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PLENOPTIC IMAGE COMPRESSION FOR IMPROVED CORRELATION STABILITY USING IMPROVISED ACO IN WAVELET DOMAIN

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ABSTRACT

Digital images have become popular for transferring, sharing, storing and visual information and hence high speed compression techniques are needed because the uncompressed multimedia (graphics, audio and video) information requires significant capacity limit and transmission transfer speed. . Images captured by a light field or plenoptic camera provide more information about the scene than traditional images, like alternative points of view and focus planes. The effective resolution of the plenoptic camera is very low compared to the image captured. Is a novel visual representation that contains more information than standard digital images. In this work existing compression schemes are applied on plenoptic images and various functions like mean square error, peak signal to noise ratio, correlation and standard deviation can be determined and its behavior is analysed.

INDEX TERMS- ***Plenoptic image, JPEG, DCT, JPEG2000, ACO, Compression.***

I. INTRODUCTION

An image is basically a 2-D signal processed by the human visual system. The signals representing images are generally in analog form. In any case, for processing, storage and transmission by computer applications, they are changed over from analog to digital form. A digital image is fundamentally a 2-Dimensional array of pixels [1]. Images form the significant part of information, especially in remote sensing, biomedical and video conferencing applications. The digital light field camera was introduced by Ren Ng in [4], where a micro lens array was used to sample angular information about the light rays. Images captured by a light field or plenoptic camera provide more information about the scene than traditional images, like alternative points of view and focus planes. The effective resolution of the plenoptic camera is very low compared to the image captured [5-8]. This is because it sacrifices spatial resolution to capture information about the angle of the light ray, which is useful in many applications. Many works attempts to increase the effective resolution using super-resolution techniques [9-10].

Different focal planes and points of view can be recovered by a rendering algorithm. This increase in the information however requires more storage space in relation to the effective image resolution. There are a few researches in compression of this new data representation [11-14], but the path to standards devoted to this specific type of image is a long road. Standards like JPEG [15] and JPEG2000 [16] are very well established, including hardware and image editing software support. Using them is advantageous on the commercial point of view, since adapting them are cheaper than establishing a new standard. There is also the SPIHT, which is a fast algorithm with better results than JPEG, but it does not have any commercial version [17- 18].

The main contribution of this work is the study of the plenoptic image compression behavior. It is used existing compression schemes and existing rendering algorithms without modification. This replicates a real scenario where commercial cameras are modified to capture plenoptic images, and seeks to answer if the application would be not hindered by the compression.

II. PLENOPTIC IMAGE

Dust, rain, fog, snow, murky water and insufficient light can cause even the most sophisticated vision systems to fail. Plenoptic cameras offer an appealing alternative to conventional imagery by gathering significantly lighter over a wider depth of field, and capturing a rich 4D light field structure that encodes textural and geometric information. The plenoptic image is composed by a series of microimages. The same feature can be perceived in various microimages, in slightly different positions. The microimages are arranged in a hexagonal pattern which increases the utilization of the sensor. If the focus on the main lens is manually adjusted, the feature can move or change multiplicity across the micro-images. The compression is applied on this image, and then recovered to be used for the rendering algorithm.

Figure 1. Example of plenoptic image

III. COMPRESSION SCHEMES

A. JPEG

The JPEG standard illustrated in figure .is based on the use of the DCT in 8x8 blocks, followed by quantization and entropy encoding. The block approach leads to a better correlation of the input data, enhancing the algorithm performance. But this leads to the blocking artifacts where discontinuities appear between the blocks.

