A Digital Video Stabilization Method Based On Hilbert-Huang Transform

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Abstract— **In this work, a new technique for digital image stabilization (DIS) based on the Hilbert–Huang transform (HHT) is introduced. It shows the basic features of the HHT in order to differentiate the local motion signal coming from a video sequence into two different motions. The Number of embedded systems equipped with a digital image sensor. In this system such as shaky cameras, mobile phones, and robot can introduce image sequences with an observed variation caused by two different types of movements: the intentional camera motion and the unwanted jitter motion. The HHT can be applied in applications for not agreed signals into lesser portions with specific features (e.g., biomedical applications). Further head, for DIS, local motion vectors of a video sequence are calculated, and they are apply to the HHT in order to define both signals. The original signal is spilt into a multiple waveforms, called intrinsic mode functions (IMFs), by using process of empirical mode decomposition. Hilbert transform is applied on each IMF hence this energy content can be differentiate depending on the basic features of the shaking phenomena high frequencies and small power contents of intentional and jitter motions. And thus, reduced motion is applied in order to eliminate possible shaking fluctuations and originating an image sequence with smoother transitions.**

***Keywords*- Digital image stabilization (DIS),** Hilbert–**Huang transform (HHT),** image **sequence processing, IMF (Intrinsic Mode Function), EMD (Empirical Mode Decomposition),jitter motion designation.**

I. Introduction

Video stabilization is an important subject. The video stabilization process aims at discard unwanted motion phenomena from video sequences in order to achieve it a reduced sequence that displays intentional camera movements.

The different types of image processing applications need motion-compensated image sequences or video as a inputs. The unwanted positional oscillation of the video sequence will effect on the visual quality and varies the subsequent processes for several applications. Vehicles equipped with visual systems use video stabilization to get maximum performance in shaky image analyse. In addition, unwanted motion is rejected from motion-disrupted video stabilization even differentiate in video communication systems with reduced codecs in order to increase efficiency. Moreover, in a video stabilization system was utilized in a solar optical telescope using image displacements in order to discard the shaky motion from the given sequence of a satellite.

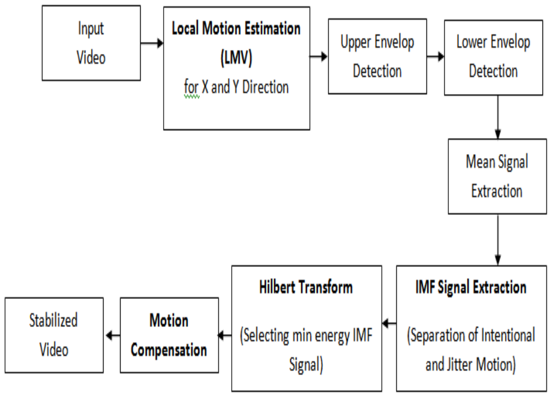

Fig. 1 Block diagram of the proposed system

Video stabilization systems we can classify into four primary categories: optical, orthogonal transfer charge-coupled device (CCD), electronic and digital stabilizers. Optical image stabilizers method used in video cameras that stabilize the recorded image by varying the optical path to the sensor. The important element of all optical stabilization systems is that stabilization process is applied earlier on the decided image which transduce it into digital information by using the sensor orthogonal transfer CCD which change position of the image within the CCD. While the image is capture, depends on analysis of the present variation of bright stars .Electronic image stabilizers use variation gyroscope sensors to join the camera in order to achieve the camera variation.

The image sequence is reduced by using the different direction of the sensor's readings. The digital image stabilization (DIS) is the process of discarding the jitter motion effects of a moving camera to generate a decreasing image sequence by using image processing techniques. Additionally, DIS method is apply on video sequence as a post processing step, as well as we can apply in real time video process, depending on the application. Typically, a video stabilization

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process, applied after the given video which consists of three main stages, given motion estimation, jitter motion determination, and image warping.

