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# MULTI-LEVEL CO-VARIANCE MEASURE BASED VIDEO COMPRESSION TECHNIQUE FOR EFFICIENT VIDEO TRANSMISSION

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## ABSTRACT

*The high volume data transmission has various issues like bandwidth occupation, latency and much more. To overcome the difficulty in data transmission, we discuss a frame level Co-Variance Measure based video compression technique. The method first splits the video into some frames and for each successive frame, the method computes the co-variance matrix. The method generates three different co-variance matrix, where each matrix maintains the variance of RGB layers of the frames. The method extracts the features of RGB image and at each layer the method computes the variance of feature values. Based on extracted features, the method computes the co-variance measure between all the three layer feature matrix. Based on the measure computed, the method identified variance of feature and based on identified feature variance the method sends the core frame or subsequent frame.*

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KEY WORDS

*Data Transmission, Video Compression, Multi Level Covariance Matrix, Bandwidth Utilization*

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## INTRODUCTION

The modern information technology uses multimedia content for the various purpose of authentication in security systems. Not only that the video transmission being used in other applications like video conferencing where the user can perform his activities through video conferencing. In video conferencing the events happening at the remote site will be transferred to the web technology and the end user can vide the events from his own place. The video conferencing has many emerging applications in educational institutions. In educational society, the learner need not go to the place of a tutor but still he can learn from the tutor. The lecture given by the tutor is transferred through the network technology and provided to the learner.

In order to provide the e-learning to the learner, the huge video must be transferred to the user location. The video content occupies more amount of bandwidth and introduces more overhead in data transmission. While performing data transmission, the data occupies more bandwidth and introduces more overhead in different intermediate nodes. In order to overcome the problem of overhead in data transmission, the video content has to be compressed and transferred. There are many data compression techniques available, but suffers from the problem of accuracy. A video can be referred as the collection of frames and snapshot. Each snapshot has a number of frames and each frame occupies a certain amount of memory. If you consider the subsequent frames of any video, you can find only a minimum difference in the video content or visual features. By handling the visual feature variation a high-quality video compression is achieved.

Because of the video is transferred through the network and the network has fixed bandwidth. To improve the throughput of the network, the bandwidth must be utilized in an efficient manner. By utilizing the network bandwidth condition in data transmission, the efficiency of the video transmission can be achieved. Also, the video frame can be identified as an image. An image can be viewed as a container with multiple layers. The image has three different layers of red, green and blue. When you consider the subsequent images and verify the layer

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content, there will be little change in any one of the layer feature. The multi layer covariance matrix can be used to maintain the difference in the layer features of the image. The multi layer covariance matrix used to store the difference in color features and by computing the difference between them, the feature difference between two images can be obtained.

## METHODS

There are some methods has been discussed for the video compression and this section discusses some of the methods.

Low-complexity depth map compression in HEVC-based 3D video coding [1], discusses a low-complexity procedure is proposed to reduce the complication of depth map density in the high-efficiency video coding (HEVC)-based 3D video coding (3D-HEVC). Since the complexity map and the corresponding texture video represent the same scene in a 3D video, there is a high correlation between the coding information from depth map and texture video. The experimental examination is done to study depth map and video texture correlation in the coding information such as the motion vector and prediction mode. Based on the correlation, they suggest three efficient low-complexity methods, including early finish mode decision, adaptive search variety motion estimation (ME), and fast disparity estimation (DE). Experimental results show that the future algorithm can decrease about 66% computational difficulty with a negligible rate-distortion (RD) performance loss in comparison with the original 3D-HEVC encoder.

Video Compression Algorithm Using Motion Compensation Technique [2], video compression using motion compensation technique that reduces video data based on motion estimation from one frame to another. Motion recompense is an algorithmic method employed for the brainwashing of video data for video density. Motion compensation describes a frame regarding the transformation of a reference frame on the current surround. The orientation edge may be preceding in time or smooth from the future. The proposed method reduces the candidate of the prediction modes based on the Sum of Absolute Hadamard-Transformed Difference (SATD) between the original block and the inter-predicted block. The motion of each block is obtained based on the SATD value. The current frames are further reduced by using the combination of motion and most probable displacement. The proposed method reduces the number of motion in frames to either one or two. When descriptions container is correctly synthesized from previously stored images, the compression efficiency can be improved. Temporal redundancy is exploited so that not every frame of the video needs to be coded independently as a new image.

Parametric Video Density Scheme Using AR Based Surface Synthesis [10,11], a video coding arrangement based on the parametric density of texture is future. Each macro block is branded either as an edge block, or as a non-edge block containing texture. The non-edge blocks are coded by modeling them as an auto-regressive process (AR). By applying the AR model in the spatiotemporal domain, we safeguard both spatial as healthy as chronological consistency. Edge blocks are programmed using the standard H.264/AVC. The proposed algorithm achieves up to 54.52% more compression as compared to the standard H.264/AVC at the similar visual quality.