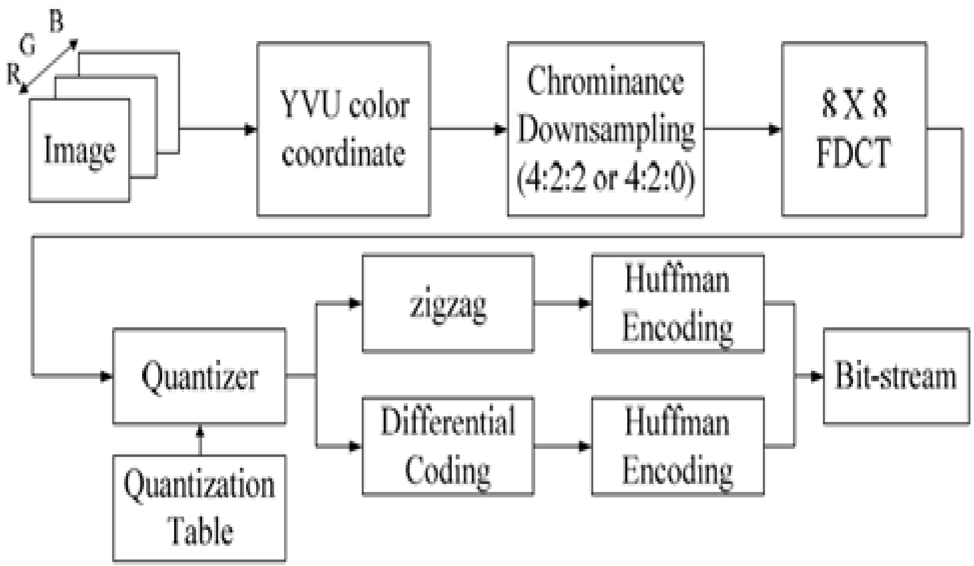


Figure 2. JPEG Compression Encoder

B. SPIHT

The SPIHT is based on the wavelet transform, and uses a tree representation for the coefficients. It was introduced by Said and Pearlman as a refined version of the EZW. The energy is concentrated near the root node so the descending nodes usually have less energy than the parent node. The compression is achieved by partitioning the tree, pruning nodes below a certain threshold. Advantages of this scheme are a fast progressive image transmission and an exact bit rate control.

C. JPEG2000

The JPEG2000 is also based on the wavelet transform, and can achieve up to 90% of compression without loss of quality. It uses the EBCOT (embedded block coding with optimized truncation) and is capable of lossy and lossless compression.