The first processing stage is applied to the determination of parameters that recognise the whole camera motion that means the displacements between features in subsequent frames are obtained. At the starting, local motion vectors (LMVs) are calculated for first frame during the process for motion estimation. Essentially, LMVs represent the difference between two continuous frames. Thus, LMVs include both the intentional and the jitter motion of the camera. This process useful over the other two stages in terms of time complexity. Therefore, the main aim is to first calculate local extreme are identified. Local maxima are connected by line to form the upper envelope. And use exact same procedure is followed for the local minima to produce the lower envelope. All the data has a between the upper and the lower envelope. If the mean is produced by the upper and lower envelopes is designated as*m1* and the difference between the data $x(t)$ and $m1$ is the first component of k1, then

$$k1(t) = x(t) - m1(t) \quad (1)$$

$$m1(t) = [U(t) + L(t)]/2 \quad (2)$$

where, U (t) and L (t) are the local maxima and the local minima, respectively. We can consider k1 (t) is to be an IMF, except that some error will be introduced by the spline curve fitting process. Hence, a sifting process is repeated multiple times. In the sifting process there are two purposes riding waves smaller waves that seem to “ride” bigger waves are discarded, and the signal is converted into a more symmetric form about the local zero-mean line.

After that in the second round of sifting, *k1* is treated as the data .Then, a new mean is calculated with the same procedure. Considering that the new mean is $m11$, then

$$k11(t) = k1(t) - m11(t) \quad (3)$$

After repeating the sifting process up to h times, $k1h$ is labelled as an IMF, meaning

$$k1h(t) = (h-1)(t) - m1h(t) \quad (4)$$

Let k1h = c1 be the first IMF from the data. C1 will contain the finest scale or the minimum period component of the data. The process to generate one IMF may be consider Then, $c1(t)$ is removed from the rest of the data so that the residual is calculated

$$r1(t) = x(t) - c1(t) \quad (5)$$

Where r1 is the residue and it contains information on longer period components. The residue is treated as the new data and subjected to the same sifting process the aforementioned procedure is repeated in order to obtain all the subsequent *rw* functions as follows:

$$Rw(t) = rw-1(t) - cw(t) \quad (6)$$

II. Literature Review

In ref.s[1]Algorithm used in this paper is practical DE blurring algorithm. These algorithms synthesize the pixel values in the hole as a combination of video patches (localized 3D windows in video volumes) sampled from visible regions of the video. Each algorithm is characterized by the energy functional that measures the compatibility of candidate in painting patches at the boundary of the hole and, at the same time, the compatibility of divergent candidate in painting patches with each other. The energy functional is either denned explicitly (globally) or implicitly (locally) and the video in painting is formulated as a global or local energy minimization accordingly.

In [2] paper, we further improve by allowing more complicated camera motions in the video in painting, including zooming, panning and their combination. The types of video we tested include cartoons from TV, videos generated by computer games, and videos taken using digital Camera. From the technical perspective, several achievements are realized.

III. EMPIRICAL MODE DECOMPTION

In the EMD process when we took video in the form of wave. It must has shaky or intentional form, by using EMD we can calculate the IMF signal of original video by subtracting lower envelope from upper envelope. We get mean signal, after that we also subtract mean from original signal and get IMF signal. IMF is nothing but mean signal reduced from original signal, after that IMF signal is applied to the Hilbert-Huang transform which separate out jitter motion and intentional motion.