Optimizing Motion Compensated Prediction For Error Resilient Video Coding [3], worried with optimization of the motion salaried prediction framework to recover the error resilience of video coding for broadcast over lossy networks. First, precise end-to-end misrepresentation estimation is working to optimize both motion approximation and prediction inside an overall rate-distortion outline. Low complexity practical variations are proposed: a technique to approximate the top motion via simple falsehood and source coding rate representations, and a source-channel forecast method that uses the predictable decoder orientation frame for prediction. Second, orientation frame generation is reentered as a problem of strainer design to optimize the error pliability versus coding competence tradeoff. The singular cases of leaky prediction and biased prediction (i.e., finite impulse response filtering), are examined. A novel reference surround generation method, called widespread source-channel forecast, is proposed, which involves immeasurable impulse reply filtering.

A Better Low Multifaceted Spatially Scalable Acc-Dct Based Video Density Method [4], suggest a low multifaceted Scalable ACC-DCT based video density approach which tends to adventure hard the pertinent chronological joblessness in the video edges to improve density efficiency with less dispensation complexity. The video signal has high temporal redundancies due to the high correlation between successive frames. This redundancy has not been exposed enough to current video compression techniques. Our model consists of 3D to 2D transformation of the video frames that allows exploring the temporal redundancy of the video using 2D transforms and avoiding the computationally demanding motion compensation step. This change turns the spatial-temporal association of the video into high latitudinal correlation. Indeed, this method converts each collection of pictures (GOP) to one image (Accordion Representation) ultimately with in height spatial relationship. This perfect is also combined with up/down sampling method (SVC) which is based on a combination of the forward and retrograde type discrete cosine transform (DCT) coefficients. As this grain has various regularities for efficient calculation, a debauched algorithm of DCT-based Scalability notion is also proposed.

Three-Dimensional Penetration Map Motion Approximation and Compensation for 3D Video Compression [5], propose a new method to 3D depth plan motion guesstimate and compensation for 3D video density. 3D video provides representative vision also will be a feature of forthcoming video displays. The numerous kinds of 3D formats include multiview 3D, a single interpretation of a depth map, time separation multiple 3D, and so on. 3D video requires huge amounts of data and needs a countless deal of storing space to store 3D material. Also, when 3D video is conveyed, the huge quantity of data should be compressed to decrease bandwidth usage. To resolve this problematic, we assume single view with a profundity map 3D format and enterprise a 3D depth map density arrangement for 3D video. We reflect depth map motion estimate and compensation to realize temporal compression of 3D video.

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Video Compression by memetic algorithm [6], the position equation of Standard Particle Swarm Optimization is modified and used as step size comparison to find the best matching block in the present frame. To attain adaptive step size, time variable apathy weight is used in its place of constant inertia heaviness for getting true gesture vector dynamically. The period varying inertia weight is based up on preceding motion vectors. The step size reckoning is used to predict best corresponding macro block in the orientation frame on a macro chunk in the current frame for which motion vector is originated. The result of proposed technique is compared with existing block matching algorithms.

A New Video Density Method using DCT/DWT and SPIHT based on Accordion Representation [7], current a new video density method which tends to hard achievement the relevant progressive joblessness in the video to improve hardness efficiency with minimum dispensation complexity. It includes 3D (Three Dimension) to the 2D (Three Dimension) alteration of the video that allows traveling the temporal joblessness of the video using 2D transforms and evading the computationally difficult motion payment step. This alteration converts the three-dimensional and temporal correlation of the video signal into a high three-dimensional correlation. Indeed, this method transforms each assembly of movies into one picture finally with the high spatial association. SPIHT (Set Partitioning in Hierarchical Trees) exploits the possessions of the wavelet-transformed imageries to upsurge its efficiency. Thus, the De-correlation of the subsequent pictures by the DWT (Discrete Wavelet Transform) makes well-organized energy compaction and then produces a high video density ratio. Many untried tests had been conducted to prove the technique efficiency especially in high bit rate and with slow motion video.

Detection of Double Compression in MPEG-4 Videos Based on Markov Statistics [8], Markov founded features are accepted to detect double density artifacts, which suggest that the original video might have been interposed. The advantages and boundaries of double MPEG-4 compression finding are analyzed. Experimental consequences have demonstrated that our scheme outperforms most current methods.

