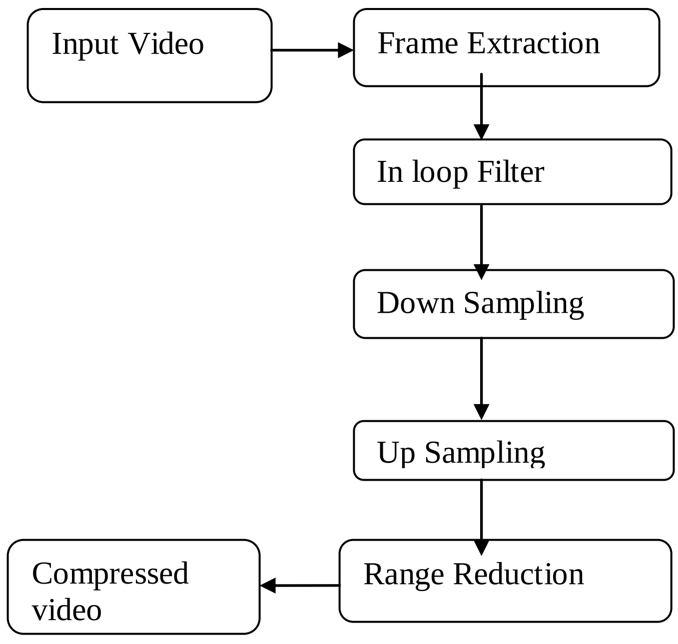
3.4 BENEFITS

- Reduce a depth bit rate as much as possible while ensuring the quality of the synthesized view.
- The depth value varies smoothly except object boundaries or edges
- The edges of the depth map usually coincide with those of the corresponding color image.
- Object boundaries should be preserved in order to provide the high-quality synthesized view.

4. ARCHITECTURE

Initialize video as input and compress that video, then frame extraction module read that input video and extract the number of frames with sequence number from that video. The in loop filter is used to suppress the compression artifacts, especially on object boundaries, by taking the depth characteristics into account and also weighted mode filtering concept is employed to design an in-loop edge-preserving denoising filter.

A weighted mode filtering method is proposed based on a joint histogram. During the compression down sampling reduces resolution of frames and also smooth the sharp edges in depth map. The proposed weighted mode filtering is tailored to up sample the decoded depth video. In range reduction module designs a similar approach to the spatial down/up sampling method to further reduce the encoding bit rate. The depth map consists of less texture details compared with the color video, enabling us to reconstruct efficiently the original dynamic range of the depth map from the lower dynamic range data.



5. CONCLUSION

- `The proposed techniques to compress the depth video by taking into account the coding artifacts, the spatial resolution, and the dynamic range of depth data. Specifically, an efficient post processing method was proposed to suppress the coding artifacts based on the weighted mode filtering and utilized as an in-loop filter.
- I also presented the spatial resolution sampling and the dynamic range compression to reduce the coding bit rate. The novelty of the proposed approach comes from the efficiency of the proposed up sampling filters, which has been tailored from the in-loop filter based on the weighted mode filtering.
- The experimental results showed the superior performance of the proposed filters compared with the existing filters. The proposed filters can efficiently suppress the coding artifacts in the depth map as well as recover depth edge information from the reduced resolution and the low dynamic range. As a result, and incurring much lower coding bit rate, I can achieve the same quality of the synthesized view.

6. FUTURE WORK

- In the future the video is compressed using graph based transformation. The graph based transformation is applied in a hybrid manner for each block, so that best transform achieve best rate distortion performance.
- Adaptive geometry-based intra prediction method for efficient depth video coding is developed.

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