Video Compression based on Fractal Isosceles Triangular Partition using Hybrid Swarm Intelligence

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ABSTRACT
Symmetry property of fractal transforms enriched the compression techniques of digital multi-media data. The major part of multi-media data is video and image. The diverse nature of video required more memory and bandwidth for storage and transmission. For the efficient processing of video needs compression. Isosceles triangular partition (ITP) techniques provide the symmetry of range block and domain blocks in terms of triangular shape not in a rectangle. The triangular shape reduces the process of non-overlapping of blocks and increases quality of video compression in terms of PSNR. Instead of quality improvement of video suffered from the process of compression ratio and process of encoding time of video. The bottleneck problem of isosceles triangular partition is search space and mapping of blocks. For the betterment of search space and mapping of blocks used hybrid swarm intelligence. The hybrid swarm intelligence reduces the search space and increases the efficiency of mapping and increases the compression ratio of video compression. The design algorithms simulated in MATLAB software and used some short duration of video clip and measure some standard parameters such as PSNR, encoding time, compression ratio and MSE. The design algorithm gives better results instead of isosceles triangular partition.

Keywords
Video Compression, Encoding, Isosceles Triangular Partition, Hybrid Swarm Intelligence

1. INTRODUCTION
Swarm intelligence enhances the coding and decoding efficiency of video compression. The process of swarm intelligence removes the bottleneck problem of domain mapping and reduces the search space for fractal transform non-overlapping blocks. The mapping of non-overlapping blocks is very slow process and increases the time of video encoding and the process of video encoding suffered from the problem of efficiency and constraints of parameters [31-33]. The swarm intelligence gives the variety of algorithms for the purpose of searching of blocks coefficient and mapping of domain blocks [2, 3]. In this paper used two swarm algorithm one is ant colony optimization and other is particle swarm optimization [4, 14]. Both swarm algorithms are meta-heuristic and memory based iterative algorithms. The meta-heuristic nature of algorithm gives the diversity for the processing of encoding and retains the quality of compressed video. The design algorithm used ant colony optimization for the processing of the group of frames for the range and domain selection. Instead of ant colony optimization particle swarm optimization used for the processing of mapping and encoding the block coefficient to domain and range. The both swarm algorithms makes hybrid swarm algorithm for the mapping and searching the reference and frame correlation for the compression. The hybrid swarm algorithm is memory based its take more iteration time and increases the complexity of process. The hybrid swarm intelligence algorithm used with the combination of partition techniques of video [8-13]. For the partition of blocks used isosceles triangular partition techniques. The triangular partition techniques generate the blocks in terms of triangle not in from of rectangle and increase the more symmetry for fractal video processing [26, 27]. The rectangle block directly mapped the symmetry property and reduces the overlapping and improved the performance of video encoding. The isosceles triangular partition process matches the range and domain in terms of angle mapping of triangle [15]. The rest of the paper discuss isosceles triangular partition in section II. In section III discuss the process of hybrid swarm intelligence algorithm. In section IV describe the processing of compression, in section V describe simulation results and finally discuss conclusion and future work in section VI.

2. ISOSCELES TRIANGULAR PARTITION
The fractal video compression is a lossy compression strategy [31-33]. Isosceles triangular partition is a fractal technique for image compression. The isosceles triangular partition techniques enhanced the performance of encoding process of fractal video compression [5-7]. The isosceles triangular partition process used the grayscale image and video for the mapping of symmetry. The mapping of symmetry reduces the space of non-overlapping blocks of domain and range. The process of fractal encoding describes here with the figure 1[16-23].

