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Determination of IMF using Hilbert–Huang Transform

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ABSTRACT
In this paper, DIS technique is presented. DIS is proposed to stably remove the unwanted shaking phenomena in the image sequences captured by cameras without the influence caused by moving object in the image or intentional motion. Local Motion Vector estimation technique is used Sum Of absolute difference (SAD) method . local motion vectors(LMV) of an image sequence are calculated . LMV of image sequence is used for DIS Technique, which is based on the Hilbert–Huang transform (HHT) is proposed. The HHT technique contain main block is empirical mode decomposition (EMD).The calculated Image sequence of an local motion vectors are processed by the HHT in order to define both signals. The real Signal is divided into a number of waveforms, called intrinsic mode functions (IMFs), using the process of empirical mode decomposition.
Keywords **-** DIS,EMD,HHT,Image sequence,IMFs, LMV.

I. Introduction

Digital image sensor, such as handheld cameras, mobile phones, and robots, are equipped with variety of embedded systems which can produce image sequences. The produced image sequences contains motion caused by two different types of movements: the smooth camera motion (intentional) and the unwanted shaking motion(jitter). Image stabilization is a form of technology used to stabilize an image for a much clearer picture, which can be include in a camera, important for producing the sharpest photos. The image stabilization process aims at removing irregular motion phenomena from image sequences in order to accomplish a compensated sequence that displays smooth camera movements [1].The image stabilization systems can be classified into three major types: the electronic, the optical, and the digital stabilizers. The electronic image stabilizer (EIS): Camera attached electronic image stabilizer (EIS) uses Motion gyroscope sensor for detecting camera movement. Optical image stabilizers (OIS): Video cameras that stabilize the recorded image by varying the optical path to the sensor are used in Optical image stabilizers (OIS).Because both EIS and OIS are hardware dependent, the applications are restricted to device built-in online processes. Digital image stabilization (DIS):Digital image stabilization (DIS) is the process of removing the undesired motion effects to generate a compensated image sequence by using digital image processing techniques without any mechanical devices such as gyro sensors or a fluid prism [2].The major advantages of DIS are: 1) machine independence and 2) suitability for hardware implementation [2].

II. Local Motion Vector(LMV)

The motion estimation unit and the motion compensation unit are two processing units of the DIS system .To estimate the reliable global camera movement through the acquired image sequence is main purpose of motion estimation unit .To estimate the local motion vectors (LMV) had been developed various algorithms such as representative point matching (RPM), edge pattern matching (EPM), bit-plane matching (BPM) and others. The major objective of these algorithms is to reduce the computational complexity. LMVs are calculated during the process of motion estimation within smaller frame regions Essentially, LMVs represent the offset of specific image regions between two consecutive frames. Thus, LMVs include both the intentional and the unwanted motion of the camera. Figure.1.typical DIS system are divided into three stages, in the first stage, LMV is estimated within a specific frame region. The segregation of the previous estimated LMV into the intentional and the unwanted camera movement is dedicated in second stage. After the segregation unit, the image sequence is further processed in the image compensation unit where the high-frequency movement is removed from each frame[1].

This paper is organized as follows. In Section 3 ,HHT includes EMD process is presented. In Sections 4, the experimental results are provided, respectively. Finally, conclusions are drawn in Section 5.

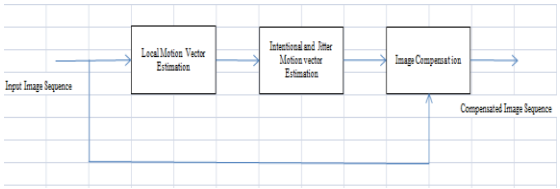

Fig.1 typical DIS System after acquiring the image sequence.

III. Hilbert Huang Transform(HHT)

Hilbert-Huang Transform (HHT) is a data analysis tool, first developed in 1998, which is National Aeronautics and Space Administration's. It is designated name for the combination of the EMD and the HSA. Empirical mode decomposition(EMD) divided into basis functions called intrinsic mode functions (IMFs). Combination of the EMD and the Hilbert spectral analysis (HSA) is HHT; the HSA includes the Hilbert transform of each IMF generated by the EMD process [1].

