

CONCLUSIONS AND FUTURE SCOPE

7.1. CONCLUSIONS

Three transform method (CT, DCT, and SVD) - Proposed Method1

Proposed method (CT, DCT, and SVD) is more imperceptible, robust and reliable compared to existing method (DWT, DCT, SVD) as per Table 3.1 and Figure 3.3. Structural Similarity and PSNR is increased in both the cases. Increased PSNR is justification for increase imperceptibility and increased robustness of proposed algorithms.

Four transform method (DWT, CT, DCT, and SVD) - Proposed Method2

When DWT is also added to the CT, DCT and SVD it also includes the multi-resolution and localization in space and time properties of the proposed1. Hence this is much more robust and reliable than proposed1 as shown in Figure 3.7 and Table 3.2.

Validation

Proposed1 and 2 are validated by applying Low-pass, Median and High-pass Filtering, pyramidal, JPEG, JPEG2000 compression, Cropping and Gaussian Noise. Out of filtering attacks median has less impact on watermarked images as per Table 4.1 and Figure 4.2 - 4.3 etc. High pass filter is distorting more. This distortion is less in the proposed methods compared to existing. JPEG2000 results are better. Noise and cropping performance also improved in the proposed methods.

Security for Medical Images

These methods are working well with modalities X-ray, CT, US and MRI as per Table 5.1 – 5.13 and Table 6.1 – 6.13 etc.. When they are attacked while transmission also security is restoring.

In this dissertation work two hybrid watermarking algorithms are proposed by using CT, DCT, DWT & SVD etc. Their performance is compared with the existing by using robustness and imperceptibility. They are also validated by applying attacks such as filtering,

compression, cropping, and noise. After validation, their suitability for medical images is verified in case of single and multi modalities.

The proposed methods are working well in case of medical imaging modalities. In all the case metrics are improved compared to existing methods. These facts are also concluded from the Table 7.1 and 7.2. These tables represent the performance improvement with the proposed methods compared to many other existing methods. Both PSNR and Structural Similarity drastically improved with our methods compared to existing.

Table 7.1 PSNR Comparison of Proposed Methods with Existing Methods

Paper No.	Name of the Author(s)	Used original image in Existing paper	Image modality used in proposed method(s)	Considered Transforms for combination	PSNR[dB]		
					Existing Method	CT-DCT-SVD (Proposed1)	DWT-CT-DCT-SVD (Proposed2)
1	P.S.Murthy	Lena	Lena	DWT-DCT-SVD	38.79	57.6596	65.8233
2	Farzad.G	Lena	Lena	DCT-DWT-SVD	39.79	57.6596	65.8233
3	A.K.Singh	Brain(CT)	Brain (CT)	DWT-DCT-SVD	40.75	61.72	68.82
4	A.Kaushik	Chest(CT)	Brain (CT)	CT-SVD	39.52	60.54	67.92
5	A.Sharma	Brain (MRI)	Spinal cord (MRI)	DWT-DCT	41.54	62.35	69.99
6	S.Maumder	Lena	Lena	CT-SVD	33.79	57.6596	65.8233
7	S.Azizi	Vegetable	Lena	CT-SVD	33.79	57.6596	65.8233
8	Bijan.F	Cat	Lena	CT-DCT	36.79	57.6596	65.8233
9	Rajalaxmi.C	Lena	Lena	DCT-SVD	35	57.6596	65.8233

Table 7.2 Structural Similarity Comparison of Proposed Methods with Existing Methods

Paper No.	Name of the Author(s)	Used original image in Existing paper	Image modality used in proposed method(s)	Considered Transforms for combination	Structural Similarity		
					Existing Method	CT-DCT-SVD (Proposed1)	DWT-CT-DCT-SVD (Proposed2)
1	P.S.Murthy	Lena	Lena	DWT-DCT-SVD	0.9851	0.9981	0.9991
2	Farzad.G	Lena	Lena	DCT-DWT-SVD	0.9951	0.9981	0.9991
3	A.K.Singh	Brain(CT)	Brain (CT)	DWT-DCT-SVD	0.9988	0.9993	0.9995
4	A.Kaushik	Chest(CT)	Brain (CT)	CT-SVD	0.9986	0.9991	0.9993
5	A.Sharma	Brain (MRI)	Spinal cord (MRI)	DWT-DCT	0.9991	0.9994	0.9998
6	S.Maumder	Lena	Lena	CT-SVD	0.7751	0.9981	0.9991
7	S.Azizi	Vegetable	Lena	CT-SVD	0.7751	0.9981	0.9991
8	Bijan.F	Cat	Lena	CT-DCT	0.8851	0.9981	0.9991
9	Rajalaxmi.C	Lena	Lena	DCT-SVD	0.7551	0.9881	0.9981

- ❖ Proposed method CT, DCT, SVD is more imperceptible and robust compared to existing method DWT,DCT, SVD due to directionality and anisotropy properties of CT
- ❖ The watermark capacity also increased due to application of transformation and optimization of coefficients and their placement.
- ❖ Error (MSE) present is also less compared to the existing Method. This is due to the replacement of existing DWT with CT. DWT can consider the scale issues but not curved information. Whereas CT covers curved information. DCT covers compaction and SVD takes care of the Eigen values. Hence this combination of hybrid algorithm producing better results than the existing one.

- ❖ When DWT is also added to the CT, DCT and SVD it also includes the multi-resolution and localization in space and time properties to the proposed1. Hence it is much more robust and imperceptible than proposed1.
- ❖ Out of filtering attacks median filtering has less impact on watermarked image. High pass filtering is distorting more. This distortion is less in the proposed methods compared to existing.
- ❖ In compression, JPEG200 results are better than other compression attacks like JPEG and Pyramidal.
- ❖ Noise and cropping performance also improved in the proposed methods.
- ❖ These methods are working well for modalities such as X-ray, CT, Ultrasound and MRI. When they are attacked while transmission also security is restoring. In the proposed case patient information is added as watermark and hence EHR need not transfer to the other end.

7.2. FUTURE SCOPE

The performance can be further increased

- The work can be extended with multiple watermarks and also adding secure key so that security can enhanced.
- This can be implemented with large datasets using machine learning algorithms to improve the quality of reconstructed image also reduces distortion.
- An optimization can be performed by using evolutionary techniques which further improves security and reconstruction of watermark.