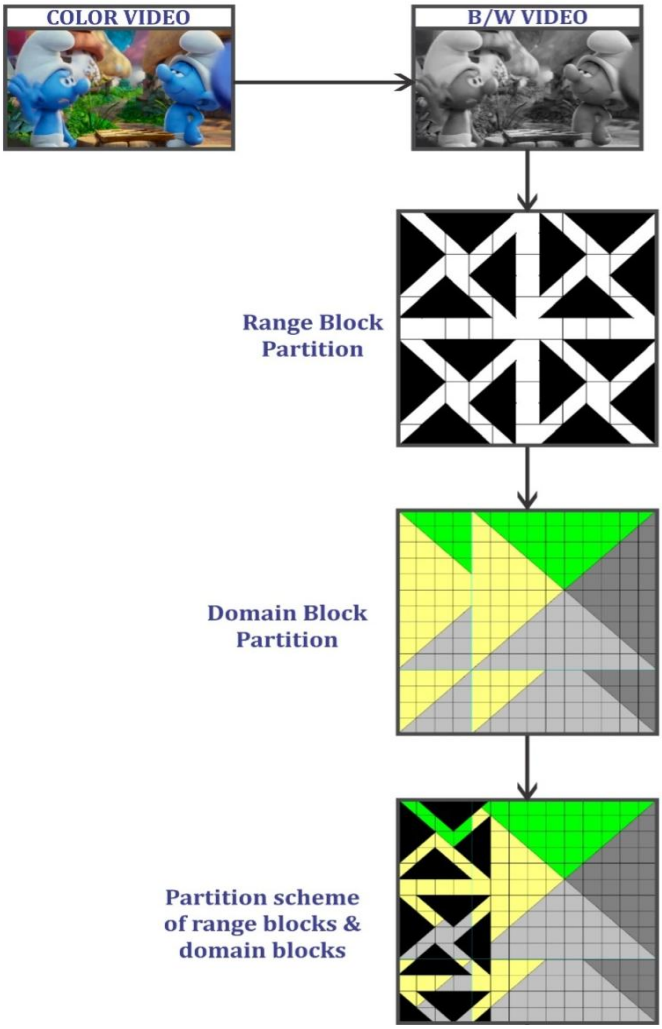

Figure 1: Process block diagram of isosceles triangular partition of RGB video

The color video RGB mode converted into grayscale video and the process of partition describe as following derivation [28].

The mapping of triangular block in concern of M1, M2……,Mn for the fractal encoding process as

$$Fc = Rc(M_1, M_2, \ldots . . M_{cn})^n \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\underset{map}{} = \sum_{l,p \to l} sim\ (R(x,y,z)) + D \sum_{l,\to l}^{k \to l} [S]^k + \sum_{,p \to lu} Encode\ (M(R))^n \ldots\ldots\ldots\ldots\ldots (2)$$

where $D\ and\ R$ are the two range and domain blocks of triangle formation. M_n is the last block set of fractals transform form of video encoding [29,30].

3. HYBRID SWARM INTELLIGENCE

The hybrid swarm algorithm is a combination of ant colony optimization and particle swarm optimization (called PHI). The combination of the swarm algorithm also called fusion of the swarm algorithm. Here ant colony algorithm decides the selection of domain with respective reference frame for the mapping of range. The process of searching is done by the particle swarm optimization [31-33]. The particle swarm optimization iterates the encoding process of fractal transform. The frames of video treat as artificial ants and the difference of frames treat as pheromone of ants and the process of ants describes here. A1 is the process of ants, y is the similar point of blocks S is set of blocks Q is pheromone updates. For the processing of ants in video encoding [24, 25]

Input: $GOF = \{(\mathrm{A}_{1,}y_1), (\mathrm{A}_{2,}y_2), \ldots \ldots (\mathrm{A}_{L,}y_L)\}$

$$S^b = \{(\mathrm{A}_{l_b,}y_{l_b})\}_{l=1}^{L}, b = \{1, \ldots \ldots Q\}$$

$$T = \{\mathrm{A}_{1,}\mathrm{A}_{2,} \ldots \ldots \ldots \mathrm{A}_U\}$$

$$T^b = \{(\mathrm{A}_{u_b})\}_{u=1}^{U}, b = \{1, \ldots . Q\}$$

Output: $y_u, Pu \in T$// here T is set of blocks

For each block, $b = 1$ to Q do

Define $S_0^b = S^b, T_0^b = \emptyset, U_0^b = T^b, M_{0b}^c = I$

For iteration, k=1 to K do

With $\theta_{u_b p}^c \in (S_K^b + T_k^b), Pp \in \{1, \ldots . , P_{u_b}\}$

Estimate $Pl_b \in S_k^b, I2C(\mathrm{A}_{l_b}, c)$

With $\theta_{l_b p}^c \in (S_k^b + T_k^b - l), P_p \in \{1, \ldots . , P_{l_b}\}$

Update $S_{k+1}^{b},\ T_{k+1}^{b}, U_{k+1}^{b}$

And finally proceed the optimized frames data for the processing of encoding in ant process.