HHT have three main blocks:

3.1. EMD

3.2. Hilbert Transform

3.3.Jitter Motion Vector Estimation

3.1 EMD

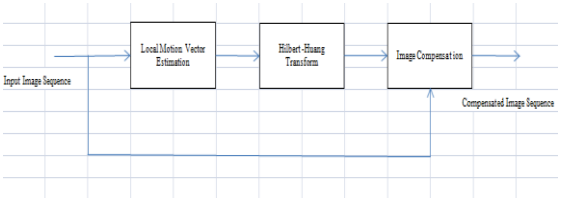

Fig.2.Shows DIS method using HHT

In general, The first component to the HHT method is EMD algorithm .The EMD separates nonstationary data into locally nonoverlapping time-scale components. EMD attempts to decompose any signal into a finite set of functions, whose Hilbert transforms give physical instantaneous frequency values. These functions are called intrinsic mode functions (IMFs)[1].

EMD Algorithm :-

The sifting process is as follows:

1) Identified the local extrema (maxima, minima) of the signal.

2) Connect the maxima with an interpolation function, creating an upper envelope about the signal.

3) Connect the minima with an interpolation function, creating a lower envelope about the signal.

4) Calculate the mean of the upper and lower envelopes.

5) Subtract the local mean from the original signal.

Iterate on the residual

6) The residue is treated as the new data and subjected to the same sifting process (start of outer loop in Fig. 3)[4].

Figure.3.shows Flowchart of EMD Process. The sifting process is repeated until the signal meets the definition of an IMF. Then, the IMF is subtracted from the original signal, The process to generate one IMF considered as an inner loop, as shown in Figure.3. and the sifting process is repeated on the remainder. The residue is treated as the new data and subjected to the same sifting process (start of outer loop in Figure.3.) This is repeated until the final residue is a monotonic function. The last extracted IMF is the lowest frequency component of the signal, better known as the trend. Terminating criteria are applied to the sifting process for IMFs since allowing sifting to go beyond a certain point. The entire EMD process is terminated if any of the following criteria is satisfied:

- when the residue is a function with one unique extremum.
- when the residue becomes a monotonic function from which no IMF can be extracted [1].

The sum of the IMFs and the residue recovers the original signal, which indicates completeness.

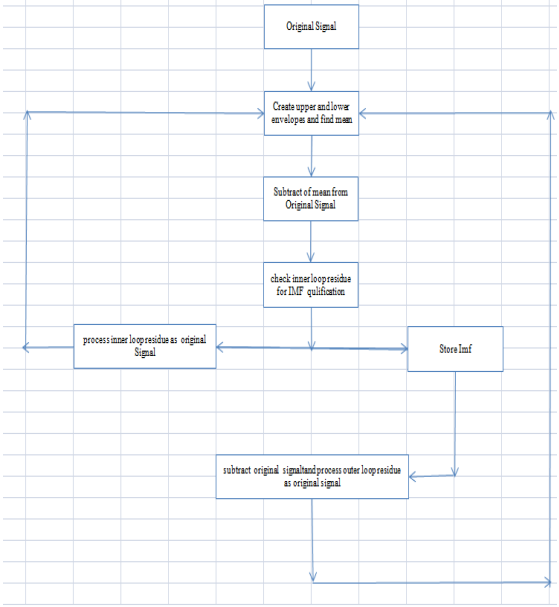

Fig..3.shows Flowchart of EMD Process

IV. Experimental Result:

To verify the effectiveness of the proposed DIS method, The experimental results of proposed system are presented in this article. The horizontal displacements and vertical displacements are presented, the procedure for horizontal motions is exactly the same.

