International Journal For Technological Research In Engineering
Volume 5, Issue 10, June-2018 *ISSN (Online): 2347 - 4718*

VIDEO STABILIZATION: AN IN-DEPTH SURVEY

Nitin Kumar[1], Neelabh Gupta[2], Yogesh Tiwari[3]
[1,2]M.Tech Scholar, [3]Assistant Professor HOD(ECE) ,
[1,2]Digital Communication, CGI Bharatpur Rajasthan.

Abstract: Video stabilization is a video processing technique to enhance the quality of input video by removing the undesired camera motions. There are various approaches used for stabilizing the captured videos. Most of the existing methods are either very complex or does not perform well for slow and smooth motion of hand held mobile videos. Hence it is desired to synthesis a new stabilized video sequence, by removing the undesired motion between the successive frames of the hand held mobile video. Various 2D and 3D motion models used for the motion estimation and stabilization. The paper presents the review of the concept video stabilization, its approaches and applications.
Keywords: Video Stabilization, digital video,

I. INTRODUCTION

Due to advancement in the technology, it is now possible to take videos from cheaper multimedia devices like mobile phones. But, due to handshaking of user, the cameras on moving things (global motion) or vibration produced due to moving objects in the scene (local motion), the captured video becomes unstable.

Video stabilization is an algorithm used to improve the video quality by removing unwanted camera shakes and jitters. The removal of unwanted vibrations in a video sequence induced by camera motion is an essential part of video acquisition in industry, military and consumer applications.

The video stabilization can either be achieved by hardware or post image processing approach. Hardware approach can be further classified as mechanical or optical stabilization. Mechanical stabilizer uses gyroscopic sensor to stabilize entire camera. Optical stabilization activates an optical system to adjust camera motion sensors [1]. These techniques are not suited for small camera modules embedded in mobile phones due to lack of compactness and also due to the associated cost. In the image post processing algorithm, there are typically three major stages constituting a video stabilization process viz. camera motion estimation, motion smoothing and motion compensation. There are various algorithms proposed for stabilizing videos taken under different environment from different camera systems by modifying these three stages. Image post processing techniques are favorable over mechanical or optical approaches since modern VLSI techniques will allow a more compact camera design.

To stabilize the video the approaches proposed can be classified as mechanical, optical and digital video stabilization techniques. [1] So, instead of holding camera in hand, mechanical stabilization proposes putting camera on some mechanical devices. This is probably simplest, cheapest and obvious method. The mechanical devices on which camera are to be put has included tripod, steadicam. But, the mechanical device mostly used is gyroscopic sensor. Due to handshaking of user, the light rays which are supposed to fall on image sensor, actually falls somewhere else. So, optical image stabilization technique ensures that the light rays fall properly on image sensor even if handshaking of user or camera movements takes place [2].

But, digital video stabilization technique processes video, frame by frame, post whole video is taken. Also, as mechanical and optical stabilization technique require some hardware it obviously needs some space to accommodate that hardware and is unsuitable in small devices like mobile phones. Also, optical stabilization is much expensive method compared to digital technique. The digital stabilization technique considers motion estimation and motion smoothing. Motion estimation compares the current frame with previous frame to find best matching block and calculates motion vectors for that block and motion smoothing removes motion vectors due to unintentional. Video stabilization is an algorithm used to improve the video quality by removing unwanted camera shakes and jitters. The removal of unwanted vibrations in a video sequence induced by camera motion is an essential part of video acquisition in industry, military and consumer applications.

The video stabilization can either be achieved by hardware or post image processing approach. Hardware approach can be further classified as mechanical or optical stabilization. Mechanical stabilizer uses gyroscopic sensor to stabilize entire camera. Optical stabilization activates an optical system to adjust camera motion sensors [1]. These techniques are not suited for small camera modules embedded in mobile phones due to lack of compactness and also due to the associated cost. In the image post processing algorithm, there are typically three major stages constituting a video stabilization process viz. camera motion estimation, motion smoothing and motion compensation. There are various algorithms proposed for stabilizing videos taken under different environment from different camera systems by modifying these three stages. Image post processing techniques are favorable over mechanical or optical approaches since modern VLSI techniques will allow a more compact camera design.

