MULTI-RESOLUTION SVD BASED INVERTIBLE DIGITAL IMAGE WATERMARKING USING DUAL TREE COMPLEX WAVELET TRANSFORM

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Abstract

This paper proposes a new way of performing the image watermarking algorithm using Dual tree complex wavelet transform based on the multi-resolution singular value decomposition method. The basic reason to choose multi-resolution singular value decomposition (SVD) in combination with dual tree complex wavelet transform (DT-CWT) is due to its efficient and enriched performance towards the common image attacks like Median and Gaussian. Also the multi-resolution SVD will enhance stability in the singular values of an image. Here, the performance of watermarking is evaluated by considering the image quality metrics like Root Mean Square Error (RMSE), and Peak Signal to Noise Ratio (PSNR).

Index Terms: *Multi-Resolution SVD, Dual Tree Complex Wavelet Transform (DT-CWT), Root Mean Square Error (RMSE), Peak Signal to Noise Ratio (PSNR).*

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1. INTRODUCTION

Now a day's data hiding is a challenging task in terms of providing services to the particular authorised entities. In this regards image watermarking plays an important role to maintain authorship and rigid nature in the secured information. The process of watermarking can be categorized into two different ways that is visible or invisible watermarking. In the visible watermarking situation the watermark like data may be printed on the image or in the case of invisible watermarking the watermark is merged into the cover image, and it will appears as normal image to un-authorized persons. Several researches had shown their contribution towards enhancing the robustness in authorised information and also create interest in developing the new algorithms for increasing the reliability. In this scenario, one such approach is wavelets which cause revolutionary impact on the image processing nevertheless the image watermarking. Y. Wang *et.al.*[1] have discussed a non-blind digital image watermarking algorithm based on discrete wavelet transform, It results about 38.7744dB of PSNR and an amount of RMSE is 8.6233. Merely in case of DWT, due to the process of down sampling during decomposition we loss the trueness of the watermark image. The drawbacks in the DWT can be overcome by using SWT, Elizabeth Chang *et.al*,[2], proposed a method on SWT and it results a PSNR of 38.7847dB and RMSE of 8.6231, but the problem with SWT is that it considers all the redundant information in the image. This will results more memory requirement. To overcome the weakness of wavelets in higher dimensions, E. Ganic *et.al.*[3], proposed a proposed an image watermarking technique based on DWT-SVD, and it results PSNR of 39.3011 and the amount of RMSE is 5.9702. C. Yuan *at.el.*[4] proposed a SWT-SVD domain watermarking and it will results 39.4018dB and the amount of RMSE is 8.0589. In this paper we proposed a method to enhance the performance of multi-resolution images watermarking named as Multi-resolution SVD based invertible digital image watermarking using Dual Tree Complex Wavelet Transform.

1.1 PROPOSED METHOD

The main drawback of discrete wavelet transform is its inadequate directional sensitivity and also it shows negative impact on shift invariance property. The reason behind to

choose the complex wavelet transform is, it will solve the problem of shift invariance in an effective manner. Unfortunately we are unable to reconstruct the original watermarked image, in order to fulfil this requirement the concept dual tree was introduced into the existing one. Now the dual tree complex wavelet transform perform the image decomposition in an enriched manner. Moreover the efficiency of the DT-CWT technique can be emphasized by introducing the concept called singular value decomposition (SVD). The purpose of choosing the SVD is that, it can represent intrinsic algebraic properties in an effective manner and also these singular values of an image boost up the stability. Merely the image watermarking using DT-CWT based on SVD impinges the performance of multi-resolution images.

1.2 PROPOSED WATERMARKING ALGORITHM

i. Embedding the Watermark:

In the process of embedding the watermark image into a cover image we utilize the DT-CWT and the multi-resolution SVD for the sake of providing transparency. The process of embedding the watermark is as shown in Figure1.

The transparency is achieved of efficiently decompose the image with multi-resolutions, but normal SVD approach can't meet such requirement. In order to achieve high degree of security by maintaining each and every resolution in the image that is going to be watermarked. Initially, perform image resizing operation to both cover image and watermark image to make sure that watermarked image should be appeared as free from ilmage degradations. Then, apply image decomposition process to obtain coefficients of the images with the help of dual tree complex wavelet transform. These coefficients are corresponding to the multi-resolution images. In order to achieve stability in this multi-resolution image coefficients singular value decomposition has to be applied; moreover the multi-resolution SVD can cause the coefficients of an image free from perturbations. These singular values have to be combined in a prescribed manner that is by selecting the appropriate singular value coefficients in both the images. Let the approximate value for combining the singular values is α factor, then proper selection this value will leads to an efficient watermarked image. Then reconstruct the newly formed image coefficients with the help of dual tree inverse complex wavelet transform which results an watermarked image with enriched stability.