Input: A set of ants $A_{ni} = \{a_1,\ a_2, \ldots, a_j\}$, and each ants $a_i$with the symmetry blocks c_i and the moves d_i, the velocity move position of blocks C, and the constant rate of velocity for blocks update.
Output: the SF (similar frames)
Distribute ants according to their difference
Set D_{ni} as the minimal velocity inA_{ni}.
while A_{ni} is empty
update the velocity and position of ants A_{ni} to A'_{ni}
Set the S as the maximum frames
while $\sum_{\forall_i \in A'_{ni}} \left\lceil \frac{d_i}{c} \right\rceil \left\lfloor \frac{S}{pc_i} \right\rfloor \left\lfloor \frac{S}{D_{ni}} \right\rfloor Xc$ do
end while
end while
Return SF

4. ENCODING PROCESS

Input: A set of SFs $= \{sf_1, sf_2, \ldots, nsf_n\}$, each symmetry frames of hybrid algorithm. the process of algorithm describes here
if the Encoding frame n_i is added into the FV (fractal video)
for each n_i in SF do
measure difference D_{n_i} by $MAP(ITP)$
$d_{n_i} = D_{n_i}$

$$a_{n_i} = 0$$

end for
measure reference frames by $IPT(fs)$
Set t as encoding iteration for video
end if
Find the frames n_j with $a_{n_j} \geq t$ and the shortest blocks $d_{n_j}\ in\ sf$
Find the frames n_k with the same $d_{n_k}\ in\ sf$
if $j \neq k$ then

$$t = asf_{n_k}$$
$$j = k$$

end if
end if
encode fractal video

$$sf_{n_j} = fs_{n_j} + D_{n_j}$$
$$d_{n_j} = d_{n_j} + D_{n_j}$$
$$t = t + dnj$$

end while

5. EXPERIMENTAL ANALYSIS

For the evaluation of the performance used some standard parameters such as PSNR, MSE, compression ratio (CR) and encoding time of video. The value of PSNR shows that the information of the quality of video. The value of compression ratio shows that the value of fast encoding process of video. All process describes here.

DESCRIPTION OF DATASET

Table1: Shows description of dataset used for compression of varied videos

Sr.No.	Video Name	Format of video
1	Amitabh video	AVI
2	Man video	AVI
3	Snake video	AVI
4	Cinema video	AVI
5	Magic video	AVI
6	Life video	AVI
7	Water video	AVI

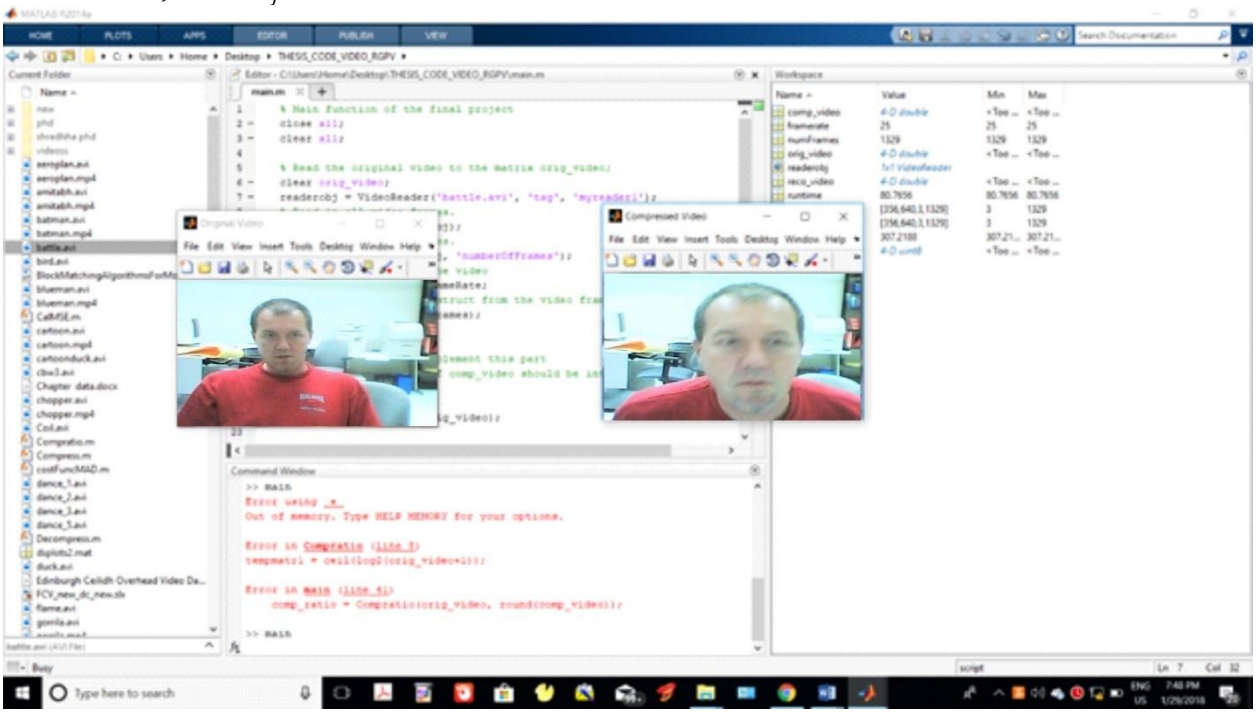

Figure 2: Shows that the original video and compressed video view of Man.avi video using ITP method.