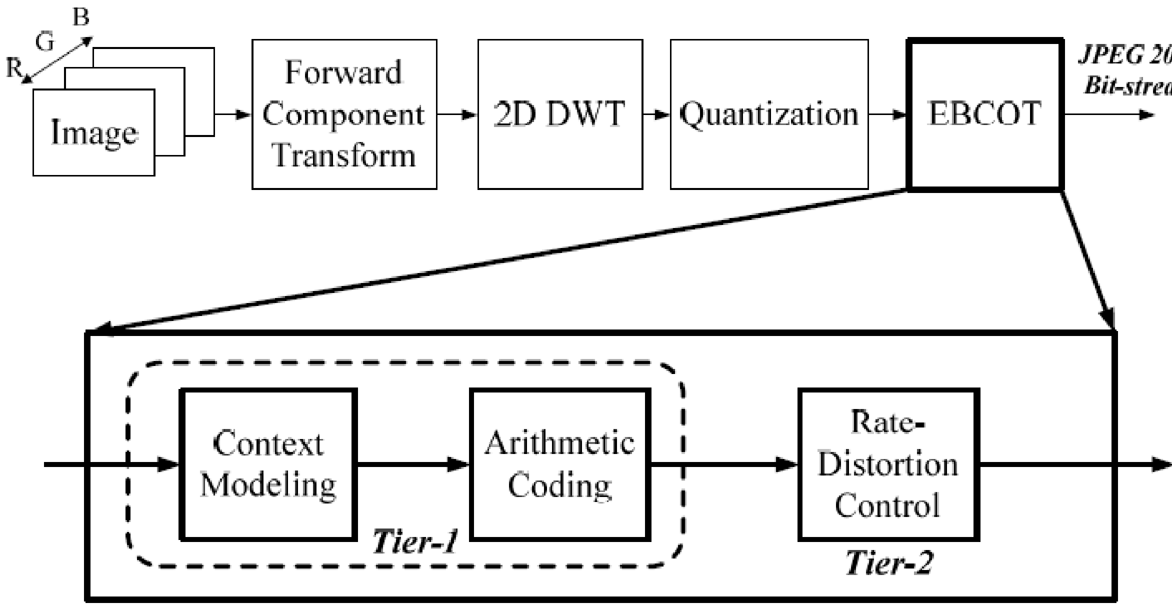


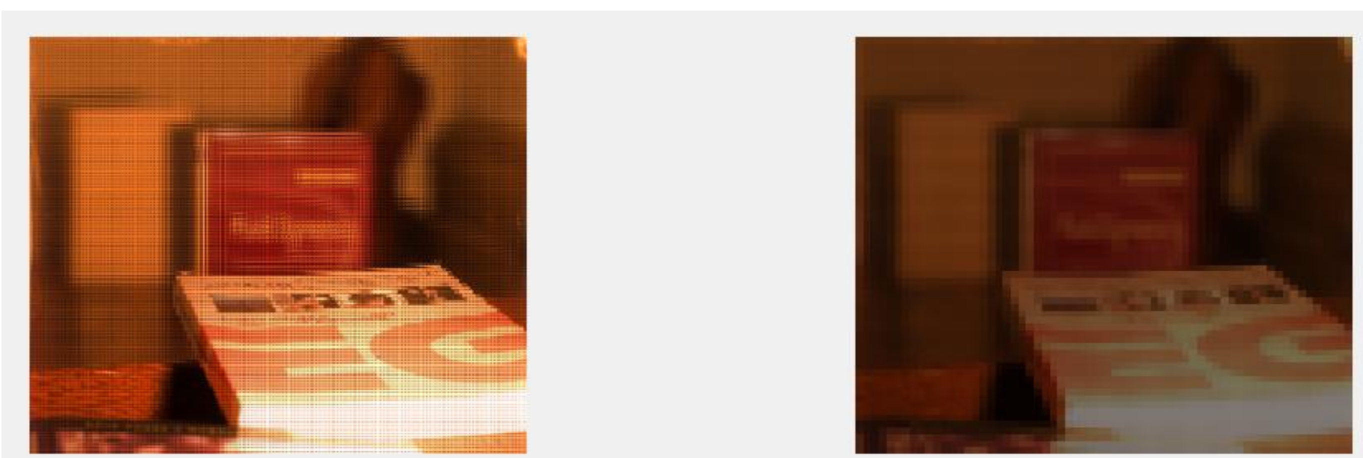
Figure 3. JPEG2000 Compression Encoder

IV. RESULTS

The plenoptic image is compressed with three methods namely SPIHT, JPEG, JPEG2000 with the proposed ACO method. Then we compare their image results using PSNR, MSE, correlation.

4.1.1 Results for SPHIT Compression

The below given section, shows the results for SPIHT based compression of plenoptic image.



