Efficient Video Stabilization Using SURF Features & Filtering

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Abstract— Video stabilization techniques have gathered a great interest in recent years. With handheld camera, motion and vibration are difficult to be avoided, so we have a need of that algorithm that gives a high quality of video. A framework of video stabilization is based on point feature extraction. Video stabilization is a process to remove the unwanted motion variation from video. This paper present three operation motion estimation, motion filtering, motion correction. Global motion is related with the motion of background i.e. remove with the help of Kalman filter. In this method feature points are extracted from the input video based on the Speeded Up Robust Feature (SURF). Random Samples Consensus (RANSAC) is used to remove the local motion. Weighted Least Square (WLS) algorithm is used to remove global motion and finally Kalman filter to remove unwanted motion. Experimental result show that proposed technique provides great deal of stabilization and good robustness.

Index Terms—: SURF, Kalman Global motion

I. INTRODUCTION

The increasing availability of micro digital cameras and mobile phones has attracted everybody to photography. The video stabilization technique is a convenient technique that is mechanically executed in high-end digital cameras as a special function to minimize hand-shaking motion vibrations. The video stabilization technique can implement by using software and hardware device. The video stabilization system can be grouped into three types (1) electronic image stabilizer (EIS) (2) optical image stabilizer (OIS) (3) Digital image stabilization (DIS) [1]. Both EIS and OIS required hardware system that put restrictions on them. In contrast DIS worked without hardware updates. Methods used for the motion estimation can be divided into two grouped (1) intensity based motion estimation (2) feature based motion estimation. Feature based motion estimation is more error free then the intensity based motion estimation. Two feature point extraction algorithms are (1) SIFT (Scale Invariant Feature Transform) (2) SURF (Speeded Up Robust Features).RANSAC Random Samples Consensus) is normally used to eliminate local. motion vectors and false correspondences. SFM (structure from motion) can be used to redesign the scene in 3D. However, thereare two demerits of using RANSAN and SFM: (firstly, RANSAC can only discard

feature points on fast moving objects. If the object is moving with very slow speed in contrast to the background, RANSAC cannot debar feature points accurately. Secondly, SFM can lead to overkill. In this paper main contribution is to develop motion estimation algorithm for video stabilization.

II. RELATED WORK

Video stabilization procedure have been deliberated for a long period of time and attracted even great attentiveness in recent years. Uomori et al [2] progressed an automatic image-stabilizing technique for camcorders; make use of only digital signal processing. Kinugasa et al. [3] on the basis of scanning region selection of imager have realized a dense electronic image stabilizer. However, the stabilization rate becomes very bad at high-level frequency. Paik et al [4] presented a DIS for video cameras. It is made up by an edge detection module, a motion detection module and a digital zooming module. The preferred DIS system is model mainly for reducing the hardware in a video camera device. Censi et al [5] extracted and tracked corner features points in order to calculate global motion. With regard to some image transformations, such as scaling and rotation the features are not strong. To overcome the difficulty in scaling and rotation, SIFT features [6], and PCA-SIFT [7] are being mainly used for calculating the global motion[8-11]. Recently, Wang et al. [12] proposed a DIS algorithm locate on feature point tracking. They used the Kanade-Lucas-Tomasi (KLT) tracker to calculate the global motion between two successive frames. For speed up the further tracking process the motion prediction by the Kalman filter (KF) is incorporated into the KLT tracker. Amanatiadis et al. [13] proposed a novel digital-image stabilization method based on independent component analysis (ICA). In this process ICA and data from the image frame sequence are deconvolved and unwanted motion from the frame sequence can be removed. Huang et al [14] proposed a algorithm to stabilize blurring video for vehicular applications based on feature point analysis.

III. PROPOSED WORK

The video stabilization algorithm consist of following steps: reading the frame memory, Extraction of feature point and matching of feature point, determine the local motion by RANSAC, Global motion calculation based on particle filtering, intentional and unintentional motion calculation by Kalman filtering, illustrated in Fig 1. Here we discuss various step of video stabilization algorithm. Extraction of feature point and matching of feature point. In this by using SURF and SIFT, selecting feature point for motion estimation is very important because unstable feature cause unwanted motion SURF is a image interest point detector, first presented by Herbert SURF is Bay et al [15].RANSAC based on local motion estimation RANSAC is used to eliminate the outlier



Fig1:Flow chart of video stabilization algorithm

feature points. RANSAC decide inliers and outlier depending upon the input data fits the model or not. After the k^{th} *iterations*, the result that has minimal outliers is used as the origin value of the parameters in the affine transform model. The corresponding filtered result obtain by RANSAC is shown in Fig 2.

Intentional and unintentional motion is come under the global motion. We only want to compensate the transformation created by unintentional camera moves; transformations due to intentional motion should be recognised. We used the Kalman filter to determine the intentional motion of the camera.



Fig2. SURF correspondences filtering by RANSAC

IV. EXPERIMENTAL RESULTS

In this paper we purposed a efficient video stabilization method using RANSAC, SURF and filtering. The key insight of this paper is to estimate the feature point and estimate the local motion using RANSAC and SURF, global motion by filtering. By using the K iterations of RANSAC error is minimized. To calculate the performance of the algorithm, we

adopted ITF (Inter-frame Transformation Fidelity) [11] measure used in equation 1:

$$ITF = 1/N_{\text{frame } \sum k=1}^{N \text{frame } PSNR} (k)$$
(1)

N frame no of video frames. PSNR (k) is peak signal to noise ratio defined by equation 2:

 $PSNR (k) = 10 \log_{10 \text{ Imax}} / MSE (k)$ (2)

 I_{MAX} is maximum pixel intensity and MSE (k) is mean square error between successive frames.

We compared our technique with other one approach based on particle filtering, which are presented by Yang *et al.* [10]. We chose SURF in this series of experiment as the feature is used in the two algorithms. The total number of feature points in a frame sequence and the number of particles are both 30. In Yang's algorithm the total number of particle is 30.

Table 1: ITF results of the three algorithms

	Original	Yang's	Proposed
Sequence 1	17.03	20.15	20.75
Sequence 2	15.01	19.72	20.38
Sequence 3	17.64	21.21	21.15
Sequence 4	15.02	16.27	17.04
Sequence 5	16.07	19.41	20.03
Sequence 6	18.24	19.93	20.81
Sequence 7	15.63	18.11	18.96
Sequence 8	14.95	18.20	18.62

V. CONCLUSION

In this paper we propose a efficient video stabilization method based on some algorithm and particle filtering. The key insight this paper is to extracting the feature point removing the local motion and global motion that contain the intentional and unintentional motion. Kalman filter are used to obtain better global motion estimation. Experiments have confirmed the effectiveness and robustness of the purposed algorithm.

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