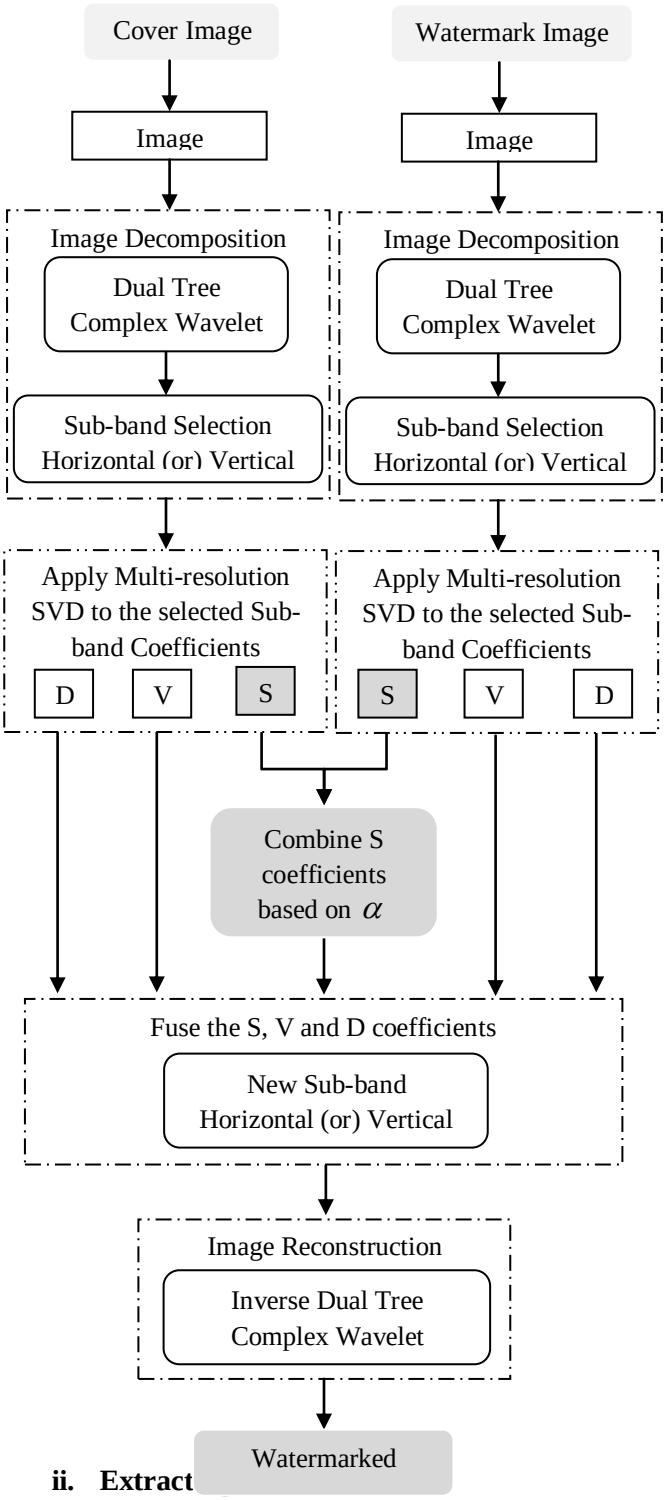


Figure1. Process of Embedding the Watermark

ii. Extract

On the other hand, in order to recover back the watermark image from the watermarked image, we need to abide by the following procedure. The watermarked image is an image which inherits the confidential information; the information may be either a picture or a digital data. Now in order to obtain the hidden information, first we need to convert the spatial domain values into transform domain by using dual tree complex wavelet transform such procedure in named as image decomposition. The decomposed coefficients are applied to multi-resolution SVD for the sake of obtaining the singular values of the image; these singular values are corresponding to the watermarked image. Now the α factor plays vital role in categorizing the coefficients that are corresponds to the watermark image, by using this value the watermark image can be recovered back effectively from the watermarked image. These transformed domain watermark image coefficients are then converted into spatial domain with the help of dual tree inverse complex wavelet transform. The process of extracting the watermark is as shown in Figure2.