In order to evaluate the performances of the method, three different image sequences are processed. In this paper, three image sequences are used to find out IMF and horizontal ,vertical LMV. In Ist image sequence is shaky car video which is available in video library of Matlab. It has 10 sec duration, 132

frames. Frame rate is 13.2frame/sec. the frame size can be depends on duration of image sequence. In II[nd] image sequence is walking man ,it is taken from web camera 1.3Mpixel ,10sec duration and 132 pixel size. In I[st] image sequence is moving car. It has 216 frames,15 sec duration.The resulting vertical and horizontal LMV from an image sequences is shown in Fig 4(a),5(a),6(a) .the resulting vertical and horizontal LMV calculate translational movement. The upper and lower envelope are created using the local maxima and local minima of initial signal. mean envelope can be calculated from upper and lower envelopes fig 4(b),5(b),6(b)Horizontal (X) LMV Signal ,upper and lower envelopes and mean signal and 4(d),5(d),6(d) vertical (Y) LMV Signal ,upper and lower envelopes and mean signal.The resulting IMF shown in fig.4(c),5(c),6(c) of X signal and fig4(e)5(e)6(e) of Y signal.

V. Conclusion:

DIS method based on the HHT has been presented. LMV and EMD , which is first block of HHT has been presented. By using Image sequences achieve the definition of two fundamental motion such as horizontal and vertical LMV.EMD results also achieve such as upper and lower envelope, mean and first IMF.

Table I:
Resulting values of DIS algorithms for all the tested image sequences.

Image Sequences	**Displacement (Pixel) at Frame 60**		**Displacement (Pixel) at frame 131**	
	X	**Y**	**X**	**Y**
I[st]	-20	28	-31	-64
II[nd]	-16	-46	-20	-26
III[rd]	-4	37	-64	64

VI. Work To Be Implemented:

Implementing work is Hilbert transform ,which can be used to generating various IMF. Observedmotion caused by two different types of movements: the smooth camera motion (intentional) and the unwanted shaking motion (jitter).

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Book:

