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SCALED WAVELET TRANSFORM VIDEO WATERMARKING METHOD USING HYBRID TECHNIQUE: SWT-SVD-DCT

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ABSTRACT

In this paper we compare proposed technique based on SWT-SVD-DCT with 3D-DCT by applying various types of attacks on video by increasing payload of watermark in video. After applying SWT to frames of video, we apply SVD to each subband of red layer. Then we exchange singular values of the HH band with singular values of HH band of the watermark. On other two layers the block with higher S values are selected and apply DCT to the selected band and insert the watermark on each of the selected band. The best thing of the proposed technique is its robustness against most common attacks as compare to 3D-DCT. In order to check the robustness and imperceptibility in both techniques PSNR, SSIM and correlation parameters are used. Analysis and experimental results show higher performance and able to withstand various attacks of the proposed method in comparison to the 3D-DCT method.

***Keywords:* SWT, SVD, DCT, SSIM and Correlation.**

I. INTRODUCTION

Video watermarking is inherited from image watermarking to provide copyright protection to the videos. The accelerated use of digital media made distribution of digital information much easier and faster. The ease of their reduplication has created a need for copyright compulsion schemes in order to protect the content of owners. The process of video watermarking is to embed the digital information in original video by using various methods of watermarking. The methods to embed the watermark in digital data depend on the particular space available in original video. Existing methods of digital watermarking mainly divided into two categories: 1) Spatial domain and 2) Frequency domain. Spatial values which changes the intensity values (Luminance, Chrominance and color space) on overall video frames. Previously watermarking techniques were based on spatial domain example least significant bits (LSBs). This method is easy and simple however they are not robust against common digital signal processing operations such as video compression. Frequency domain technology embeds watermark in the transform of the signal. The main strength of frequency domain techniques is addressing the restrictions of spatial methods; the main drawback with frequency domain refers to high computational requirement.

Three techniques in frequency domain are namely Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT), Discrete Fourier Transform (DFT), Singular value decomposition (SVD).The DWT domain is mathematical tool which decompose image into four sub bands which are low and high frequency bands. In order to avoid degradation of host video and make it invisible data is embed in high frequency sub bands because details like sharpness, edges etc of an image are present in high frequency sub bands but reduce the robustness. To improves the robustness and increases the capacity of embedding data, watermark is embedded into LH and HL sub bands.

In recent years, the DWT is chosen as the transform domain by many watermark methods. But the DWT is only done once when embedding watermark in those methods. A Scaled wavelet DWT method is proposed with SVD and DCT. In scaled wavelet DWT we maintain the original size of image without losing any values required to embed the watermark.

II. LITERATURE SURVEY

Spread spectrum watermarking is a well known proposed scheme which embeds a set of randomly generated real numbers with Gaussian distribution into the most significant magnitude DCT coefficients [1]. But this method has limitation of using watermark. Singular value decomposition (SVD) is explored as a new transform technique for watermarking [2]. Watermarking using SVD works on a simple concept of finding the SVD of original image and then modifying the singular values to embed the watermark but these methods is not robust against geometrical attacks [3]. Further, a new hybrid technique is developed by combining SVD with other transforms such as DCT, DWT, etc [4]. In that they combine advantage of three techniques (DCT-DWT-SVD).scheme is very robust for different kind of image processing attacks [5]. Embedding watermark in all subbands has advantage of increasing robustness against all attacks because the watermarks inserted in high frequencies are resistant to various attacks and also it is difficult to remove or destroy the watermark from all subband and also method has high capacity for watermarking [6].

SSIM is the best quality assessment method. SSIM is used to achieve better quality video as It extracts the image structural characteristics. SSIM based video coding using discrete wavelet transform provides better compression efficiency than Discrete Cosine Transform (DCT). This method can achieve significant gain at lower bit rate in terms of rate SSIM performance. Experimental results show that better video quality is achieved using DWT [7]. DWT-DCT-SVD based video watermarking gave good results in comparison of Hybrid DWT-SVD method with DCT and finds the PSNR and other values. In this DCT method is very time consuming though it offers better capacity and imperceptibility [8]. Each technique cannot fulfill the overall requirements of to get best watermarked video. two or more techniques which is also called hybrid techniques of watermarking to get high performance of watermarking. So First time SVD based algorithm using DWT was presented by Genic and Ahmet Eskicioglu(2004) [9].Wavelet techniques are more robust against various types of attacks as compare to DCT. But if we combine DCT with wavelet technique its also gives better results [10].

III. PROPOSED TECHNIQUE

Proposed technique combines three different watermarking methods SWT, SVD, DCT. At first SWT is applied to original frames of video. To achieve imperceptibility SVD is applied to each subband of red layer and then

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exchange the singular values of HH band with singular values of watermark. For remaining two layers apply SWT to get four subbands and apply SVD on all the subbands then apply DCT on the band with higher entropy value of S. Inverse SVD, inverse DCT and inverse SWT is performed to get watermarked image. Block diagram of watermark embedding is in fig.1. The procedure for embedding and extracting the watermark is given below.

3.1 Watermark Embedding

1. Take the Original colored video to be watermarked and divided it into frames.
2. Using SWT method, decompose the red layer of frame of video into 4 subbands: LL, HL, LH and HH.
3. Apply SVD to all the obtained subbands of red layer of frame and compare all S values of obtained blocks.

