Tracking of Blood Movement in the Heart using Elongated Horizontal Large Diamond Search Pattern and Optical Flow Technique for Enabling the Detection of Atrial Septal Defect

Mrunal Ninad Annadate, Manoj Nagmode

Abstract*—In major congenital heart ailments comes Atrial Septal Defect (ASD). Many techniques viz. ECG, MRI, Ultrasound etc., are in use to detect ASD. Performance of heart is analyzed by the Doctors through test results or observations of heart Ultrasound. In this research work it is proved that the disorder ASD is detected using the technique of block matching and optical flow. These algorithms enables the doctors or experts to detect ASD automatically and hence reduces the dependency on humans. This paper proposes a new Elongated Horizontal Large Diamond Search Pattern (EHLDSP) and Optical Flow algorithm for detection of ASD based on MV. Experimentation was carried out on A4C view of 2D Echo Cardiogram, collected form the hospitals as well as from open available database. Ground truth image is used by the cardiologist to compare the results. In this paper, performance of the proposed Elongated Horizontal Large Diamond Search Pattern (EHLDSP) method is compared with other techniques on the basis of cost functions like PSNR and computation complexity. EHLDSP algorithm is used to check the pixel movements and to calculate Motion Vector (MV), followed by the estimation of the displacement of blood cells from either right to left or vice versa. This will help in the reduction of dependency on specialized doctors or human factor can be reduced. For automatic detection of abnormality, research is going on in this area to make it fast and accurate. Proposed algorithm reduces the average computation by providing speed improvements of about 91% over FS/ES and about 6% over existing DS. Also, EHLDSP has shown improvements in the PSNR value in comparison with other methods.

***Index Terms*—Atrial Septal Defect (ASD), Electrocardiogram (ECG), Apical Four Chamber (A4C), Motion Vectors (MV)**

I. INTRODUCTION

Ultrasound is commonly used technique in medical diagnostics as it is safe, real time, non-invasive, convenient and comparatively cheap with respect to other techniques. Currently tools which are used during clinical examination requires expertise in selecting the required views. For automatic detection of abnormality, research is going on in this area to make it fast and accurate. This will help in the reduction of dependency on specialized doctors or human factor can be reduced. Ultrasound technique play a crucial role in the overall analysis of ASD, because it can be recorded in the form of Video's and therefore allows a dynamic analysis of moving objects and structures.Approach to be used for the detection of ASD is described in this paper.

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Technique described in this paper make use of blood flow movement tracking from Atrium wall of LA to RA or vice versa.Blood flow tracking is done using optical flow and block matching techniques. Classification of motion estimations algorithms is based on three categories viz. Pixel, Block and Region. The Block Based algorithms are best in terms of quality and they are simple as well. Block size plays important role in reducing the complexity. Macroblock size and computations are inversely proportional. Better predictions and accuracy can be done, if the block size is small. However, it requires large motion for improved prediction quality. In this experimentation 16X16 block size is used to provide trade-off between motion overhead and prediction quality. ME complexity gets reduced, if search space is reduced. Number of computations is directly proportional to size of search area, smaller the size, lesser the computations and vice versa. For tracking the blood flow, movement of blood can be identified by comparing each block with its previous block this is achieved by dividing the ultrasound image into several blocks.Organization of various sections is as follows. Section two covers the overview. Section three includes the methodology used in validating the experiments. Experiments and results are described in Section Four. Proposed method's assessment of computational performance and accuracy is also part of Section Four. Section Five and Six respectively, covers the Discussion and conclusion.

II. RELATED WORK

Muhanned Al Anwer et al. in [1] have showcased a newly developed technique called as Dynamic Multi Shape Search (DMSS) for automatic detection of ASD by tracking the blood flow with the help of block matching and optical flow techniques. Qi Zhang et al. in [2] proposed a SIV (speckle image velocimetry) techniques for measurement of blood flow in LV (left ventricle). M.N. Annadate, M.S. Nagmode in [3] have proposed the technique for automatic detection of heart disorders to reduce the dependency on medical experts for evaluation of 2D Echo, also to increase the accuracy through automation. Dhiraj Manohar Dhane, Chetan S. Deokarin [4] demonstrated echocardiogram videos key frame browsing, extraction and summarization. Ritwik Kumar, et al. in [5] authors presented an automatic view classification of motion in echocardiogram videos and cardiac structures.

M.N. Annadate, M.S. Nagmode in [6] authors, have showcased the results of experimentation work they have carried out using seven different denoising filters. HMF out performs LEE on parameters like PSNR, MSE, SSIM and QI. Tatiana Chumarnaya et al. in [7] evaluated the common myocardial diseases. Aroh Barjatya in [8] Explained and evaluated various motion estimation techniques using block matching. Alia M. A. Siddig , et al. in [9] explained the process of Dynamic Multi-Shape Search for Motion Estimation in Ultrasound Image. TQ Nguyen and SH Chanin [10] evaluated the Subpixel Motion Estimation Without Interpolation. Jobin T Philip et al. in [11] compared the results of BM and OF techniques for SSIM, processing time, MOS and PSNR. Saida Khachira et al. in [12] studied myocardial motion estimation in US. Marius George Linguraru et al. in [13] used template to match the velocity computation in OF and presented the comparative results for ASD tracking. Razali Yaakob et al. in [14], authors evaluated the effect of macro block size on motion estimation through four different block matching algorithms. Bichu Vijay et al. in [15], proposed an innovative BM algorithm. Shiping Zhu et al. in [16] introduced a new cross-diamond search algorithm (NCDS). Shan Zhu et al. in [17], for fast BM estimation proposed a new DS algorithm. Chun-Ho Cheung et al. in [18] proposed a cross- diamond-hexagonal search pattern.