IV. HHT

HHT is a combination EMD and Hilbert spectral analysis of designed National Aeronautics and Space Administration’s. The HHT is separate out jitter and intentional motion, in this method First the data is decomposed into a particular number of IMF signal as a pre-processing stage. The Hilbert transform is applied to all resulting IMFs in order to apply each IMF Signal to HHT and select proper level energy content

V. Algorithm

1) Start
2) Video Acquisition.
3) Block Division of frames.
4) Local Motion Vector Estimation
    a. X direction
    b. Y Direction
5) Finding Upper Envelop
6) Finding Lower Envelop
7) Finding mean Signal by subtracting lower envelop from upper.
8) Extracting IMF signal for separation of intentional camera motion from jitter motion.
9) Hilbert- Huang transform for finding energy level of each IMF signal.
10) Selecting Min. energy IMF signal.
11) Motion Compensation using min energy IMF signal.
12) Stabilized Video

VI. Result and Description

The system has been implemented on matlab, in which shaky video considered as input. Then first find out the LMV means lower and upper envelope. Then find IMF signal for X direction and y direction. In this process our input video goes

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towards zero fluctuation and then applies the multiple IMF signal to HHT .After that HHT gives the stabilized video as output which is given in below fig.2

First find without HHT output and after that With HHT.

Without HHT Output Result

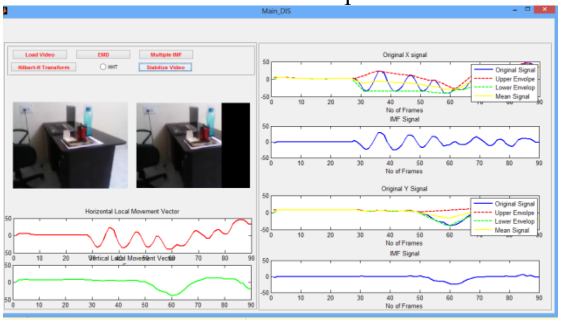

Fig 2 (a) LMV (Local Motion Vector)