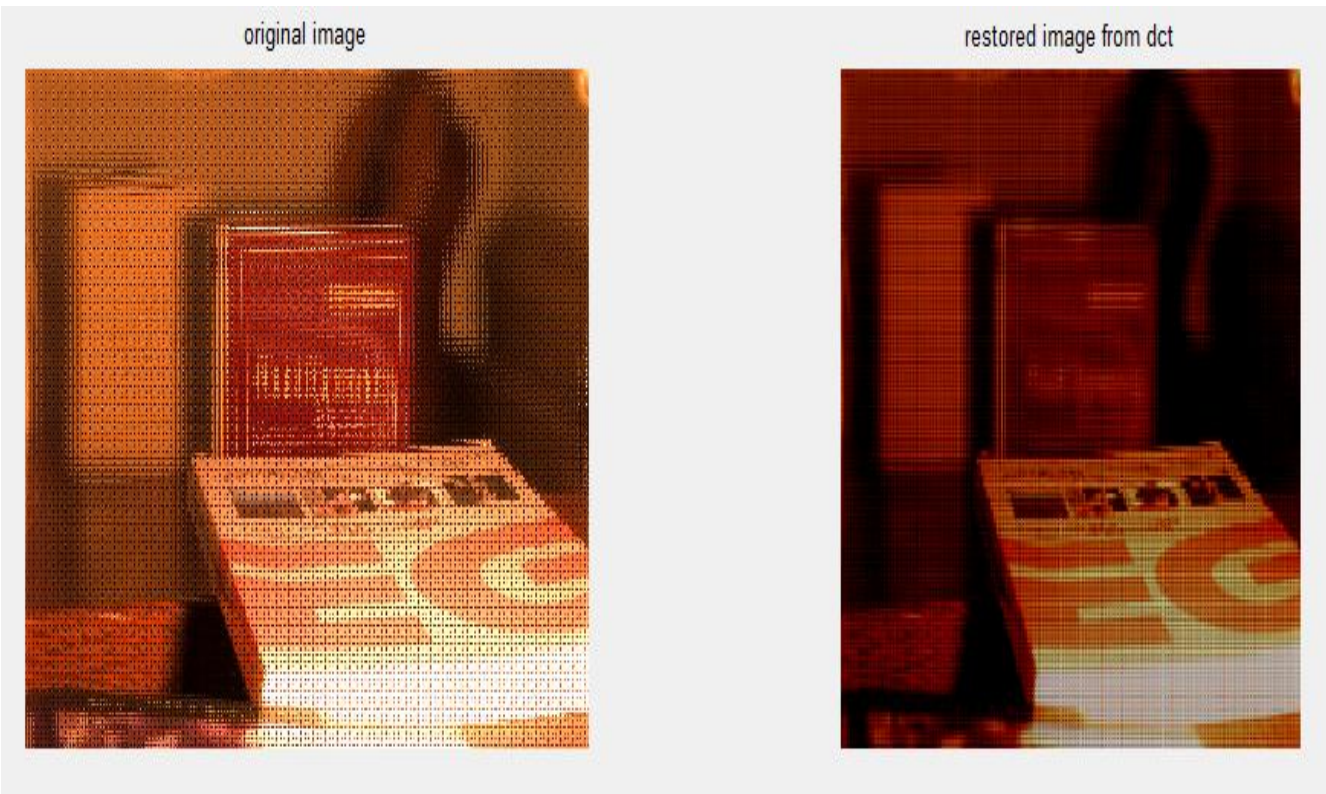
(a) Original (b) Compressed

Figure 4.1 shows the results of SPIHT Compression on the plenoptic image

The above figure shows the results of compression on the crayon plenoptic image using the SPIHT method the original image (a) shows the actual state of the image with black rows and columns and the compressed state shows the reduction in the blank pixels, however the over appearance of the image is perceived to be block as the compression over saturates.

4.1.2 Results for DCT Compression

The below given section, shows the results for DCT based compression of plenoptic image.



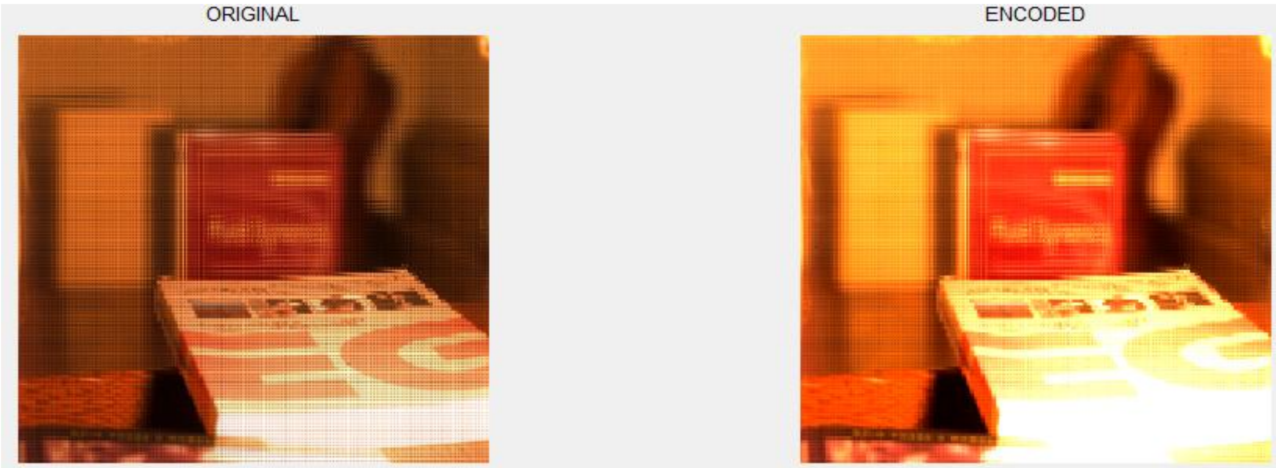
(a) Original **(b) Compressed**

Figure 4.2 shows the results of DCT Compression on the plenoptic image

The above figure shows the results of compression on the crayon plenoptic image using the DCT method the original image (a) shows the actual state of the image with black rows and columns and the compressed state shows reduction in the colour values of the image, the over appearance of the image is perceived to be dimmed as intensity of the pixels are reduced. This is due to the fact that the DCT compression is based on averaging the pixel intensity of the DCT block.

4.1.3 Results for JPEG2000 Compression

The below given section, shows the results for JPEG2000 based compression of plenoptic image .