III. METHODS

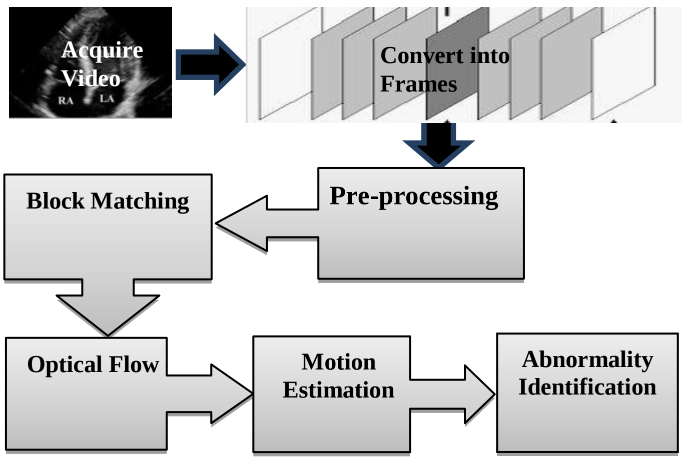


Fig. 1 Block Schematic

As part of previous research work [15] various noise models were studied in detail and denoising filters like Lee, Kaun, Frost, Median, HMF, SRAD were evaluated on parameters like MSE, PSNR, QI, SSIM and best performing filters like Lee and HMF were used in combination for carrying out denoising or de-speckling.

A. *Atrial Septal Defect (ASD)[13],[7]*

In this defect blood in the heart can flow from the right to the left or opposite, because of hole in the septum wall.

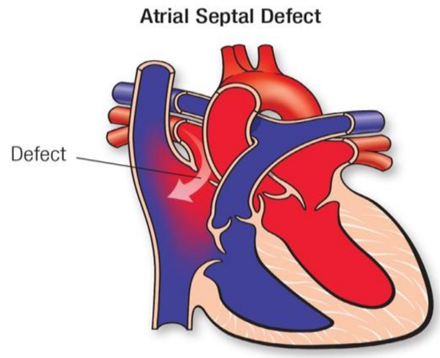


Fig. 2 Heart with ASD

B. *Motion Estimation Techniques[8], [12]*

In this process motion vectors are determined [8].

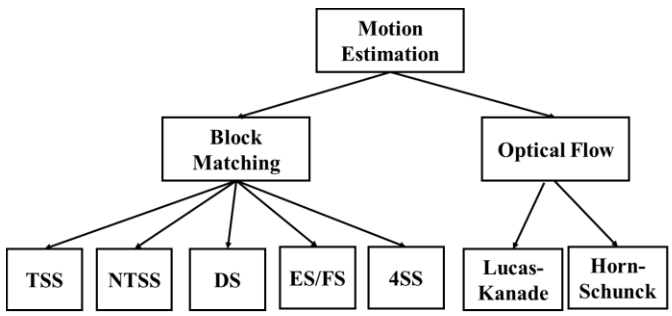


Fig. 3 Motion Estimation Techniques

1. Block Matching [8],[11],[14]

Here current frame is divided into macro blocks of equal sizes. Macro blocks of adjacent frames in the video are compared. [8]. Location wise movement of macroblock is tracked by drawing a motion vector (MV)[8].

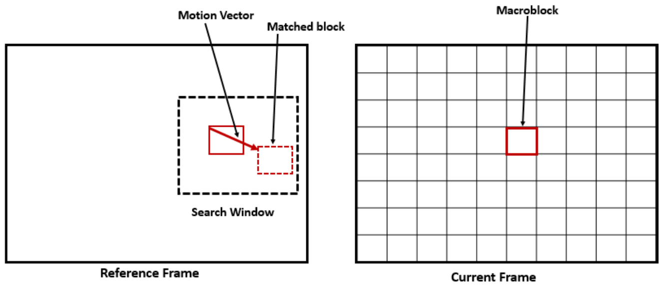


Fig. 4 Block Matching Technique

There are several algorithms of BM, few of them are listed below and these are applied on the database used in this research [8]. Three Step Search (TSS), Exhaustive / Full Search (ES/FS), Four SS (4SS), Diamond Search (DS), New TSS (NTSS) [8].

1.1 Diamond Search (DS) [8], [11], [15]- [18]

Divided into two types

- Large DS Pattern (LDSP) – Performs coarse search to find a small area of optimal MV.
- Small DS Pattern (SDSP) - Performs fine search in the located area to find the best MV.

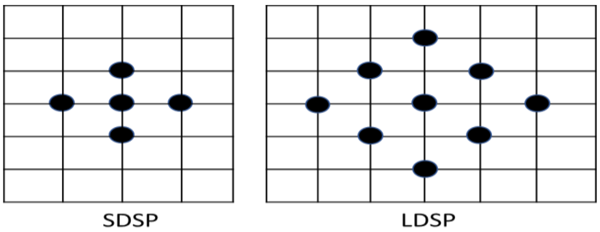


Fig. 5 DS Patterns

1.2 Proposed Elongated Horizontal Large Diamond Search Pattern (EHLDSP)

Elongated Horizontal LDSP (EHLDSP) algorithm finds the best match of Large Diamond search pattern (LDSP) using combination of three patterns viz. LDSP and/or Elongated Horizontal Large Diamond Search Pattern (EHLDSP) and SDSP [15]. Results obtained using EHLDSP algorithm are better than DS with lesser number of search points. Each pattern i.e. EHLDSP and LDSP, in the proposed method has 5 search point. EHLDSP algorithm is carried out in three steps search - LDSP followed by EHLDSP and SDSP. Best match is given by the minimum cost function position among five checking point in LDSP or SDSP.

Proposed EHLDSP Algorithm:

Step1: Apply LDSP, if Minimum Block Distortion (MBD) is at the center, go to step3 (block is not moving), otherwise go to step 2.

Step2: If MBD is on the left or right position of LDSP apply EHLDSP. If MBD is at the center of EHLDSP go to step 3, otherwise step two is continued.

Step3: Apply SDSP and obtain MBD which will give the best motion vector.