II. BASIC CONCEPT OF VIDEO STABILIZATION

The goal of any video stabilization algorithm is to create a new video sequences where the motion between the frames has effectively removed. In general any digital video stabilization algorithm consists of three stages Motion Estimation (ME), Motion Smoother (MS) and Motion Compensation (MC) as in Fig. 1 ME estimate the motion between the frames, and sends the motion parameters to MS, which removes the unwanted camera motions. MC then

computes the global transformation necessary to stabilize the current frame.

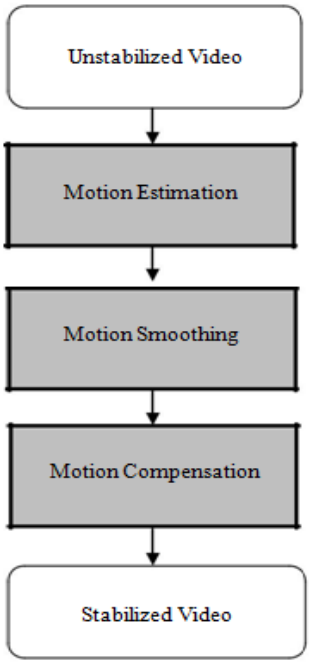

Fig. 1Steps followed for video stabilization

A. Motion Estimation

Motion estimation is determining motion vectors from adjacent frames in a video sequence. The motion vectors may relate to the whole frame or specific part, such as rectangular blocks, arbitrary shaped patches or even considering a single pixel. In any of the video stabilization algorithm motion estimation is the important stage. Since in Real word camera motion often involves some type of global transformation it is particularly important to get an accurate estimate of the global motion when performing motion estimation.

B. Motion Smoothing

The output of the motion estimation process discussed is capable of computing the motion vectors between two frames. The objective of motion smoothening is to remove the jitters and undesired motions present in the captured video. These undesired motions usually consider as high frequency motion such as vibration, and can effectively remove by low pass filters. Thus, motion smoothing also called as motion filtering.

C. Motion Compensation

Motion compensation is removing temporal redundancy between frames in order to produce stabilized video. It is different from motion smoothing which is used for removing spatial redundancy between frames. Using the smoothed motion vectors from motion smoother, motion compensation is performed frame by frame. For example, stabilized frame2 is obtained by performing motion compensation original frame1 using the corresponding smoothed motion vector. To get stabilized frame3, stabilized frame2 and its corresponding smoothed vectors are used and so on. In such a fashion, the entire stabilized video sequence can be generated.

III. VIDEO STABILIZATION APPROACHES

The Video stabilization can either be achieved by hardware or post image processing approaches which are described as below:

A. Hardware Approach

1. MECHANICAL STABILIZATION

In the first category we use hardware motion sensors or mechanical devices such as gyros, accelerometers and mechanical dampers. Thus instead of holding camera in hand, mechanical stabilizers such as tripod, Steadicam are used which reduce platform vibration and in turn provide stabilization. [1]

2. OPTICAL IMAGE STABILIZATION

In optical image stabilization(OIS) CCD/CMOS sensors, microcontrollers, Hall sensors are used. Optical stabilization is much expensive than digital technique but its computational complexity is low as it is concerned with light rays falling on the camera's lens.[1] In these approaches detection and correction steps are applied before acquisition so as to avoid post processing computation.

B. Post Image Processing Approach

1. OBJECT TRACKING VIDEO STABILIZATION

The second category is of object tracking [2, 3]where objects such as person, vehicle, and road signs are the targets to track. This is also known as video tracking. The objective of video tracking is to associate target objects in consecutive video frames.

2. DIGITAL VIDEO STABILIZATION

This is the estimation based approach. In this category, a video stabilization pipeline usually comprises three stages: motion estimation, motion smoothing, and motion compensation [5].