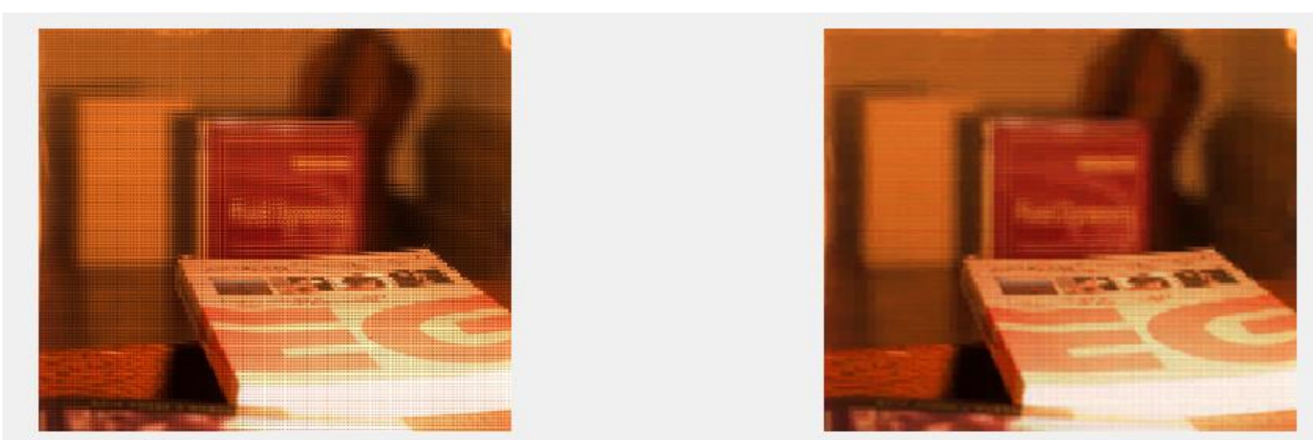


(a)Original **(b) Compressed**

Figure 4.3 shows the results of JPEG2000 Compression on the plenoptic image

The above figure shows the results of compression on the crayon plenoptic image using the JPEG2000 method the original image (a) shows the actual state of the image with black rows and columns and the compressed state shows enhancement in brightness of the plenoptic pixels, the black pixels are still visible showing the uneven compression of the image. The visual perception is improved, but the overall quality is not up to mark as major part of the image data shows uncompressed data.

4.1.4 Results for Proposed ACO Compression



(a) Original **(b) Compressed**

Figure 4.4 shows the results of proposed ACO Compression on the plenoptic image

The above figure shows the results of compression on the crayon plenoptic image using the proposed ACO method the original image (a) shows the actual state of the image with black rows and columns. The visual perception is improved, but the overall quality is up to mark as major part of the image data shows uncompressed data.