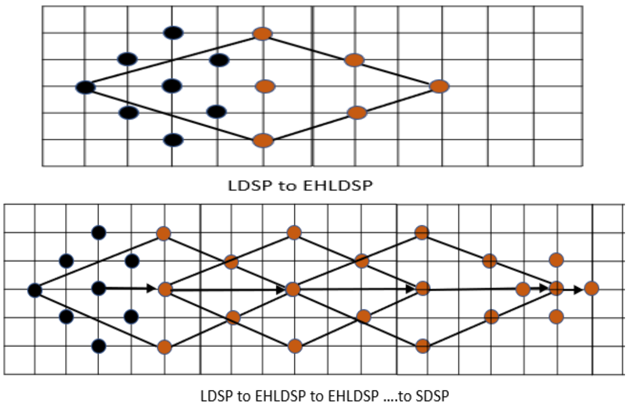


Fig. 6 EHLDS Patterns

2 *Optical Flow Technique [1],[9]-[11]*

Optical flow methods provide an estimate of motion in terms of spatio-temporal image intensity gradients. Two methods viz. Horn-Schunck and Lucas-Kanade are widely used and are discussed in this paper. Each pixel is checked with previous frame for its movement and is given by a 2D vector called as optical flow. Optical flow involves finding the direction gradient.It is important to know that since we are dealing with video signals, we have a 3D function of x,y and t. Video is stored in the form of frames as a function of x,y and t, assuming continuous frames. We assume that the brightness across successive frames is constant. The assumption made is called as Brightness Constancy.

This can be represented as

$$f(x,y,t) = f(x+dx, y+dy, t+dt) \quad (1)$$

Here we have assumed continuous time t to facilitate calculations. In above equation, LHS represents the first frame, while RHS represents the next frame. Hence brightness at x and y in the first frame is the same as brightness at x+dx and y+dy in the next frame. We compute the Taylor's series approximation of equation to obtain.

$$f(x,y,t) = f(x,y,t)+\frac{\partial f}{\partial x}dx + \frac{\partial f}{\partial y}dy + \frac{\partial f}{\partial t}dt \quad (2)$$

Hence we have

$$\frac{\partial f}{\partial x}dx + \frac{\partial f}{\partial y}dy + \frac{\partial f}{\partial t}dt = 0 \quad (3)$$

Let $\frac{\partial f}{\partial x} = f_x$, $\frac{\partial f}{\partial y} = f_y$, $\frac{\partial f}{\partial t} = f_t$

Hence above equation reduces to

$$f_x\,dx + f_y\,dy + f_t\,dt = 0 \quad (4)$$

Diving the above equation by dt, we obtain

$$f_x\frac{dx}{dt} + f_y\frac{dy}{dt} + f_t\frac{dt}{dt} = 0 \quad (5)$$

$$f_x\frac{dx}{dt} + f_y\frac{dy}{dt} + f_t = 0 \quad (6)$$

In this equation, $\frac{dx}{dt}$ and $\frac{dy}{dt}$ are the rate of change in x and y directions, respectively. This equation is called the Optical Flow Equation. We need to compute the gradients (f_x, f_y, f_t) for finding the optical flow. Since we are dealing with digital images, the finite difference approximates the gradient. In the equations given below, the two frames considered are f(x,y,k) and f(x,y,k+1).

$$f_x\frac{dx}{dt} \approx \frac{1}{4}\{ f(x+1, y, k) - f(x, y, k) + f(x+1, y+1, k) - f(x, y+1, k) + f(x+1, y, k+1) - f(x, y, k+1) + f(x+1, y+1, k+1) - f(x, y+1, k+1)\} \quad (7)$$

$$f_y\frac{dx}{dt} \approx \frac{1}{4}\{ f(x, y+1, k) - f(x, y, k) + f(x+1, y+1, k) - f(x+1, y, k) + f(x, y+1, k+1) - f(x, y, k+1) + f(x+1, y+1, k+1) - f(x+1, y, k+1)\} \quad (8)$$

$f_t \approx \frac{1}{4}\{$ f(x, y, k+1) – f(x, y, k) + f(x+1, y, k+1) – f(x+1, y, k) + f(x, y+1, k+1) – f(x, y+1, k) + f(x+1, y+1, k+1) – f(x+1, y+1, k)$\}$ (9)

Other form to represent optical flow calculations is given below:

$I_x m + I_y n + I_t = 0$ (10)

Where, spatiotemporal image brightness derivatives are defined by Ix, Iy, and It. And m is horizontal and *n* is vertical optical flow.

2.1 Horn-Schunck Method:

Assumption made in this method is that for the entire image optical flow is smooth, accordingly velocity field, $[u, v]^T$ is computed using following equation [19].

$$E=\iint (I_x u+I_y v+I_t)^2 dxdy + \alpha \iint \left\{\left(\frac{\partial u}{\partial x}\right) + \left(\frac{\partial u}{\partial y}\right) + \left(\frac{\partial v}{\partial x}\right) + \left(\frac{\partial v}{\partial y}\right)\right\} dxdy \quad (11)$$

Where, optical velocity components of u are given by spatial derivatives $\left(\frac{\partial u}{\partial x}\right)$ and $\left(\frac{\partial u}{\partial y}\right)$ and α is a global smoothness factor.

2.2 Lucas Kanade Method:

Here smaller sections of original image are taken and constant velocity is assumed in each section. Then optical flow is computed using following equation for weighted least-square.

$$\sum_{x\in\Omega} W^2 \left[I_x u + I_y v + I_t\right]^2 \quad (12)$$

Where, *W* is a window function. The equation can be further simplified to the minimization problem and is given as:

$$\begin{bmatrix} \sum W^2 I_x^2 & \sum W^2 I_x I_y \\ \sum W^2 I_y I_x & \sum W^2 I_y^2 \end{bmatrix} \begin{bmatrix} u \\ v \end{bmatrix} = -\begin{bmatrix} \sum W^2 I_x I_t \\ \sum W^2 I_y I_t \end{bmatrix} \quad (13)$$

IV. EXPERIMENTATION

Performance Parameters:

To estimate the motion in a frame, movements of all macroblocks of a frame are calculated. Below are the most popular cost functions, given by the equations 14, 15, 16 & 17 .