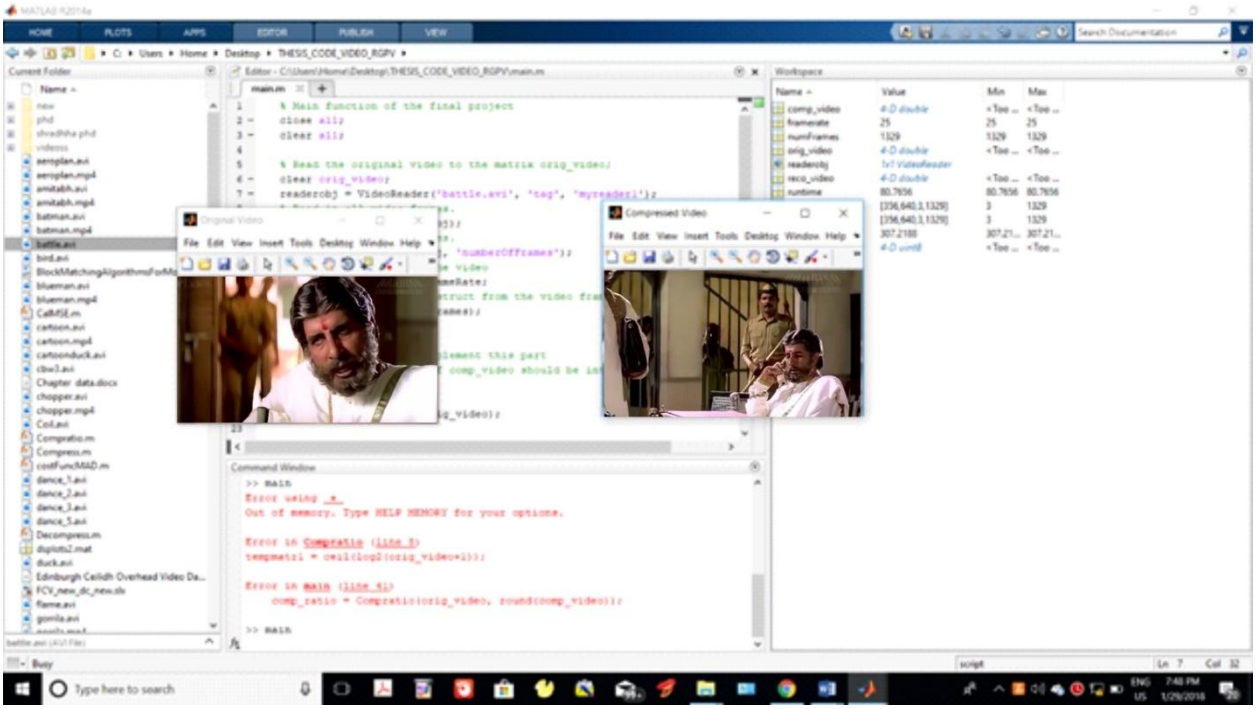

Figure 3: Shows that the original video and compressed video view of Amitabh.avi video using PHI method.

Also get the result of compression of PSNR, Compression Ratio, Mean Square Error and Encoding time for all the tested videos.

The following table shows the comparison of ITP and PHI Method with respect to Compression Ratio, Mean Square Error, Peak Signal to Noise Ratio and Encoding Time of varied AVI videos.

Table 2: Shows the Comparison of ITP and PHI Method for Man.avi video

	ITP	**PHI**
Compression Ratio	0.78	0.87
MSE	12.35	11.19
PSNR	24.04	27.12
Encoding Time	1.78	2.08

Table 3: Shows the Comparison of ITP and PHI Method for Amitabh.avi video

	ITP	**PHI**
Compression Ratio	0.65	0.91
MSE	14.27	13.22
PSNR	22.78	23.04
Encoding Time	0.77	1.24

Table 4: Shows the Comparison of ITP and PHI Method for snake.avi video

	ITP	**PHI**
Compression Ratio	0.81	0.93
MSE	19.12	18.74
PSNR	19.48	20.34
Encoding Time	0.56	0.89

Table 5: Shows the Comparison of ITP and PHI Method for Cinema.avi video.