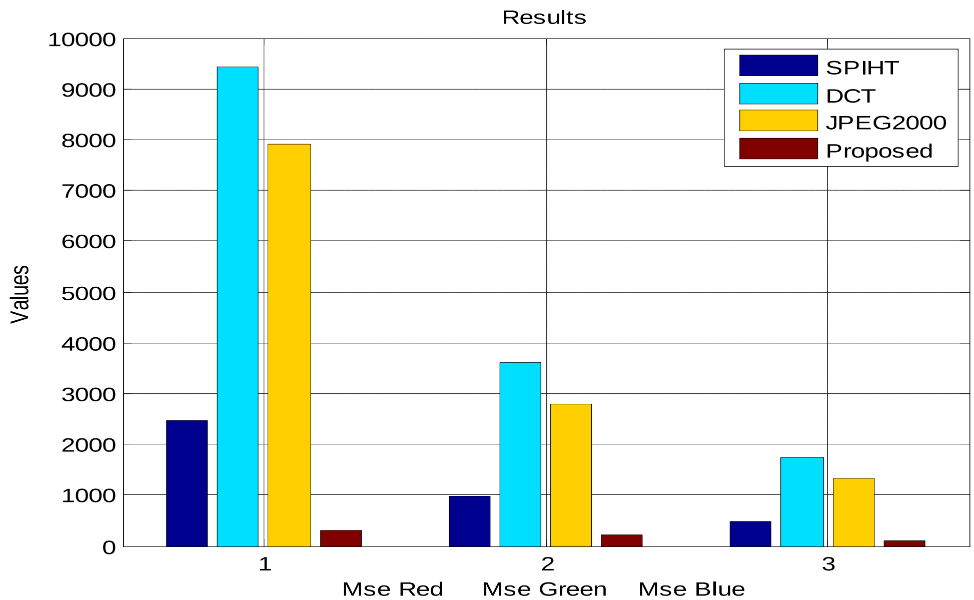


Fig 4.5 shows the graphical MSE comparison of all methods

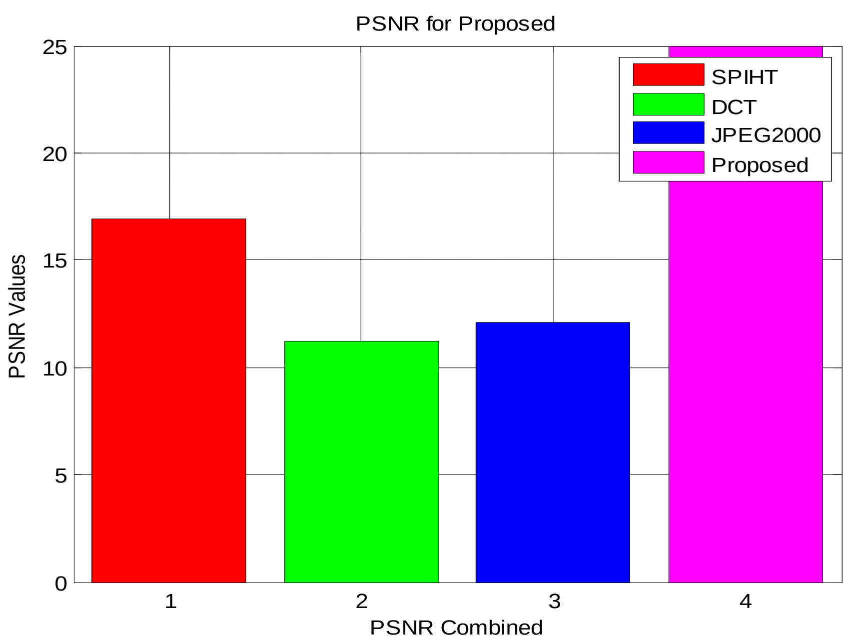


Fig 4.6 shows the graphical PSNR comparison of all the methods

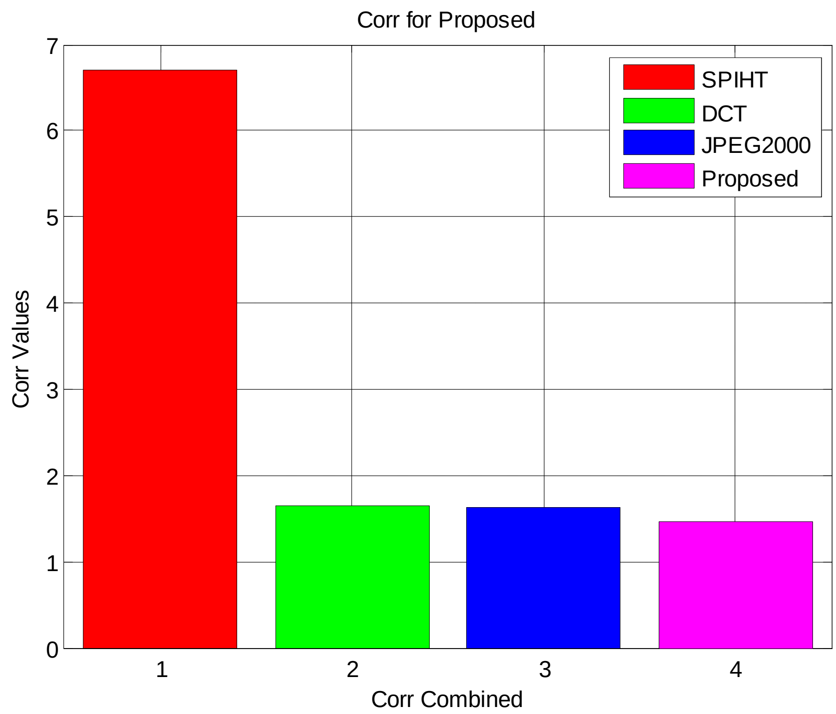


Fig 4.7 shows the graphical correlation comparison of all methods

V. CONCLUSIONS

The main objective of this work is to establish the best compression algorithm for applications uses the plenoptic images. It is known that the best compression performance for standard images belongs to the JPEG2000, which is matured over the years. This knowledge of compression holds true for plenoptic images as well. As seen in the results of compression graphs, SPIHT was a good alternative for high compression ratios as compared to the JPEG and has a lower complexity than JPEG2000. The SPIHT has a good alternative for applications with limited bandwidth. In general the results of all the three methods and the proposed ACO method shows the PSNR, MSE and correlation values in the above comparison graphs.

In future, the image compression will include many modern features including improved low bit-rate compression performance, lossless and lossy compression, continuous tone and bi-level compression of large images, single decompression architecture, transmission in noisy environments including robustness to bit-errors, progressive transmission by pixel accuracy and resolution, content-based description, and protective image security.

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