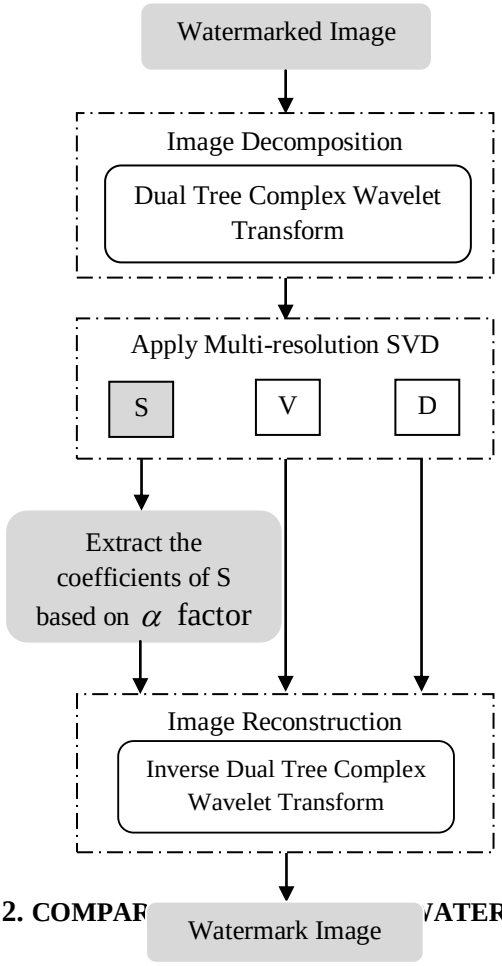


Figure2. Process of Extracting the Watermark

2. COMPAR /ATERMARKING

Watermarking Technique	RMSE	PSNR
DWT	8.6233	38.7744
SWT	8.6231	38.7847
DWT-SVD	5.9702	39.3011
SWT-SVD	8.0589	39.4018
PROPOSED METHOD	**3.9917**	**45.8613**

Table1. Comparison of various watermarking techniques with the proposed method

3. GRAPHICAL REPRESENTATIONSOF VARIOUS WATERMARKING PARAMETERS

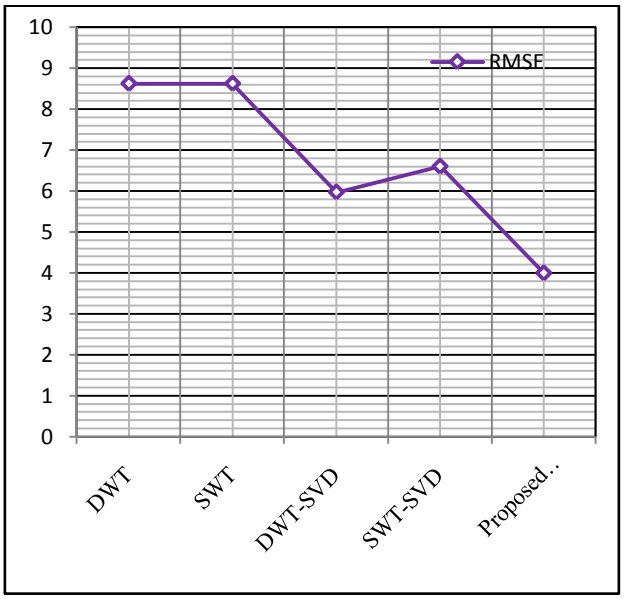


Figure3. Comparison of RMSE for various watermarking approaches

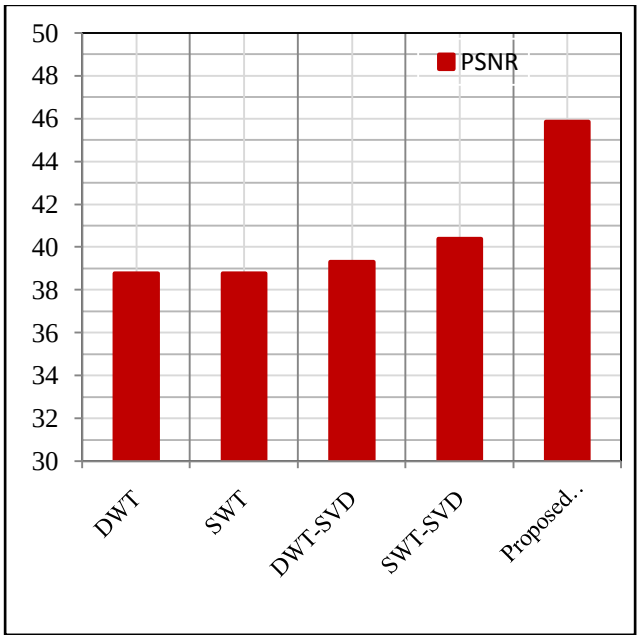
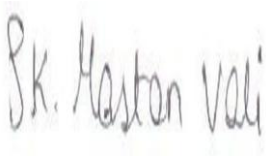


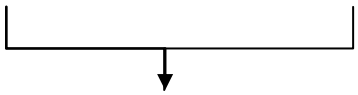
Figure4. Comparison of PSNR for various watermarking approach

4. SIMULATION RESULTS

Cover Image

Watermark Image





Watermarked Image

Extracted Watermark Image

5. CONCLUSION

In this paper a new way of performing image watermarking technique was proposed to safeguard the confidential data with the help of DT-CWT and multi-resolution SVD. With this approach the images with multi-resolution can be watermarked effectively and it can be extracted efficiently as compared to the other methods like Discrete wavelet transform (DWT), Stationary wavelet transform (SWT), DWT-SVD, SWT-SVD in terms of Root mean square error (RMSE) and Peak signal noise ratio (PSNR).

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BIOGRAPHIES

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