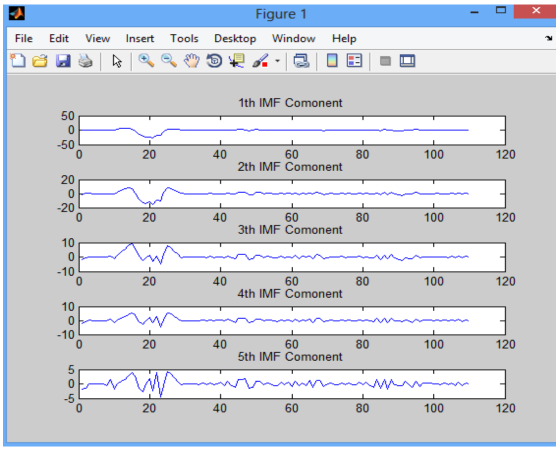

Fig 2 (b) IMF for X direction

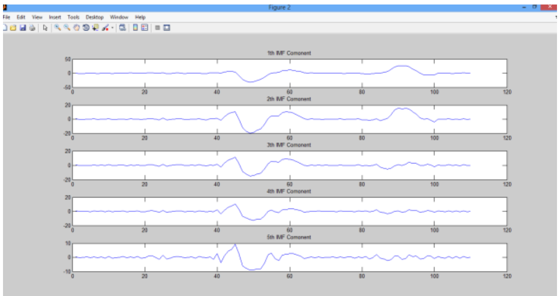

Fig 2 (c) IMF for Y direction

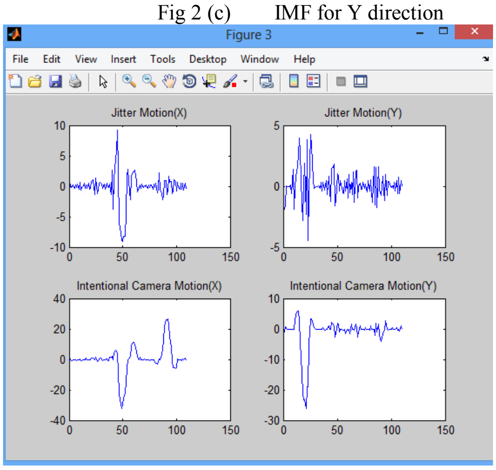

Fig 2 (d)
Jitter and Intentional motion

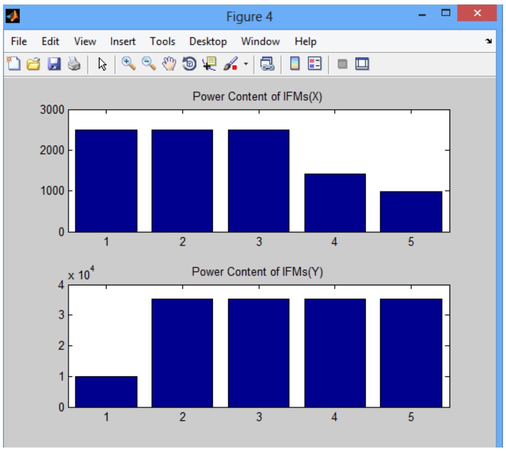

Fig 2 (e) Power of IMF Signal

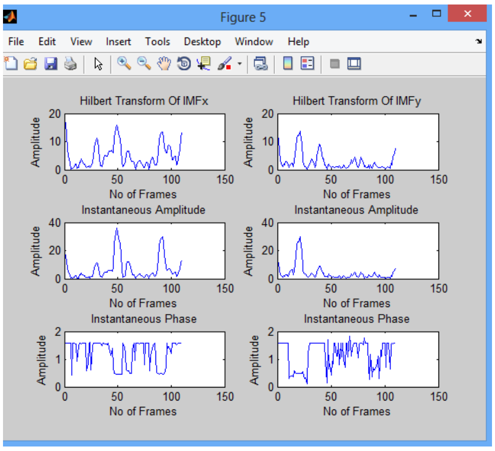

Fig 2 (f) Final result of without HHT

With HHT Output Result

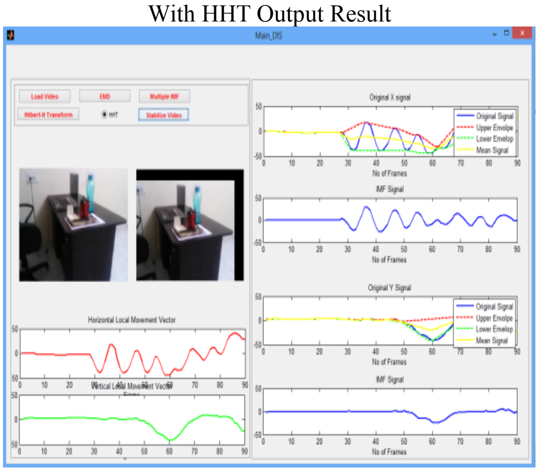

Fig 3 (a) LMV (Local Motion Vector)

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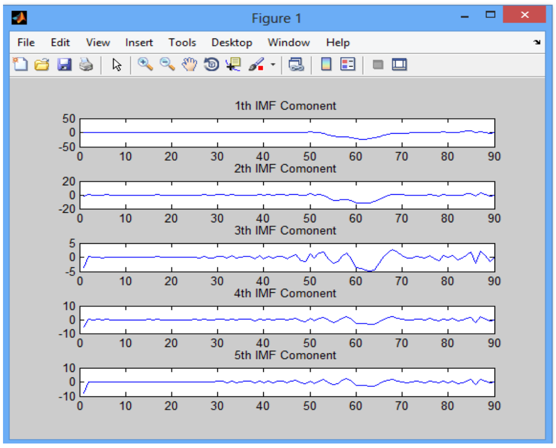