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I[st] Image sequences

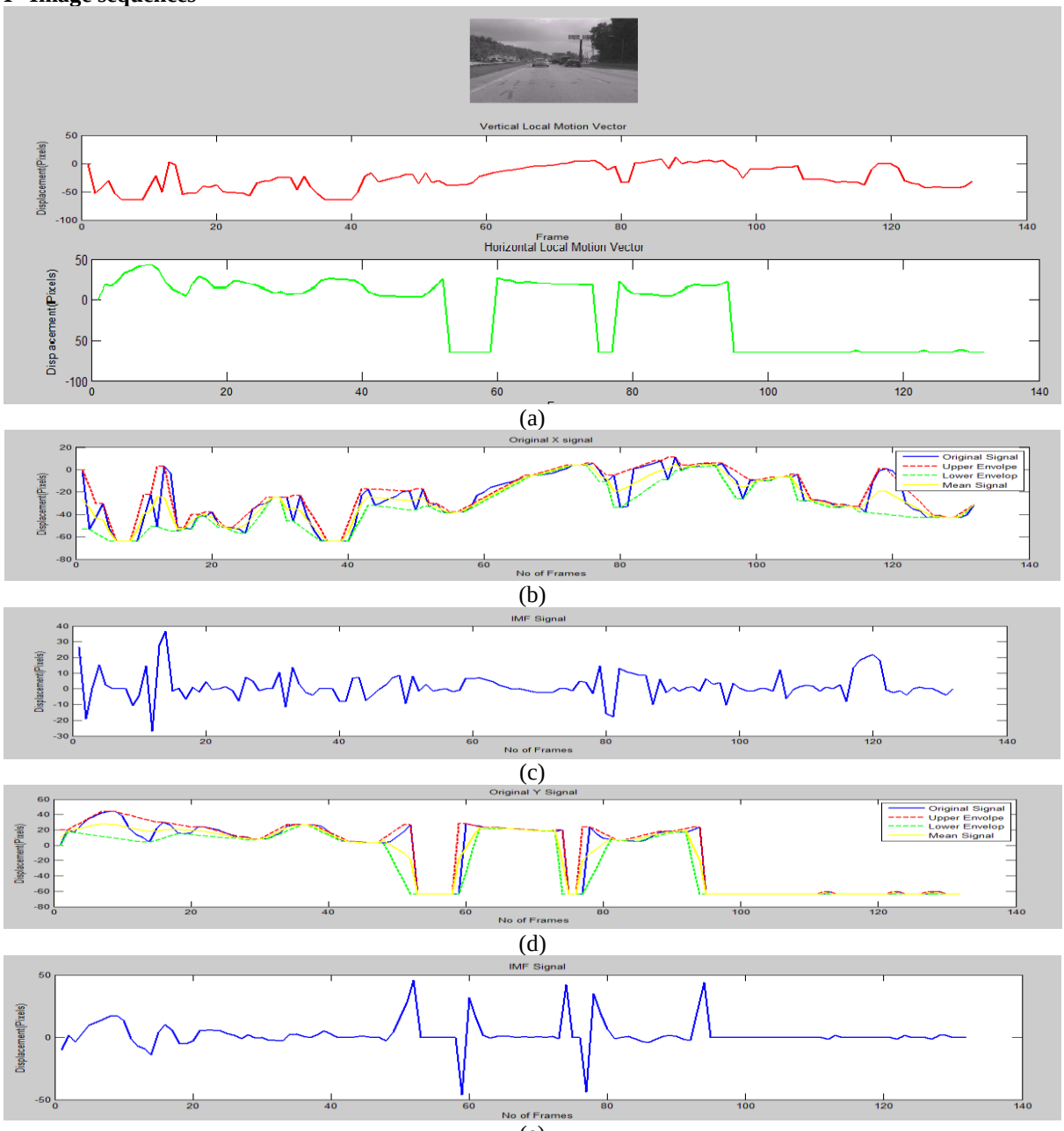


Fig.4.(a) Vertical LMV and Horizontal LMV Signal, (b)Horizontal (X) LMV Signal ,upper and lower envelopes and mean signal ,(c)generated IMF and .(d) vertical (Y) LMV Signal ,upper and lower envelopes and mean signal (e) Produced IMF.