1. Mean Squared Error (MSE) =

$$\frac{1}{N^2}\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}(C_{ij}-R_{ij})^2 \quad (14)$$

2. Peak Signal to Noise Ratio (PSNR) =

$$PSNR = 10 \log_{10} (2^B - 1)^2/MSE \quad (15)$$

Where B gives number of bits per pixel

3. Sum of Absolute Difference (SAD) =

$$\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}|C_{ij}-R_{ij}| \quad (16)$$

4. Mean Absolute Difference (MAD) =

$$\frac{1}{N^2}\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}|C_{ij}-R_{ij}| \quad (17)$$

Where N denotes the size of the macro-block.Pixels in current macroblock is denoted by Cij and pixels in reference macroblock by Rij

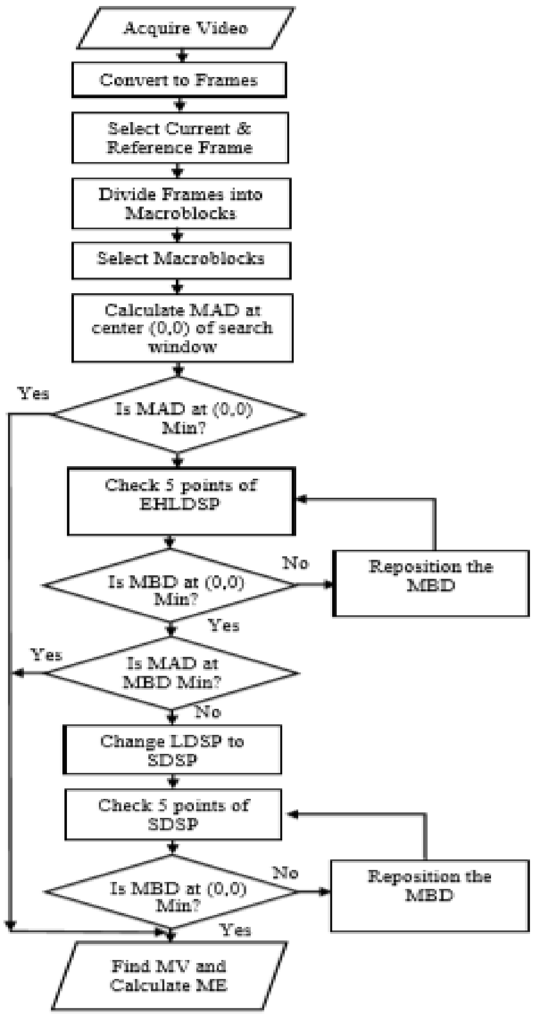


Fig. 7 EHLDS Flowchart

Algorithms:

In this work PSNR and MSE of 30 frames from Ultrasound Video with ASD have been calculated.

Algorithm FS/ES:

1. Read the two images
2. Find the size of two images(m,n,s)
3. Where m = rows, n = columns, s=1 (Grey) and s=3 (RGB)
4. If s=3, Convert to Grey Image
5. Perform 8 points in Full Search
6. Center one point and calculate the SAD
7. Put the minimum point with SAD as new Centre
8. Perform 4 points search
9. Center one point and calculate the SAD
10. Put the minimum point with SAD as new Centre
11. Find the best match

Algorithm TSS:

1. Read the two images
2. Find the size of two images(m,n,s)
3. Where m = rows, n = columns, s=1 (Grey) and s=3 (RGB)
4. If s=3, Convert to Grey Image
5. Start search with the center
6. Set search parameter p as and step size S as 4
7. Around location (0,0),Search 8 locations
8. Minimum cost function is chosen amongst the 9 searched locations
9. New search origin is set that point
10. Make step size = S/2
11. Procedure is Repeated for two more iterations till S becomes 1
12. Minimum cost function and best match macroblock is found at S=1

Algorithm NTSS:

1. Read the two images
2. Find the size of two images(m,n,s)
3. Where m = rows, n = columns, s=1 (Grey) and s=3 (RGB)
4. If s=3, Convert to Grey Image
5. Check eight extra neighboring search points of search
   center along with the original checking points used in TSS, in all total 16 points are checked (8 are at S=4 and 8 are at S=1)
6. Check for minimum distortion point in following cases
   Case 1: At search window center (stationary block), stop the search, set MV as (0,0)
   Case 2: At any one neighbor out of the eight (at S=1) of the search window center, set the origin to this point and check for distortion adjacent to this point. Accordingly check 5 or 3 points, find MBD and set MV to this location
   Case 3: At any one of the remaining eight (at S=4) checking points follow normal TSS
7. Calculate the cost functions
8. Calculate the ME

Algorithm DS:

1. Read the two images
2. Find the size of two images(m,n,s)
3. Where m = rows, n = columns, s=1 (Grey) and s=3 (RGB)
4. If s=3, Convert to Grey Image
5. Set Block 16x16 in the current frame
6. Start from center.
7. Find matching block in the reference image from 9 candidates of LDSP search points
8. Check whether distortion point is at the center.
9. If YES, Form a new LDSP and center is updated at the MD point from the previous search. Repeat step 7
10. Check MBD for 3 or 5 candidates
11. Check whether the block is at the center,Set SDSP
12. Search 4 locations near (0,0)
13. Pick the location with minimum cost function
14. The point with minimum distortion is the Final motion vector.

Proposed Algorithm - Elongated Horizontal Long Diamond Search (EHLDSP):

1. Read the two images
2. Find the size of two images(m,n,s)
3. Where m = rows, n = columns, s=1 (Grey) and s=3 (RGB)
4. If s=3, Convert to Grey Image
5. Set Block 16x16 in the current frame
6. Start with search location at center
7. Find best matching block from 9 candidates of LDSP search points in the reference frame
8. Check whether distortion point is at the center
9. If at the Centre, distortion point is not found, form a new EHLDSP and update center at the minimum distortion point obtained in the earlier search, Repeat step 7
10. If block is at the center,Set SDSP
11. Search 4 locations near (0,0)
12. Pick the location with minimum cost function
13. Motion vector is the point with minimum distortion.

Post detecting the location of ASD, blood flow direction is tracked by applying optical flow technique.