All the methods discussed above has the problem of producing tampered video quality and produces poor video quality. Also, they could not achieve higher data compression ratio

## RESULTS

### Multilevel covariance video compression

The multi level covariance approach converts the video into some frames and for each frame, the method improves the quality by applying histogram equalization. The quality improved frames are converted into the matrix, and the method computes the deviation in feature to store them in the covariance matrix. Also, the method computes the texture variance to store them in the texture variance matrix. Based on both covariance matrix, the method decides whether the entire image has to be transferred or the covariance matrix has to be sent. The entire process can be split into three different stages namely preprocessing, covariance matrix generation and video compression.

The Figure 1, shows the architecture of multi level covariance measure based video compression. Also, the figure 1, depicts the stages of the proposed approach in detail.

### Preprocessing

At this stage, the input video is taken into processing and splits the entire video into some sub-sampling images. The generated image is applied with histogram equalization, which improves the quality image and removes the noise from the image. The generated image will be used to perform feature extraction in the next stage.

Pseudo Code of Preprocessing:
Input: Video v.
Output: Frame set Fs.
Start
Read Input Video V.
Split Video into Frames Fs.
Fs = $\int_{i=1}^{Video\ Length} (\sum Frames \in Fs) \cup Frames\,(i)$
For each video Fi from Fs
Perform Histogram Equalization.
Fs = $\int_{i=1}^{size\,(fs)} HistogramEqualize\,(Fs(i))$
End
Stop.

The preprocessing algorithm discussed above converts the video into frame set and for each frame available, the method improves the quality of the image by applying histogram equalization.

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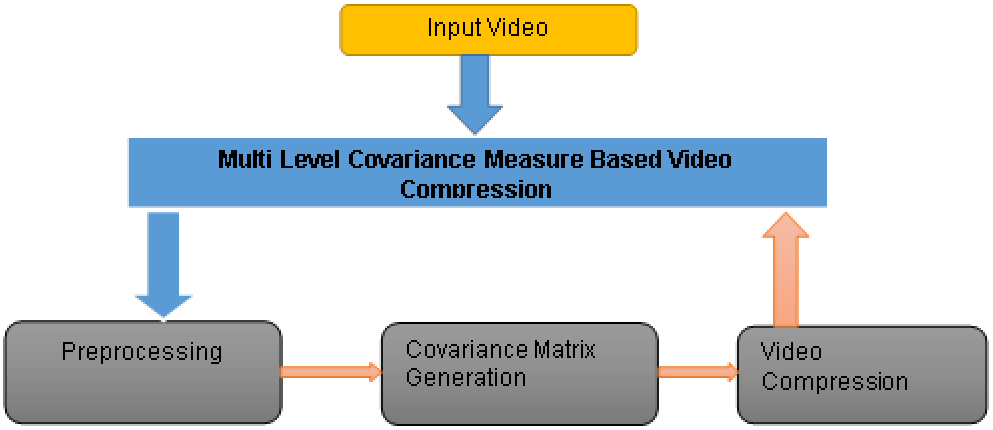


**Fig1: Architecture of multi level covariance video compression**

## Co-variance Matrix Generation

For any two successive frames being generated, the method extracts the RGB features into three different matrices. From the matrix being generated, the method computes the matching between the pixels of two different images color values. The variance of the value is stored in the matrix. Finally the covariance of the color values is computed. Similarly the method generates the gray scale images and computes the texture variance between the frames.

Pseudo Code of Covariance Matrix Generation:

Input: Frame set Fs

Start

Initialize Covariance Matrix Rcm, Tcm

For each frame Fi from Frame set Fs

Read Previous Frame $F_{i-1}$

Generate Rgb matrix Rm = RGB(Fi).

Generate Rgb Matrix Rm1 = RGB($F_{i-1}$).

Compute Rgb Covariance.

Rcm = $\int_{i=1}^{size(Rm)} Dist(Rm(i), Rm1(i))$

Convert Fi into Gray Scale.

Convert $F_{i-1}$ into Gray scale.

Compute Texture Covariance.

Tcm = $\int_{i=1}^{size(Fi)} Dist(Fi(i), Fi-1(i))$

End

Stop.

The covariance matrix generation algorithm computes the multi-layer rgb covariance and texture covariance between two different frames considered. The computed covariance value is stored in the concern matrix which will be used to perform video compression.

## Video Compression

The video compression approach performs a comparison of texture covariance and color covariance measures, if the texture covariance has more difference than the particular threshold then the method transmits the complete frame otherwise the method generates a frame with the new texture and color values which have been varying. This reduces the bandwidth occupancy and produces good compression ratio.