II[nd] Image sequences

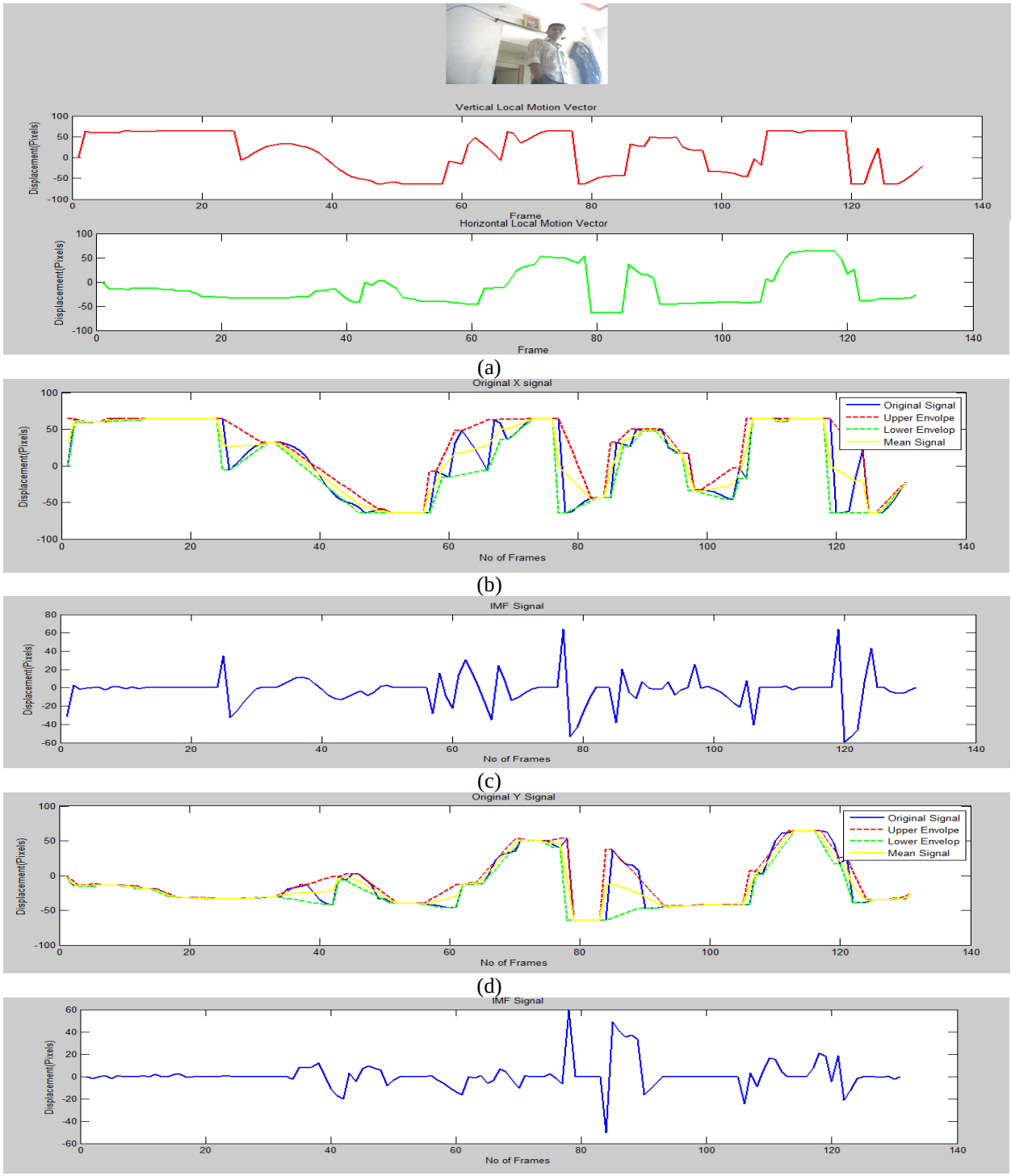
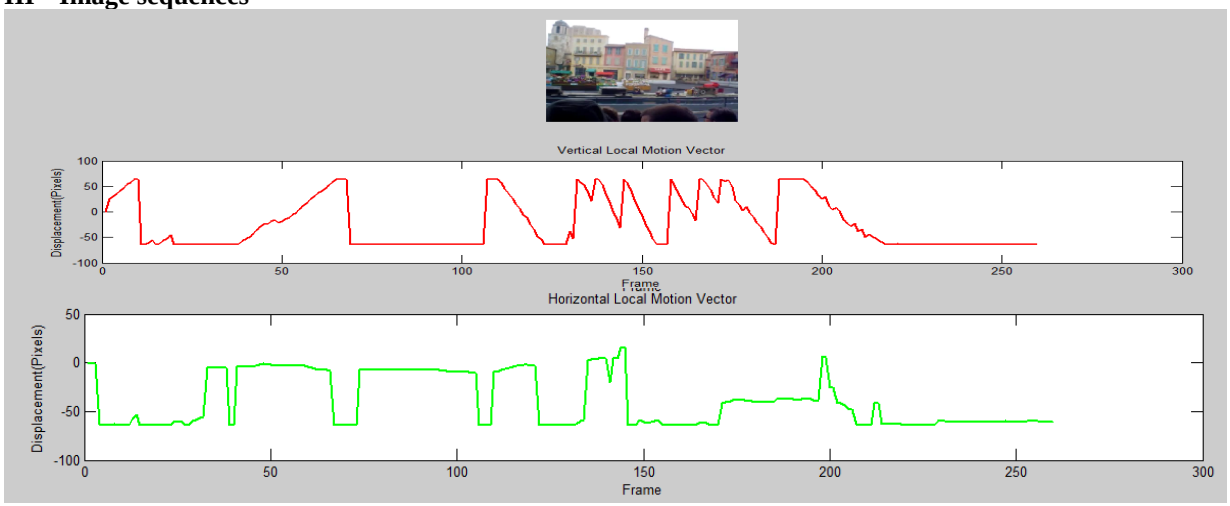
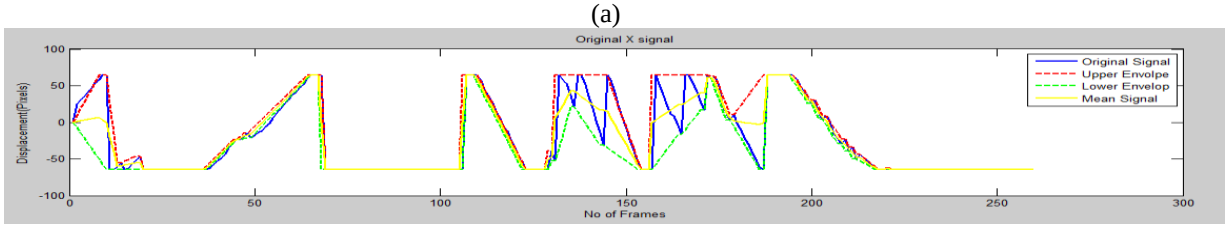