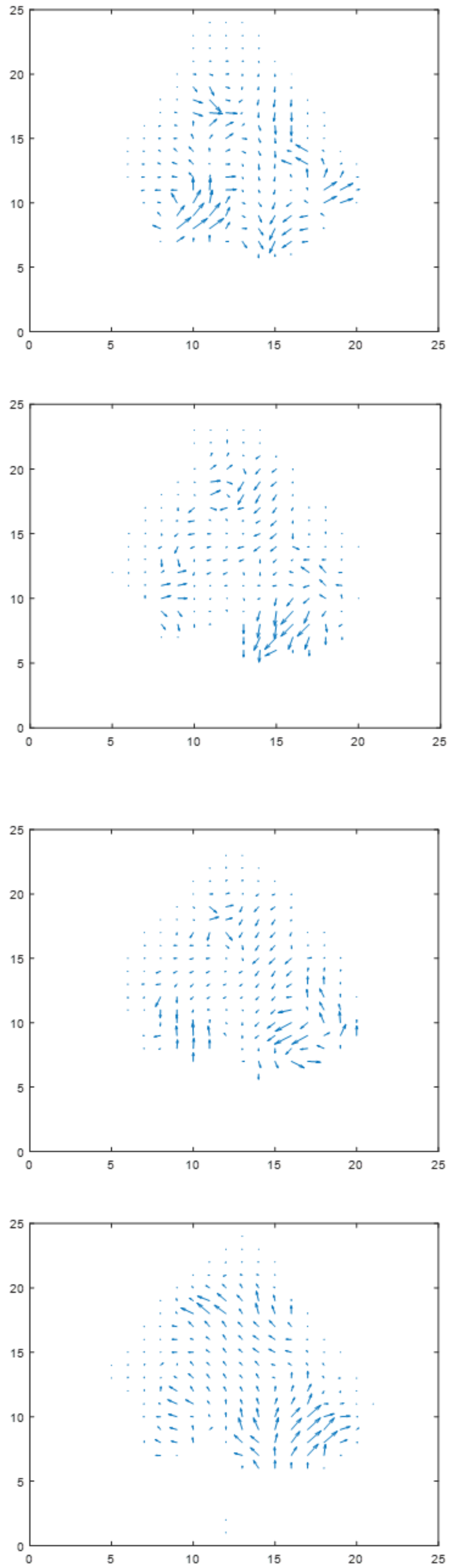
Algorithm Optical Flow (OF):

1. input the video
2. Translate into images
3. Read two consecutive images as reference and current
   Image
4. Calculate fxdx, fydy and ftdt
5. Find the MV
6. quiver plot
7. Velocity vectors are shown as arrows at the points (x,y) with Components (u,v)
8. Get next two consecutive images
9. Repeat step 5 to 8
10. Plot MV

Experimentation was carried out on A4C view of 2D Echo Cardiogram, of different 19 patients, collected form the hospitals as well as from open available database.

Results:

1. ***Block Matching***



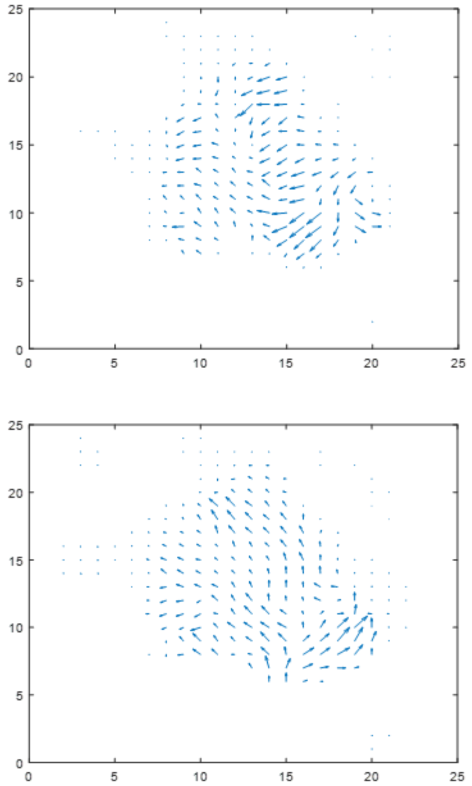
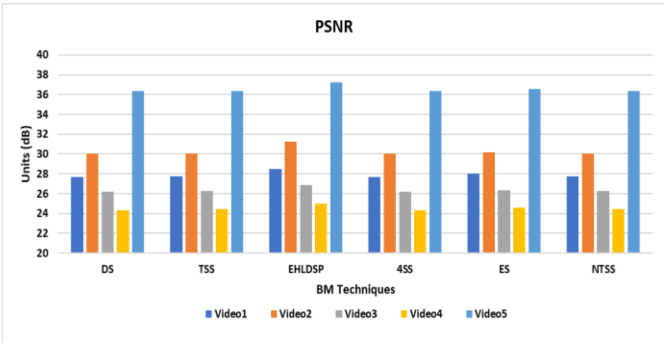
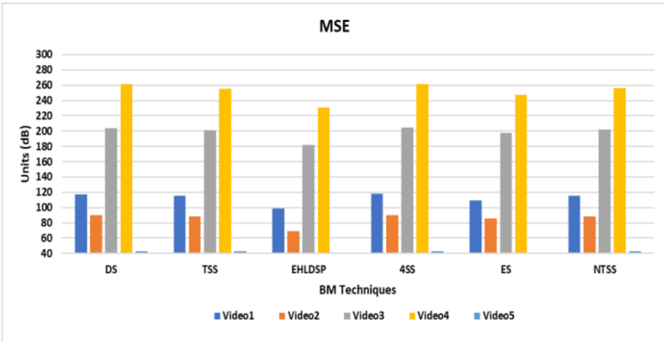


