© 2022 IJRTI | Volume 7, Issue 10 | ISSN: 2456-3315

Review of Prominent Video Stabilization Mechanisms

Parmeet Kaur Jaggi[1] , Dr Umashankar Kurmi[2]
[1] Research Scholar, LN University, Bhopal, MP
[2] Professor, LN University, Bhopal, MP

Abstract. Video stabilisation is still a reasonably active research subject despite being an important and often used image processing tool. For diverse purposes as and when required, numerous techniques and approaches are applied. Real-time video stabilisation has received less study than video stabilisation overall, particularly when it comes to projects requiring the utilisation of technology for mounting end applications like off-road vehicles and unmanned aerial aircraft (UAVs). For these applications, the stabilisation system's total real-time performance is determined by how much processing power it uses, particularly the motion estimate component. Thus, the descriptor that is employed for motion estimation plays a key part. In addition to a discussion of the requirements for real-time performance, this work provides a comprehensive analysis of all motion estimating methods and descriptors.

Keywords: Stabilization, Optical Flow, Gradient Techniques, Feature extractions

1 Introduction

The market for handheld cameras has recently grown quickly. Unexpected results might arise from amateur users recording videos. The system's installation is important, especially for the output video. The resulting video feed is of very low quality if the camera is mounted on a moving item (such as a car, tank, or aeroplane) or is held by a person. The ideal solution is to mount the camera on a sturdy holder, however if the holder's peak is too high, the camera will be vulnerable to environmental factors like wind and ocean waves. Unwanted movements might skew the impression of a scene that has been filmed. As a result, video stabilisation is crucial and need to be required to improve the hand-held mobile devices' picture quality. With video stabilisation, a video sequence's irritating shaky motion is eliminated [1]. Nevertheless, it is essential for a number of applications, including video compression, satellite imaging, video writing, background estimation, and the identification of moving objects. Additionally, information fusion jobs in medical imaging depend on it.

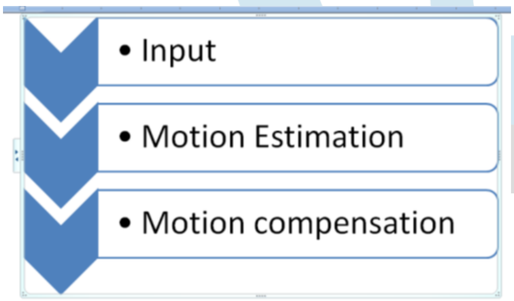

Fig. 1. Generic Video Stabilization System

2 Techniques for Video Stabilization

Any video stabilizer's first step is to calculate the camera motions. In order to retrieve motions from the video sequence, motion estimation is used. After that, by examining the spatio-temporal relationship between succeeding frames, the camera motion parameters are computed. Using a similarity metric or a distance metric, pixels (or blocks of pixels) from the previous frame are compared to pixels (or blocks of pixels) in the new frame. To address this issue, many methods have been proposed. Some attempt to match every pixel in the frame others use blocks of pixels, and lastly, points of interest may be utilised to infer motions.
Three criteria may be used to classify video stabilisation methods [2]:

1) Mechanical video stabilisation
2) Optically Stabilized Video
3) DVS

The next section discusses these methods.

Mechanical video stabilization:

A useful video stabilisation technique where stabilisation is achieved automatically is mechanical stabilization [7]. In other words, mechanical devices are not designed to detect and correct unintended movements to provide stabilised video. Motion sensors can calculate motion in mechanical stabilisation. The kind and range of employed motion sensors may change depending on the application. As an example, it is sufficient to employ a single motion detecting sensor if the camera is only exposed to movements in the x direction.

When using mechanical stabilisation, camera motions are determined by measuring the camera's acceleration or speed and applying a number of mathematical procedures to this data. Accelerometers and gyros, which are the most often used mechanical phenomena motion sensors for not only stabilisation systems but also guiding systems, automotives, etc., detect acceleration and speed. An excellent motion sensor that measures linear acceleration in the x, y, and z dimensions is an accelerometer. Acceleration information must be converted into displacement information in order to get linear camera motions. Accelerometers only measure acceleration in a single predetermined direction, which is often shown on the measuring device. Its acceleration on the x axis is determined if it is positioned there. As a result, the quantity of measuring equipment used in a system relies on how much acceleration information is required in various directions.

A gyro is a very sensitive component that detects angular speed in the roll, pitch, and yaw axes. Speed is used to calculate displacement, therefore performing one integration over the speed yields displacement.

In mechanical video stabilization, it's aimed to stay the position of the camera stable with reference to its reference position. Therefore, all the calculable movements to that camera is exposed area unit taken as unintentional motions. Since stabilization is to get rid of solely unintentional motions, there's no have to be compelled to have motion correction half in mechanical stabilization

2. Optical Video Stabilization:

The Optical Image Stabilization (OIS) system, in contrast to the DIS system, manipulates the image before it gets to the CCD. once the lens moves, the light rays from the subject are bent relative to the optical axis, leading to associate unsteady image as a result of the light rays are deflected. By shifting the IS lens cluster on a plane perpendicular to the optical axis to counter the degree of image vibration, the light rays reaching the image plane is steady [8]. Since image vibration happens in each horizontal and vertical directions, 2 vibration-detecting sensors for yaw and pitch arewont to find the angle and speed of movement then the mechanism moves the IS lens cluster horizontally and vertically therefore counteracting the image vibration and maintaining the stable image.