	ITP	**PHI**
Compression Ratio	0.76	0.88
MSE	13.45	12.18
PSNR	25.14	27.22
Encoding Time	1.66	2.16

Table 6: Shows the Comparison of ITP and PHI Method for Magic.avi video.

	ITP	**PHI**
Compression Ratio	0.51	0.72
MSE	15.01	13.92
PSNR	21.98	23.84
Encoding Time	0.82	1.14

Table 7: Shows the Comparison of ITP and PHI Method for Life.avi video.

	ITP	**PHI**
Compression Ratio	0.59	0.94
MSE	18.99	17.54
PSNR	19.99	20.51
Encoding Time	0.96	1.12

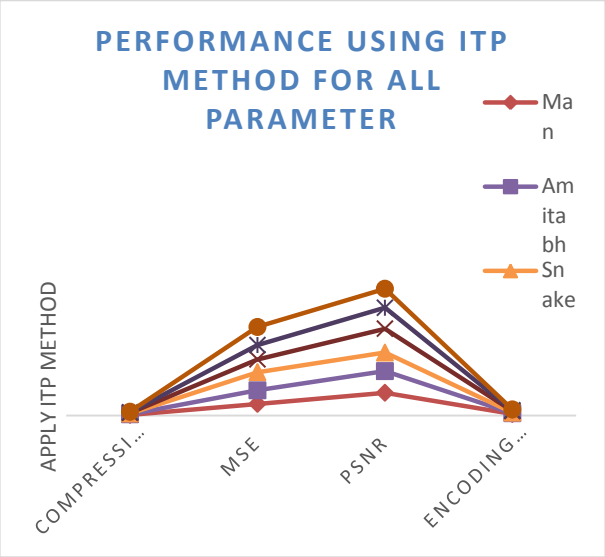

Figure 4: Shows the performance evaluation using ITP-Method for compression ratio, MSE, PSNR and Encoding Time with Man, Amitabh, Snake, Cinema, Magic and Life video avi files.

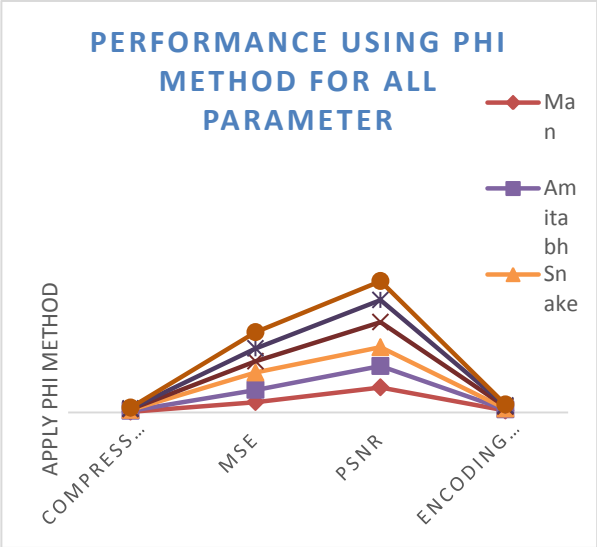

Figure 5: Shows the performance evaluation using PHI-Method for Compression Ratio, MSE, PSNR and Encoding Time with Man, Amitabh, Snake, Cinema, Magic and Life avi video files.

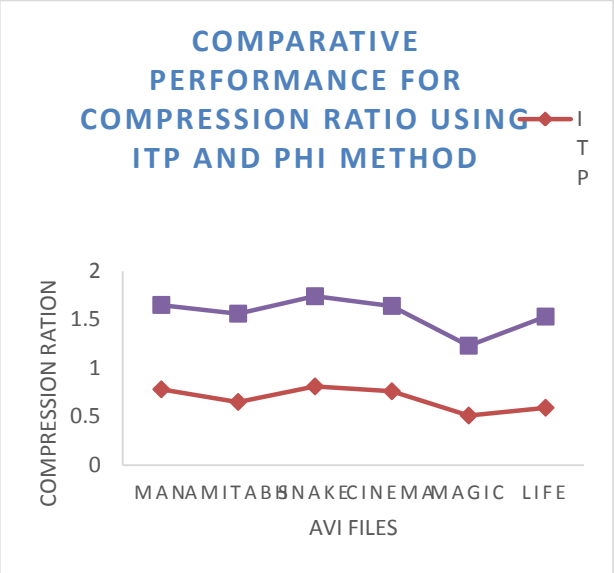

Figure 6: Shows the comparative performance of Compression Ratio using ITP and PHI method for Man, Amitabh, Snake, Cinema, Magic and Life avi video files.