Fig. 8 Motion Vector Diagrams





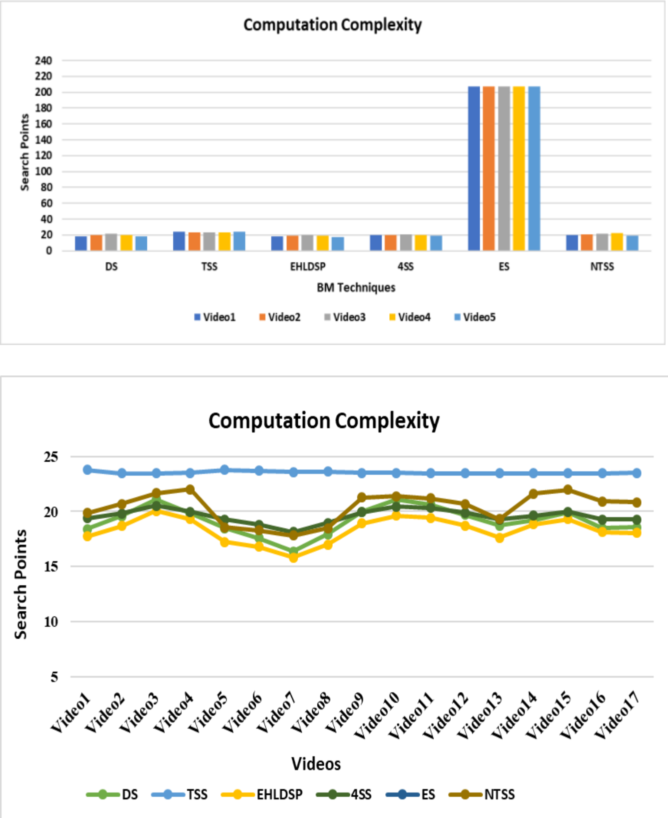


Fig. 9 Cost Functions Graphs – BM Technique

2. *Optical Flow*

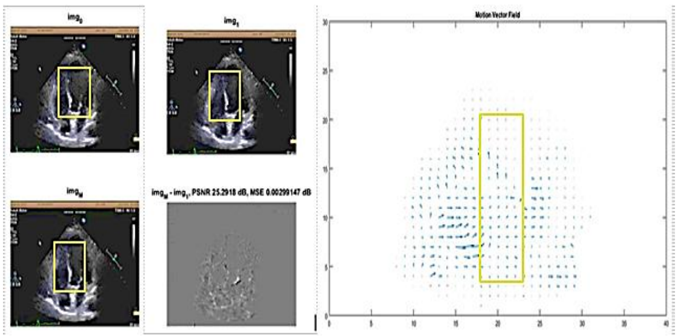
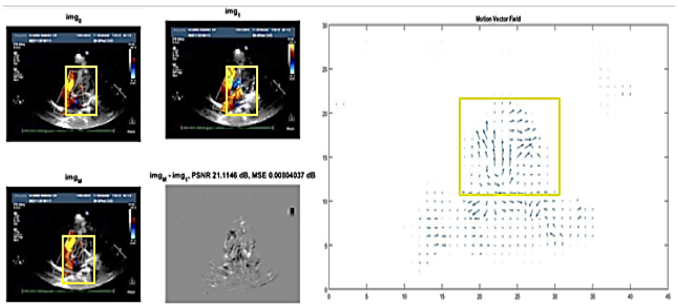


Fig. 10 Motion Estimation using Optical Flow for Normal Video



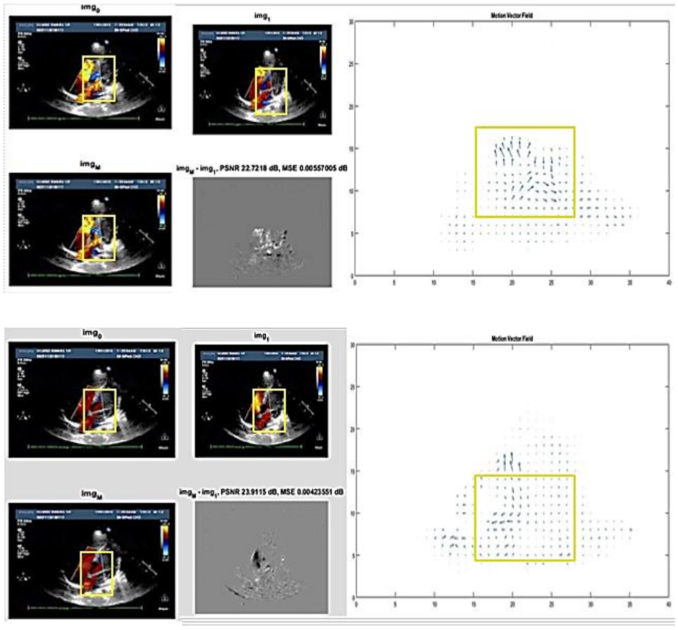


Fig. 11 Motion Estimation using Optical Flow for Abnormal Video (ASD)

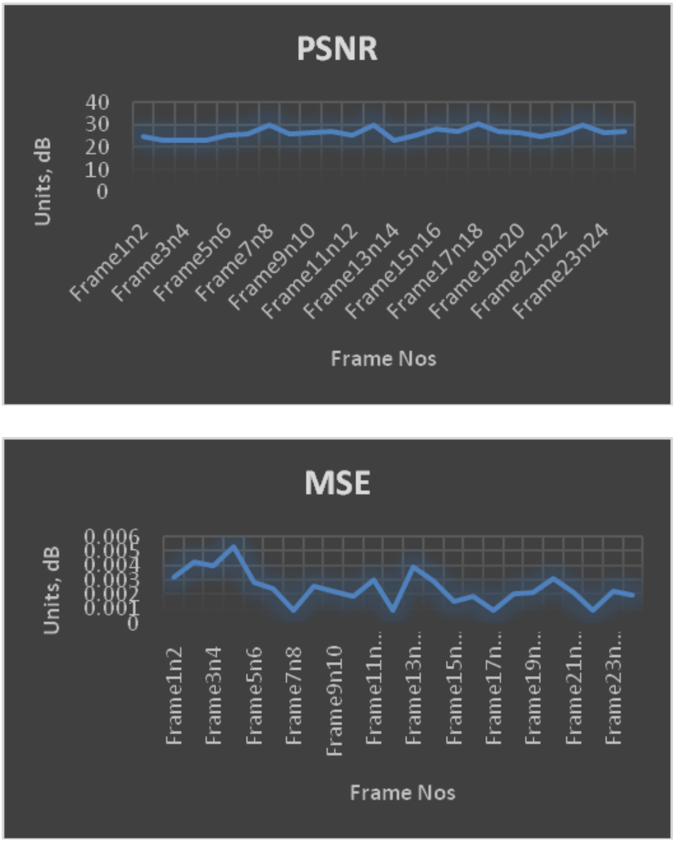


Fig. 12 Cost Functions Graphs – Optical Flow Technique

Table 1: Dataset Specifications:

