CHAPTER 7: RESULTS ANALYSIS AND FUTURE SCOPE

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7.2 ANALYSIS OF RESULTS
7.3 CONCLUSIONS
7.4 FUTURE SCOPE
7.1 RESULTS

The results projected in the fourth, fifth and sixth chapters, proposing the compression algorithms employing Adaptive DCT compression, Adapted DWT compression and Adapted HWT compression using both standard (daubechies and symlet) wavelets as well as the evolved Adstringo wavelets (or Adslets) are now summarized together for an overall comprehensive view. For this purpose, the results are collectively projected graphically in Fig. 7.1-7.12 and Tables 7.1-7.4 below in terms of:

1. PSNR Comparison for each image using Standard Wavelets for all the Proposed Algorithms:
   - The performance of each wavelet (db2, db3, db4, sym4, db5 and sym5) in implementing all the proposed compression algorithms is compared graphically on all the test images. (Illustrated in Fig. 7.1, 7.3, 7.5 and 7.7 for LENA, PEPPERS, TWIN TOWERS and WHEEL respectively)

2. PSNR and CR Comparison for each image using Adslets for all the Proposed Algorithms
   - The performance of each wavelet (Adslet 1.4, Adslet 2.5 and Adslet 3.6) in implementing all the proposed compression algorithms is compared graphically on all the test images (Illustrated in Fig. 7.2, 7.4, 7.6 and 7.8 for LENA, PEPPERS, TWIN TOWERS and WHEEL respectively)

3. PSNR Comparison by wavelet employing a particular WT for Compression
   - The performance of each Transform (Illustrated in Table 7.1 and Fig. 7.9 for DWT, Table 7.2 and Fig. 7.10 for ADWT, Table 7.3 and Fig. 7.11 for HWT, Table 7.4 and Fig. 7.12 for AHWT) in implementing the algorithms
using different wavelets (db2, db3, db4, sym4, db5, sym5 and Adslets) is compared graphically on all test images.

Fig.7.1: PSNR (in dB) Comparison for LENA using Standard Wavelets for all the Algorithms
Fig. 7.2: PSNR (in dB) and CR Comparison for LENA using Adslets for all the Algorithms.
Fig. 7.3: PSNR (in dB) Comparison for PEPPERS using standard wavelets for all the Algorithms
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Fig. 7.7: PSNR (in dB) Comparison for WHEEL using standard wavelets for all the Algorithms
Fig. 7.8: PSNR (in dB) and CR Comparison for WHEEL using Adslets for all the Algorithms
Table 7.1: PSNR (in dB) Comparison by wavelet for DWT Compression

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Fig.7.9: PSNR (in dB) Comparison by wavelet for DWT Compression
Table 7.2: PSNR (in dB) Comparison by wavelet for ADWT Compression

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Fig. 7.10: PSNR (in dB) Comparison by wavelet for ADWT Compression
Table 7.3: PSNR (in dB) Comparison by wavelet for HWT Compression

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Fig. 7.11: PSNR (in dB) Comparison by wavelet for HWT Compression
Table 7.4: PSNR (in dB) Comparison by wavelet for AHWT Compression

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Fig. 7.12: PSNR (in dB) Comparison by wavelet for AHWT Compression
7.2 ANALYSIS OF RESULTS:

All the algorithms have been validated on four carefully chosen test images (Lena, Peppers, Wheel and Own image, each having distinct features) such that the algorithms may be subjected to a variety of image features.

Analyzing the results given in section 7.1, the following observations may be made:

- The standard JPEG Algorithm has outperformed the proposed algorithms using Adaptive DCT compression and Adapted DWT in terms of PSNR values. However, **Adapted HWT compression has shown significant improvement in PSNR performance, comparable to that of JPEG**. (Fig.7.1,7.3,7.5 & 7.7)

- The results obtained using the adapted image are far superior to those obtained from the original image. (Fig.7.1,7.3,7.5 &7.7)

- The visual quality of the decompressed images obtained after implementing the proposed compression algorithms is well preserved in spite of lower PSNR values.