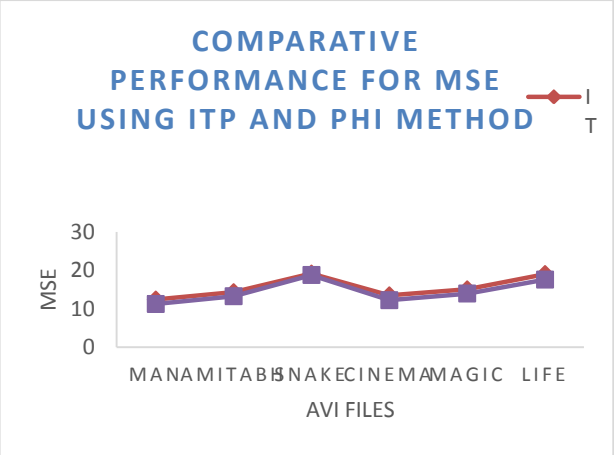

Figure 7: Shows the comparative performance of MSE using ITP and PHI method for Man, Amitabh, Snake, Cinema, Magic and Life video avi files.

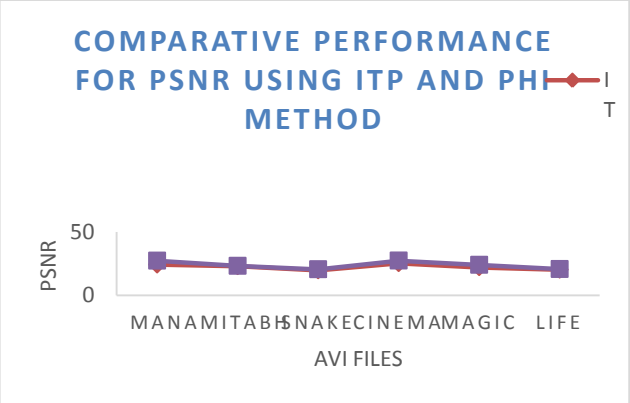

Figure 8: Shows the comparative performance of PSNR using ITP and PHI method for Man, Amitabh, Snake, Cinema, Magic and Life avi video files.

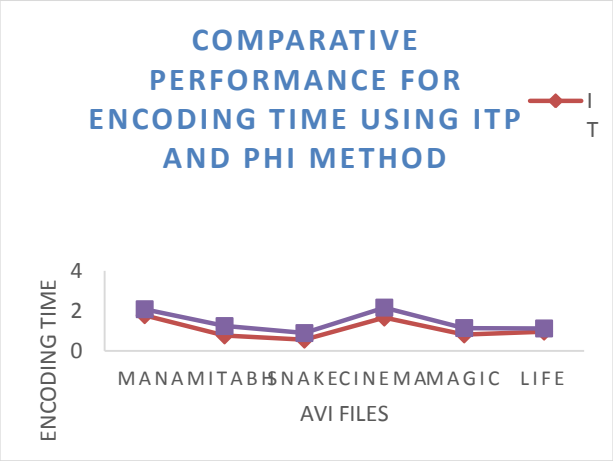

Figure 9: Shows the comparative performance of Encoding Time using ITP and PHI method for Man, Amitabh, Snake, Cinema, Magic and Life avi video files.

6. CONCLUSION & FUTURE WORK

Hybrid swarm intelligence algorithm removes the bottleneck of isosceles triangular partition encoding technique in fractal video compression. The hybrid swarm algorithm reduces the searching space from the reference blocks of frames with domain mapping blocks. The enhanced mapping blocks speed up the encoding process of video compression. The hybrid algorithm plays a role of selection of reference frames and encoding frames for the processing of video. The selection of frames in terms of the group of frames for the processing of encoding. The value of MSE is also reduced and increases the value of quality of video in terms of peak signal to noise ratio. It, Furthermore, reduces the encoding time of video and the processing of fractal video compression. The overall hybrid algorithm enhances the performance of video compression in the range of 5-10%. In future, we will use the video decoding process and reduce the losses of frames during the decompression of video. The frames loss occurred.

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