Video	Type	Length	Frame Dim (W x H)	Data & Bit Rate kbps	Frame Rate
Video01 to Vidoe17	MP4	1 Sec	640 x 480	1697	30 fps

Table 2: PSNR Comparison

PSNR																		
	Video1	Video2	Video3	Video4	Video5	Video6	Video7	Video8	Video9	Video10	Video11	Video12	Video13	Video14	Video15	Video16	Video17	Average
DS	27.71	30.00	26.18	24.34	36.36	36.94	36.15	36.50	42.71	37.07	26.90	28.88	40.50	26.33	24.21	25.12	25.04	34.18
TSS	27.77	30.06	26.25	24.45	36.34	36.95	36.18	36.48	42.86	37.13	26.98	28.98	40.51	26.38	24.35	25.23	25.20	34.24
EHLDSP	28.50	31.21	26.90	24.96	37.22	37.83	36.92	37.33	43.80	37.78	27.71	29.82	41.59	26.89	24.73	25.65	25.59	35.05
4SS	27.70	30.01	26.18	24.34	36.36	36.92	36.14	36.49	42.72	37.07	26.89	28.89	40.49	26.29	24.24	25.09	25.04	34.18
ES	27.99	30.18	26.36	24.59	36.53	37.08	36.29	36.63	42.96	37.19	27.11	29.12	40.57	26.50	24.46	25.38	25.32	34.36
NTSS	27.77	30.06	26.24	24.44	36.35	36.96	36.18	36.48	42.83	37.12	26.96	28.97	40.51	26.36	24.34	25.21	25.18	34.24

Table 3: MSE Comparison

MSE																		
	Video1	Video2	Video3	Video4	Video5	Video6	Video7	Video8	Video9	Video10	Video11	Video12	Video13	Video14	Video15	Video16	Video17	Average
DS	117.60	89.98	204.15	261.20	42.65	41.73	40.64	42.42	30.25	280.33	141.27	122.18	33.67	210.36	261.80	213.94	214.59	117.66
TSS	115.30	88.68	201.12	255.08	42.80	41.75	40.32	42.59	28.12	278.09	138.27	118.98	33.64	207.99	253.22	208.60	207.58	115.33
EHLDSP	98.81	69.08	181.96	230.48	35.50	35.29	34.25	35.45	23.00	266.66	118.58	103.71	25.97	188.03	234.43	191.96	191.38	103.38
4SS	117.93	89.85	204.26	261.80	42.73	42.13	40.68	42.42	30.03	280.77	141.72	121.96	33.76	212.42	260.15	215.07	214.62	117.84
ES	109.72	85.77	197.28	247.13	40.84	40.18	38.91	40.72	26.65	275.77	134.01	114.85	32.77	202.26	247.02	201.85	201.49	112.06
NTSS	115.57	88.73	201.57	255.76	42.65	41.72	40.34	42.41	28.55	278.28	138.93	119.31	33.64	208.70	253.81	209.39	208.30	115.60

Table 4: Computation Complexity Comparison

Computation Complexity																		
	Video1	Video2	Video3	Video4	Video5	Video6	Video7	Video8	Video9	Video10	Video11	Video12	Video13	Video14	Video15	Video16	Video17	Average
DS	18.42	19.58	21.12	19.83	18.48	17.60	16.36	17.96	19.99	21.09	20.66	19.72	18.74	19.18	19.90	18.50	18.55	18.93
TSS	23.78	23.48	23.49	23.49	23.78	23.72	23.57	23.63	23.49	23.50	23.49	23.49	23.49	23.49	23.49	23.49	23.49	23.54
EHLDSP	17.75	18.67	20.07	19.33	17.22	16.78	15.83	17.00	18.90	19.64	19.42	18.71	17.61	18.83	19.30	18.12	18.08	18.06
4SS	19.39	19.83	20.54	19.97	19.29	18.82	18.14	18.96	19.92	20.44	20.35	19.88	19.27	19.62	19.99	19.28	19.28	19.44
ES	207.41	207.41	207.41	207.41	207.41	207.41	207.41	207.41	207.41	207.41	207.41	207.41	207.41	207.41	207.41	207.41	207.41	207.41
NTSS	19.87	20.68	21.65	22.01	18.57	18.31	17.82	18.49	21.27	21.39	21.18	20.70	19.33	21.61	21.97	20.91	20.84	20.22

Table 5: PSNR Comparison with other author results on Ultrasound Videos

Ref paper/ Author	*Algorithm Used*	*PSNR / MSE /RMSE*	*Computation Comple-xity*	*Remarks*
[2]	*Speckle Image Velocimetry (SIV)*	*RMSE 1.51*		*Average of 2 frames*
[9]	*DMSS TSS 4SS*	*PSNR 23.39, 21.36, 17.43*	*7.55, 5.66, 8.35 (in sec)*	*Average of 25 frames*
Proposed	*Elongated Horizontal Large Diamond Search (EHLDSP)*	*PSNR 35.05*	*18.06 (search points)*	*Average of 30 frames*
	ES	*34.36*	*207.4*	
	TSS	*34.24*	*23.54*	
	NTSS	*34.24*	*20.22*	
	4SS	*34.18*	*19.44*	
	DS	*34.18*	*18.93*	

V. DISCUSSION

Diamond search (DS) algorithm is very popular after Full Search algorithm. FS computation time is too high as a result more preference is given to the DS algorithm reason being most accurate ME algorithm among others. Existing DS methods have a drawback of locating local minima and misses the optimum MV. For further improvement in the search efficiency and to overcome the above drawback modified DS algorithm called Elongated Horizontal LDSP has been proposed here, and is based on the DS algorithm. In proposed method PSNR improvement is seen in the range of 1.95% to 2.48% in comparison with other methods and computation complexity improvement is seen as 91%, 23%, 11%, 7% and 5% in comparison with ES, TSS, NTSS, 4SS and DS techniques respectively. Experimentation is done using the MATLAB 2017a on an INTEL Core i7 processor with 8GB of memory.