- The Compression Ratio achieved is much higher in case of the proposed algorithms when compared to JPEG. (Fig.7.2,7.4,7.6 & 7.8).

- Adapted DWT is performing better than ADCT in terms of PSNR and CR and better than JPEG in terms of CR even at higher quantization levels.

- Adapted DWT is giving better PSNR for the same CR compared to adaptive DCT. At the same time, Adapted HWT is giving better PSNR for the same CR compared to adaptive DWT. Hence, the use of DWT overcomes the limitations of
the DCT and the use of HWT further overcomes the limitations of the DWT in order to improve the efficiency of the proposed image compression algorithms.

- The significance of better compression performance of the proposed algorithms can be viewed in the perspective of the visual signal content of the images.

- The standard wavelets employed have performed well with some transforms but have showed inconsistent results with the HWT. (For eg. db5 on Lena(Fig.7.1), sym5 on Peppers(Fig.7.3), sym4 on Twin Towers (Fig.7.5) and db4 on Wheel(Fig.7.7)).

- **The newly designed adslets have given a consistence compression performance for all the algorithms**, in terms of the measurement metrics- PSNR and CR. (Figs.7.2,7.4,7.6 & 7.8)

- The Adslets in conjunction with the HWT as well as the AHWT have recorded a consistently high PSNR for all images in contrast to the performance of the standard wavelets.

- The visual quality of the decompressed images is also superior for HWT-based compression, in general. In particular, these results are good for Adslets in contrast with the relatively poor results for standard wavelets.

- Also, the adslets have given a consistence performance on all types of images, irrespective of their features, in terms of the measurement metrics- PSNR and CR. (Tables 7.1,7.2,7.3 & 7.4 and Figs.7.9,7.10,7.11 & 7.12)

- The standard wavelets employed have performed well on some images but have showed inconsistent results on other images. (For eg. db5 on Lena (Fig.7.1), sym5
on Peppers (Fig.7.3), sym4 on Twin Towers (Fig.7.5) and db4 on Wheel (Fig.7.7)).

- Observing the performance of the Adslets, it can be seen that at least one Adslet has shown a good PSNR performance on one or more of the test images. Hence, the evolved Adslet family, as a whole, can be attributed a consistently satisfactory performance on each and every image, irrespective of its dominant features.

- It is observed that, while employing Adslets for compression, the results obtained are consistently good on all images in spite of the varying features. Hence, the algorithms are image-independent and can be used effectively on any image.

- The above observations regarding the Adstringo wavelets can be highlighted in context of the fact that they have been designed particularly to suit image compression applications. This feature assumes importance when it is considered that the available standard wavelets are all general purpose wavelets and have not been designed specifically for image compression applications.

Conclusions

Based on the results and inferences presented in the previous section, the contributions made by the present work maybe stated as follows:

- The proposed algorithms based on Adapted sampling, DWT/HWT and SPIHT encoding have performed better than the existing compression methods. This behavior can be attributed to the construction of the adapted image which retains the visually significant features of the particular image by employing psycho visual redundancy.
In view of the gradual improvement in performance of the proposed image compression algorithms in selecting DWT over DCT and HWT over DWT, it can be concluded that the use of HWT in image compression algorithm results in superior quality of the decompressed image.

The newly evolved wavelets, the Adstringo wavelets or the Adslets can be said to be superior to the standard wavelets, daubechies as well as symlet as far as compression performance is concerned.

The results and inferences presented in the previous section support the proposed image compression algorithms in their claim of achieving better Compression Ratios while preserving the visually significant details in the image.

7.4 FUTURE SCOPE:

The proposed algorithms have been tested on standard images and hence, further investigation is required on medical images for lossless compression.

The efficacy of the algorithm in compressing video images needs to be investigated.

A lifting scheme may be incorporated into the proposed algorithms to reduce their computational complexity.

The evolved Adslet family can be further extended for still more efficient compression performance.