Fig.5.(a) Vertical LMV and Horizontal LMV Signal,(b)Horizontal(X) LMV Signal ,upper and lower envelopes and mean signal, (c) generated IMF ,(d) Vertical LMV(Y) Signal ,upper and lower envelopes and mean signal and (e) generated IMF

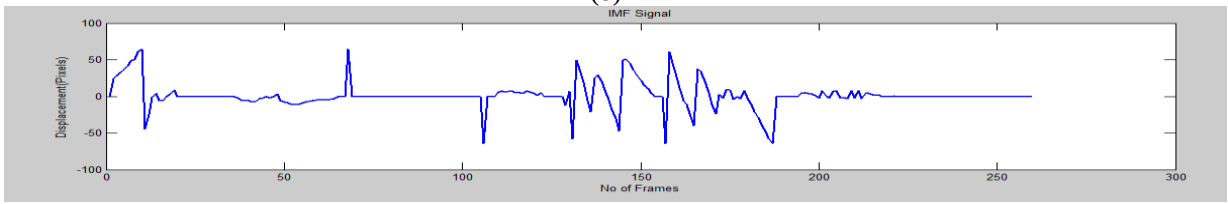
III[rd] Image sequences



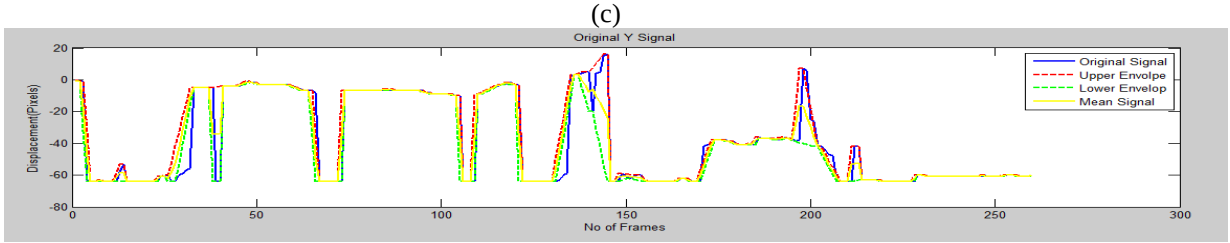
(a)



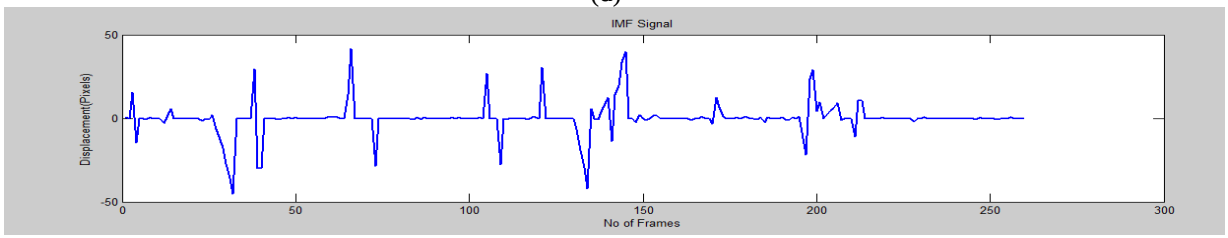
(b)



(c)



(d)



(e)

Fig.6.(a) Vertical LMV and Horizontal LMV Signal,(b)Horizontal(X) LMV Signal ,upper and lower envelopes and mean signal, (c) generated IMF ,(d) Vertical LMV(Y) Signal ,upper and lower envelopes and mean signal and (e) generated IMF