MUVIDISCO

MULTIVIEW VIDEO DISPARITY COMPENSATION USING GEOMETRIC TRANSFORMS

MuViDisCo researched and designed more efficient multiview video motion/disparity compensation techniques to be implemented in Distributed Video Coding (DVC) and 3D video coding algorithms, based on the state-of-the-art H.264 and H.265 standards. These techniques use geometric transforms (e.g. perspective transforms) to perform more efficient motion and disparity estimation, thus improving the overall compression efficiency of the coding algorithm.

3D video technology has attracted considerable interest in the last few years. In this sense, few standards have extended their capabilities to deal with 3D video signals, namely multiview. Due to the increased number of views, these standards exploit inter-view redundancies by using block-based disparity compensation.

The block matching method for disparity compensation assumes that the disparity between views can be compensated using translations only. However, the changes among views depend on several factors related with the cameras geometry, which sets the angle between each used view, as well as different objects positioned at various distances from the cameras, etc.

The purpose of this project is to build a better prediction model, which uses geometric transformations (GT), to warp each image block from one view to another, thus modeling the disparity effect and increasing the performance of traditional 3D video encoders. The perspective transform (Fig. 2) have been chosen based on its computational complexity, efficiency on the motion/disparity model representation and parameter transmission requirements. This technique was implemented and tested in the motion compensation process of the H.264/AVC encoder (Fig. 1) and in Distributed Video Coding algorithm (Fig. 3).

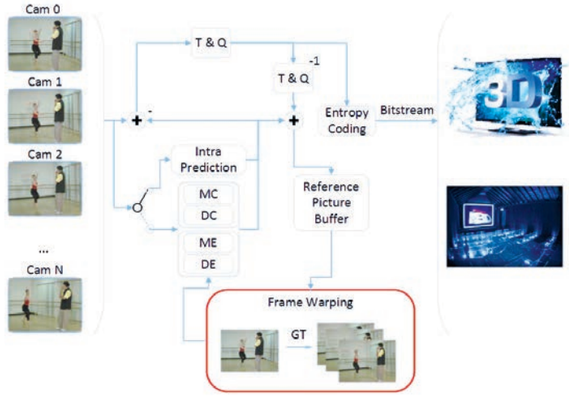

Fig.1 Using reference frame warping for motion/disparity compensation.

In DVC, the correlation in video signals is mainly exploited at the decoder side, leading to low complexity encoders and more complex decoders. In many MV-DVC solutions, the final generated SI results from the fusion of a temporal and an inter-view Side Information (SI) contribution. The inter-view SI contribution takes advantage of the inter-view correlation usually using inter-view interpolation techniques applied to compensate the disparity between adjacent view frames. However, many challenges are faced when inter-view interpolation is used for SI creation, notably due to occlusions and the impact of the visual sensors structure/camera acquisition geometry. Thus, the use of GT as an alternative to translational ME, as shown in Figure 3, provides a better solution to determine the motion model between frames.

Novel solutions were developed to increased the efficiency of disparity compensation, namely for the multiview extension encoder based on the H.265/HEVC standard. In order to perform more accurate disparity compensation, the reference picture list is enriched with additional geometrically transformed images, for the most relevant object's levels of depth in the scene, resulting from projections of one view to another. At each depth level, with significant objects in the scene, a new warped frame is generated according to the geometric relation between the objects plane and the camera.

URL
http://www.it.pt/project_detail_p.asp?ID=1476

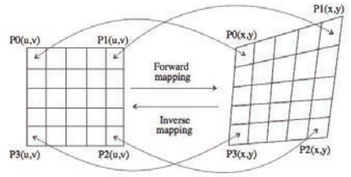

Fig.2 Perspective transform.

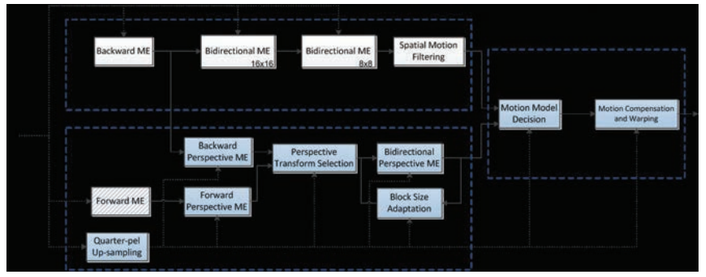

Fig.3 Exploiting the temporal correlation in DVC.

ACHIEVEMENTS

MuViDisCo has proposed a motion/disparity compensation scheme for multiview image and video that uses geometric transformations. Three methods were developed and proposed using GT to exploit temporal and interview redundancy. These methods aim to improve motion compensation in H.264/AVC and in DVC encoders, and to exploit inter-view redundancy in MV-HEVC.

By integrating warped versions of the reference frames in the reference list, the proposed encoder is able to outperform the state-of-the-art H.264/AVC video codec, with bit rate savings up to 7.5%.

In this project, a new side information generation method integrating perspective transform motion modeling was proposed for the SV-DVC solution and two key contributions in terms of interview SI creation and SI fusion were proposed for the MV-DVC solution to improve the state-of-the-art DVC RD performance (up to 10% bitrate savings were achieved).

Finally, a disparity compensation scheme for stereo video was proposed using GT frames. The new reference frames are generated by a set of GT, based on several depth planes of a 3D scene. Experimental results show the potential of this framework, which is able to achieve bitrate savings of up to 4.87% and 2.87% for image and video, respectively

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INDICATORS

FUNDING	46 K€
JOURNAL PAPERS	2
CONFERENCE PAPERS	3
CONCLUDED MSC	2

PUBLICATIONS

- A. S. Dias, C. Brites, J. Ascenso, and F. Pereira, "SIFT-based Homographies for Efficient Multiview Distributed Visual Sensing", IEEE Sensors Journal, accepted for publication, doi: 10.1109/JSEN.2014.2355914

- P. Monteiro, J. Ascenso, F. Pereira, "Perspective Transform Motion Modeling for Improved Side Information Creation", EURASIP Journal on Advances in Signal Processing, Vol. 2013, No. 1, December 2013.

- D. F. Souza, J. Ascenso, N. Rodrigues, S. Faria, F. Pereira, "Improving H.264/AVC Video Coding with Geometric Transforms", Proc. Conf. on Telecommunications - ConfTele, Castelo Branco, Portugal, May 2013.

- R. Monteiro, N. Rodrigues, S. Faria, "Disparity Compensation using Geometric Transforms", Proc. 3DTV Conf. - 3DTV-CON, Budapeste, Hungary, July, 2014.