Pseudo Code of Video Compression:

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Input: Frame Set Fs, RGB Covariance matrix Rcm, Texture Covariance Matrix Tcm.
Output; Compressed Video Cv
Start
Compute Texture Covariance Similarity.

$$Tcs = \frac{\sum_{i=1}^{size(Tcm)} Tcm(i) == Tcm1(i)}{size(Tcm)} \times 100$$

If Tcs>STh then
Compute RGB covariance Similarity.

$$Rcs = \frac{\sum_{i=1}^{size(Rcm)} Rcm(i) == Rcm1(i)}{size(Rcm)} \times 100$$

If Rcs>RTh then
Transmit the covariance matrix.

End
Else
Transmit the frame.
End
Stop.

The video compression technique, computes the texture covariance similarity and RGB covariance similarity values. If the texture similarity is less than the threshold then the method transmits the frame otherwise the method transmits only the covariance matrix. On the other side, the receiver could reframe the frame using the previous frame and covariance matrix.

## DISCUSSION

The proposed multi level covariance measure based video compression has been implemented using Matlab and the performance of the methods has been evaluated using different videos. The methods have produced efficient result in compression ration and reduce the distortion ratio than other methods.

The Figure-2 shows the comparison of video compression ratio being achieved by different methods and it shows clearly that the proposed methods have produced more video compression ratio than other methods.

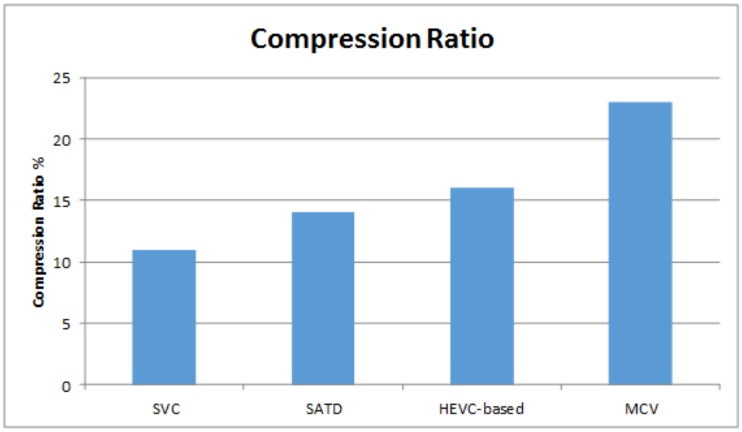


**Fig. 2: Comparison of video compression ratio**



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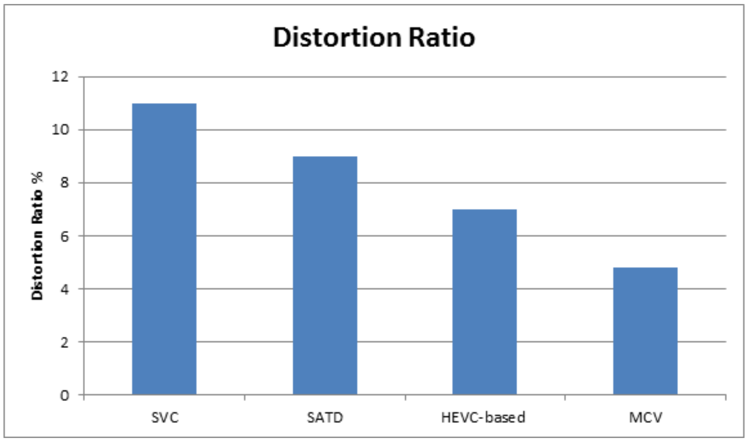


**Fig. 3: Comparison of distortion ratio**

The Figure-3 shows the comparison of distortion ratio being produced by different methods and it shows clearly that the proposed method has produced less distortion ratio, and the methods reduce the distortion ratio rapidly.

**Table 1: Comparison of various video compression measures**

| Method | Compression Ratio % | Distortion Ratio % | Time Complexity in seconds |
|---|---|---|---|
| SVC | 11 | 11 | 87 |
| SATD | 14 | 9 | 81 |
| HEVC-based | 16 | 7 | 76 |
| MCV | 23 | 4.8 | 56 |

The Table-1, shows the comparison of different video compression measures produced, and it shows that the proposed method has produced an efficient result.

## CONCLUSION

The author proposed a multi level covariance measure based video compression. The method first splits the video into some frames and for each successive frame, the method computes the co-variance matrix. The method generates three different co-variance matrix, where each matrix maintains the variance of RGB layers of the frames. The method extracts the features of RGB image and at each layer the method computes the variance of feature values. Based on extracted features, the method computes the co-variance measure between all the three layer feature matrixes. Based on the measure computed, the method identified variance of feature and based on identified feature variance the method sends the core frame or subsequent frame.

## CONFLICT OF INTEREST
The authors declare no conflict of interests.

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None

## FINANCIAL DISCLOSURE
None.

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