3. Digital Video Stabilization

Motion estimation and motion smoothing are taken into consideration in digital video stabilisation techniques. However, the foundation of any digital video stabilisation relies on motion estimation. The results are greater the motion estimate done [3,4].

The video stabilisation algorithms use a variety of motion estimation techniques. Direct approach and extraction technique are both included. Direct methods compute frame alignment while taking picture intensity levels into account.

Direct Techniques

Direct procedures are chosen over feature-based strategies for motion estimation due to their many accurate and durable performances.

Direct tactics are categorised as:

1. Subpixel Registration Using the Phase Correlation Method

Block Based Method, second

Phase Correlation and Subpixel Registration Using This Method Interpolation is the foundation of subpixel registration. Although there are non-interpolation approaches that provide subpixel registration. The interpolation approach is the extension to section correlation. This approach operates on the fourier shift rework concept. It computes the fourier two images between two frames. The difference in the frequency domain of the fourier transform of the two images is what causes the shift in the abstraction domain. Inverse Fourier Transform is then used to get section correlation.

The block-based technique breaks each frame of a video sequence into 16x16 chunks, or macroblocks, and then compares the macroblocks of the current and prior frames to determine motion vectors.

The block matching criteria are used to match the macroblocks of the current and previous frames.

The better the match between macroblocks, the lower the value of the matching criteria.

Second, Feature Based Motion Estimation

Searching for points is not conducted over all pixel points in feature-based motion estimation. But the Scale Invariant Fourier Transform (SIFT) is used to extract certain points known as feature points. However, the conventional approach is so weak that it offers no feature points for moving objects.

Additionally, the depth of field of feature points may vary.

RANSAC and SFM may be used to combat the first drawback and the other, respectively (Structure From Motion). RANSAC, however, also has the drawback of failing when an object moves slowly. By weighting the feature points and using the weighted least squares technique, this issue may also be solved. [5,6]. An implementation for real time stabilization of the system has been discussed in [9].

3 Comparative analysis

This article discusses three alternative types of video stabilisation. The third and last phase in video stabilisation is image correction. Depending on the video stabilisation techniques, the picture correction may not be realised as intended. In other words, whether mechanical or optical video stabilisation is taken into account, picture correction is accomplished using motors and a certain kind of mechanical construction. But Image correction in digital video stabilisation is only possible via software. Digital video stabilisation is thus the most economical technique.

5 Conclusions

Numerous techniques have been used to estimate motion and stabilise digital video. However, the introduction of feature-based motion estimating algorithms like SURF has resulted in a significant speed gain for real-time performance. In terms of outputs, frame rates, and resource utilisation, system performance has improved, particularly for embedded systems. We think that the combination of machine learning techniques like DL and the utilisation of user ratings and comments may be key to the success of VS in the future. This is not just driven by the fact that computer vision is undergoing a profound revolution; we are also certain that by incorporating the learning process into the VS pipeline, it will be possible to account for human perception, leading to more effective video stabilisation solutions. In order to really base stabilisation methods on subjective judgement as opposed to geometrical criteria that do not account for all perceptual components of VS, for example, reinforcement learning approaches may be helpful. In the next years, we anticipate that DL-based techniques will become a more viable option for video stabilisation.

References

1. Wilko Guilluy, Laurent Oudre, Azeddine Beghdadi,
Video stabilization: Overview, challenges and perspectives, Signal Processing: Image Communication, Volume 90, 2021,

[2] Lihui Yang, "Research on the motion estimation algorithm in AVS," 2010 International Conference on Networking and Digital Society, 2010, pp. 625-628, doi: 10.1109/ICNDS.2010.5479408.

[3] F. Yong-Jie, "Real-time digital video stabilization system based on FPGA," 2014 9th IEEE Conference on Industrial Electronics and Applications, 2014, pp. 436-438, doi: 10.1109/ICIEA.2014.6931202.

[4] G. Pang and H. Liu, "Evaluation of a Low-cost MEMS Accelerometer for Distance Measurement", Journal of Intelligent and Robotic Systems archive, vol. 30 , iss. 3, pp. 249 – 265, March 2001

[5] Ajay P. Jagtap and Prakash V. Baviskar, "Review OF Block Based Video Stabilization", International Advanced Research Journal in Science, Engineering and Technology Vol. 2, Issue 4, April 2015

[6] M. Ahmed, "Digital video stabilization-review with a perspective of real time implemention," 2017 International Conference on Recent Innovations in Signal processing and Embedded Systems (RISE), 2017, pp. 296-303, doi: 10.1109/RISE.2017.8378170.

[7] Ameer Hamza, Rehan Hafiz, Muhammad M. Khan, Yongju Cho, Jihun Cha, Stabilization of panoramic videos from mobile multi-camera platforms, Image and Vision Computing, Volume 37, 2015, Pages 20-30,

[8] Hung-Chang Chang, Shang-Hong Lai, Kuang-Rong Lu, A robust real-time video stabilization algorithm,
Journal of Visual Communication and Image Representation, Volume 17, Issue 3, 2006, Pages 659-673,

[9] Mohammed Ahmed, Dr Laxmi Singh, Pipelined FPGA prototyping of Digital Video Stabilization system for real-time implementations, International Journal of Electrical Engineering and Technology (IJEET) Volume 12, Issue 7, July 2021, pp. 159-169