Fig 3 (b) IMF for X direction

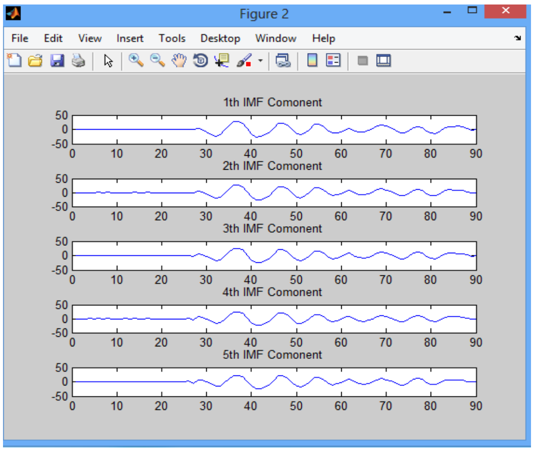

Fig 3 (c) IMF for Y direction

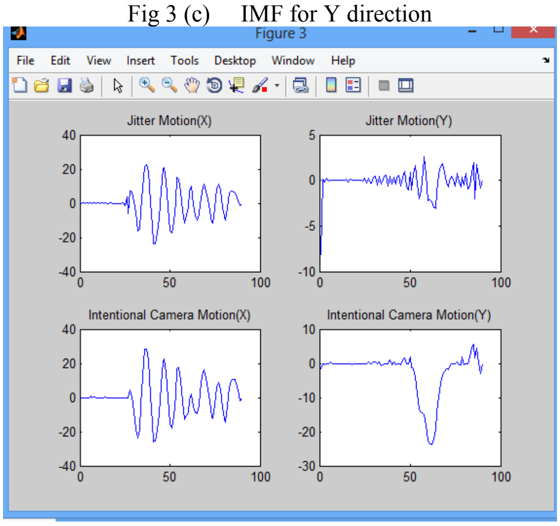

Fig 3 (d) Jitter and Intentional motion

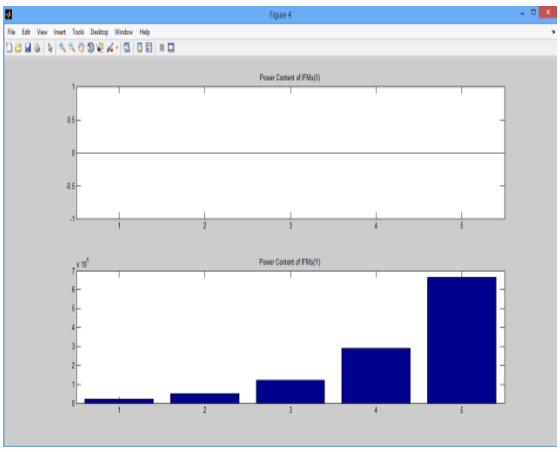

Fig 3 (e) Power of IMF Signal

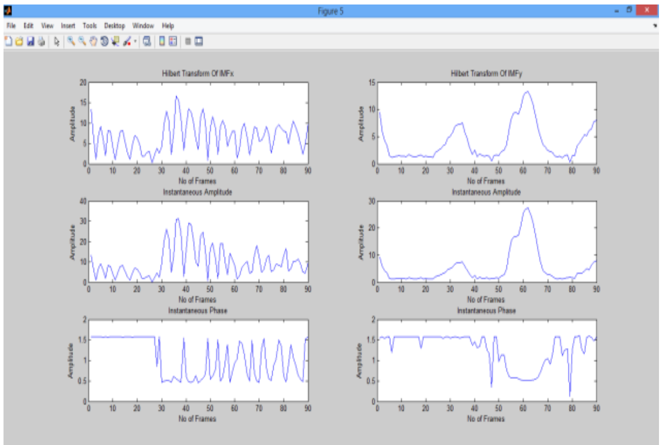

Fig 3 (f) Final result of HHT

VII. CONCLUSION

In this method, we detect the video & Remove jitter and intentional motion. Which are horizontal and vertical movement compress as nominal video. The upper envelope and lower envelope detect successfully. In DIS method based on the Hilbert-Huang Transform (HHT) has been presented. The required data is taken from a video sequence in order to achieve the definition of the two fundamental motions, the intentional and the Jitter motion. This finds the mean signal successfully. And after that we find IMF signal and apply it on HHT and find the intentional motion successfully.

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