VI. CONCLUSION

Search efficiency of Full Search (FS) is better than others. It has high accuracy in detecting Motion Estimation (ME) for small motions as well. FS can be considered as effective algorithms for proposed application. However the computational complexity is more in FS/ES, as a result more emphasize is given to Diamond Search after FS. Unwanted flow of blood motion between right and left atrium can be detected efficiently using these algorithms. Proposed method has less time complexity and better PSNR in comparison with other techniques evaluated in this work. As work is being done on heart more emphasis and importance is given to the accurate diagnosis of the disease, hence EHLDSP can be preferred over Full Search Method and DS and results obtained are good, visual results are also in line with DS, ES.

A. Future Work

As the application is in the medical domain, in the advance work more focus will be given on the accurate diagnosis. Real time, fast and accurate results can be obtained through extra steps in the algorithm by devising new technique for the assessment of heart diseases.

REFERENCES

1. Muhanned Al Anwer Alia M. A. Razak Khan, "Detecting and Tracking of ASD Using New Block Flow in Ultrasound (A Novel Approach)", INTERNATIONAL CONFERENCE ON COMPUTING, ELECTRICAL AND ELECTRONIC ENGINEERING (ICCEEE) 978-1-4673-6232-0/13/2013 IEEE : 17 October 2013
2. Qi Zhang, Moli Zhou, Yun Dong, Ming Qian, Ming Chen, "Detection of Blood Flow in Left Ventricle by Echocardiography Using Speckle Image Velocimetry", 7th International Conference on BioMedical Engineering and Informatics (BMEI 2014), 978-1-4799-5838-2/14/©2014 IEEE
3. Mrunal N. Annadate, Manoj S. Nagmode, "Automatic detection of Hypertrophic Cardiomyopathy using Segmentation Techniques in Heart Ultrasound Video", International Journal of Pure and Applied Mathematics, Volume 119 No. 12 2018, 12945-12954,
4. Dhiraj Manohar Dhane, Chetan S. Deokar, "Key Frame Abstraction, Extraction, and Browsing Of Echocardiogram Videos", 2010 International Conference on Industrial Electronics, Control and Robotics, 978-1-4244-8546-8/10/©2010 IEEE
5. Ritwik Kumar, Fei Wang, David Beymer, Tanveer Syeda-Mahmood, "Echocardiogram View Classification using Edge Filtered Scale-invariant Motion Features", 978-1-4244-3991-1/09/©2009 IEEE
6. Mrunal N. Annadate, Manoj S. Nagmode, "Efficient Speckle Reduction Techniques in Ultrasound Video Quality Enhancement– A Comparative Evaluation", 978-1-5386-3243-7/17/©2017 IEEE
7. Tatiana Chumarnaya, Olga Solovyoval, YuliaAlueva, Sergey P. Mikhailov, Valentina V. Kochmasheva, Vladimir S. Markhasin, "Left Ventricle Functional Geometry in Cardiac Pathology", Computing in Cardiology 2015; 42:353-356, ISSN 2325-8861
8. ArohBarjatya, Student Member, IEEE , "Block matching algorithms for motion estimation", DIP 6620 Spring 2004
9. Alia M. A. Siddig ,Razaz K. Yousif, MuhannedAlanwer, " Motion Estimation in Ultrasound Image Using Dynamic Multi-Shape Search", 978-1-4673-6232-0/13/2013 IEEE
10. *Stanley H. Chan , D˜ung T. V˜o and Truong Q. Nguyen* **"**Subpixel Motion Estimation Without Interpolation" 978-1-4244-4296-6/10/2010 IEEE
11. Jobin T Philip, Binoshi Samuvel, Pradeesh K, Nimmi N K, "A Comparative Study of Block Matching and Optical Flow Motion Estimation Algorithms", 978-1-4799-5202-1/14/2014 IEEE
12. Saida KHACHIRA, Fathi KALLEL, Ahmed BEN HAMIDA, " A comparative study of motion estimation algorithms in cardiac ultrasound sequences", 978-1-4673-8526-8/16/2016 IEEE
13. Marius George Linguraru1, Nikolay V.Vasilyev, Pedro J. del Nido, Robert D. Howe, " Atrial Septal Defect Tracking in 3D Cardiac Ultrasound", MICCAI 2006, LNCS 4190, pp. 596 – 603, 2006.
14. © Springer-Verlag Berlin Heidelberg 2006
15. Razali Yaakob, Alihossein Aryanfar, Alfian Abdul Halin, Nasir Sulaiman, " A Comparison of Different Block Matching Algorithms for Motion Estimation", The 4th International Conference on Electrical Engineering and Informatics (ICEEI 2013), 2013 Published by Elsevier B.V
16. Bichu Vijay, Ganapathi Hegde, Sanju S, "Fast Block-Matching Motion Estimation Using Modified Diamond Search Algorithm", International Journal of Advanced Computer Engineering and Communication Technology (IJACECT), 2319-2526, Volume -3, Issue -1, 2014
17. Shiping Zhu, Jun Tian, Xiaodong Shen, Kamel Belloulata, "A new cross-diamond search algorithm for fast block motion estimation", 978-1-4244-5654-3/09/2009 IEEE
18. Shan Zhu and Kai-Kuang Ma, "A New Diamond Search Algorithm for Fast Block-Matching Motion Estimation", 1057–7149/2000 IEEE
19. Chun-Ho Cheung, Member, IEEE, and Lai-Man Po, Member, IEEE, "Novel Cross-Diamond-Hexagonal Search Algorithms for Fast Block Motion Estimation", IEEE TRANSACTIONS ON MULTIMEDIA, VOL. 7, NO. 1, FEBRUARY 2005

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