IV. APPLICATIONS OF VIDEO STABILIZATION

There is a vast list of applications of video stabilization, ranging from cell phones to critical defense equipment's. All three defense services can use this algorithm to stabilize the video. Army can use it in tank systems to stabilize against irregular, uneven path and terrain. Air force can use it to stabilize against atmospheric turbulences & engine vibrations. Navy can use it in naval ships to stabilize against high amplitude, low frequency waves and particularly low rate is taken care by our method's ability to provide sub-pixel motion compensation. Due to its low computational cost, it can be easily implemented in consumer electronics like handheld camera and video recorders, mobiles having camera for recording videos. Hand held wireless video communication equipments also fall in the domain of presented algorithm.

V. CONCLUSION

This paper reviews about the concept of the Video Stabilization ,its Basic System , its structure and components and also about the applications of the Video Stablization.

REFERENCES

[1] H. Wu, L. Xiao, H. J. Shim and S. Tang, "Video stabilisation with total warping variation model," in

IET Image Processing, vol. 11, no. 7, pp. 465-474, 7 2017.

[2] J. Yu, K. Xiang, X. Wang, S. Cao and Y. Zhang, "Video stabilisation based on modelling of motion imaging," in IET Image Processing, vol. 10, no. 3, pp. 177-188, 3 2016.

[3] T. Nou-Shene, V. Pudi, K. Sridharan, V. Thomas and J. Arthi, "Very large-scale integration architecture for video stabilisation and implementation on a field programmable gate array-based autonomous vehicle," in IET Computer Vision, vol. 9, no. 4, pp. 559-569, 8 2015.

[4] H. Ovrén and P. E. Forssén, "Gyroscope-based video stabilisation with auto-calibration," 2015 IEEE International Conference on Robotics and Automation (ICRA), Seattle, WA, 2015, pp. 2090-2097.

[5] F. Raimbault and Y. Incesu, "Adaptive video stabilisation with dominant motion layer estimation for home video and TV broadcast," 2013 IEEE International Conference on Image Processing, Melbourne, VIC, 2013, pp. 3825-3829

[6] S. C. Abraham, M. R. Thomas, R. Basheer and P. R. Anurenjan, "A novel approach for video stabilization," 2011 IEEE Recent Advances in Intelligent Computational Systems, Trivandrum, 2011, pp. 134-137.

[7] A.T. Albrecht, T. Tan, G. A. W. West and T. Ly, "Omnidirectional video stabilisation on a virtual camera using sensor fusion," 2010 11th International Conference on Control Automation Robotics & Vision, Singapore, 2010, pp. 2067-2072

[8] A.J. Crawford, H. Denman, F. Kelly, F. Pitie and A. C. Kokaram, "Gradient based dominant motion estimation with integral projections for real time video stabilisation," Image Processing, 2004. ICIP '04. 2004 International Conference on, 2004, pp. 3371-3374 Vol. 5

[9] N. A. Tsoligkas, D. Xu, I. French and Y. Luo, "A Motion Model Based Video Stabilisation Algorithm," 2006 World Automation Congress, Budapest, 2006, pp. 1-6.

[10] L. Zhang, Q. Z. Zheng and H. Huang, "Intrinsic Motion Stability Assessment For Video Stabilization," in IEEE Transactions on Visualization and Computer Graphics,2018

[11] K. Joseph, A. N. J. Raj, Z. Fan and C. M. Vidhyapathi, "A time-efficient video stabilization algorithm based on Block Matching in a restricted search space," 2017 IEEE International Conference on Real-time Computing and Robotics (RCAR), Okinawa, 2017, pp. 651-656.

[12] H. P. Nguyen, T. T. N. Do and J. Kim, "Exponential coordinates based rotation stabilization for panoramic videos," 2017 IEEE International Conference on Image Processing (ICIP), Beijing, 2017, pp. 46-50.