$A = U^k S^k V^k$, *Where* $k = 1,2,3,4$ & $A = 1,2,3$ (1)

Where k denotes subbands of one layer of video and S^k is the singular values obtained from SVD and A denotes the number of layers.

4. Exchange the singular values of HH band of red layer with the singular values of HH band of decomposed watermark image. Where $\lambda_i^k, i = 1, \dots, N$ are the singular values of S^K.Following equati on shows the singular values of HH band:

$$\lambda_i^4, i = 1, \dots, N \qquad (2)$$

$$\lambda_i^{*4} = \lambda_i^4 + \alpha_4 \lambda_{wi}, i = 1, \dots, N \qquad (3)$$

Where λ_i^{*4} denote the new singular values of red layer and λ_{wi} denote the singular values of watermark image of HH band.

5. Now select the other two layers and apply SWT on each layer and select the highest frequency band amongst the entire obtained band and apply SVD on it.
6. The block with higher S values are selected and apply DCT to the selected band and insert the watermark on each of the selected band.
7. Apply inverse transform on modified SWT values on all the layers.
8. Apply inverse SVD to produce the watermarked layer of the frame then reconstruct the watermarked frame.

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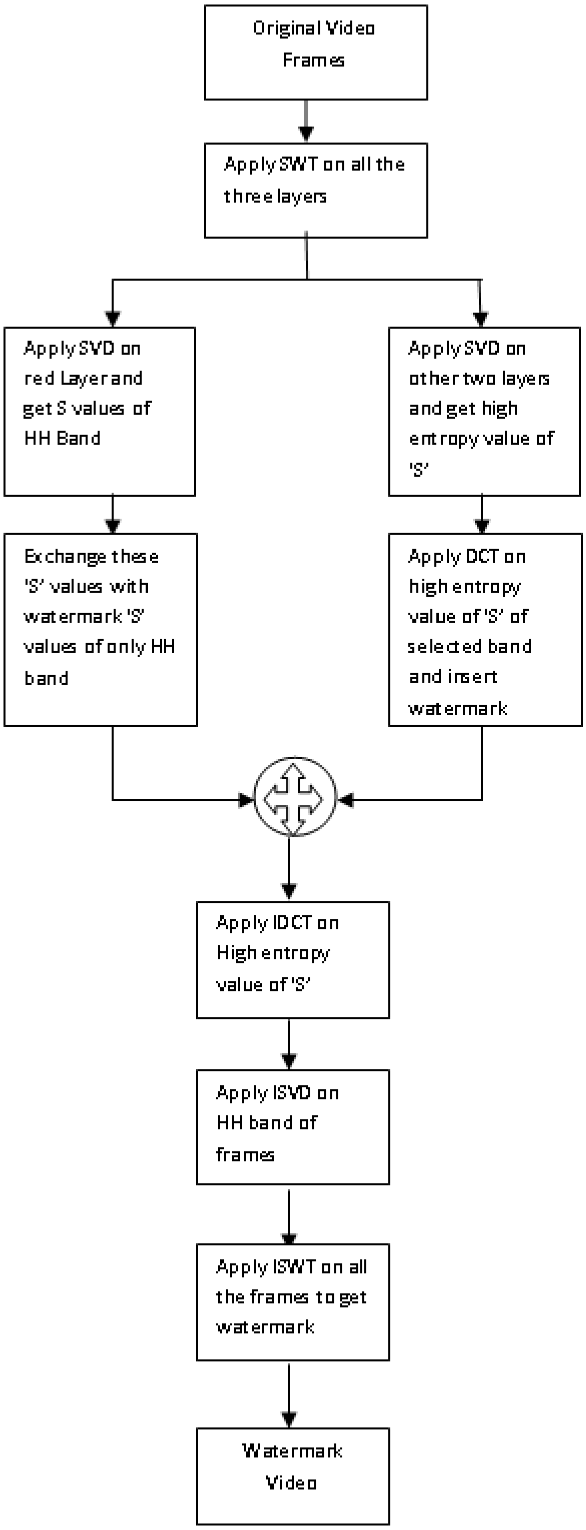

I. Fig.1 Block Diagram of Video Watermarking

3.2 Watermark Extraction

1. Apply the SWT to frames of watermarked video and decompose into four quadrants.
2. Apply SVD to each frequency quadrants (LL, LH, HL, and HH) and to the watermark.
3. Modify the singular values in each quadrant in first layer, with the singular values of the visual watermark.

4. Obtain the four sets of modified frequency quadrants of remaining two layers of frame.
5. Apply the SWT to produce the Embedded Image.
6. Apply SVD to each block and extract the singular values from each block k, where k =1, 2, 3, 4.
7. Construct the four watermarks using the singular vectors.
8. Apply DCT on these layers to get the watermark image.

IV. EXPERIMENTAL ANALYSIS

The proposed technique gives better results as compared to 3D-DCT video watermarking. Test is performed on 'Wildlife.avi' shown in fig.2(a) using watermark logo 'Watermark.bmp' whose size is 128x128 (181KB) shown in fig.2(b).The proposed technique is trying to increase the payload selected to insert in our video for copyright protection in order to get more robustness and imperceptibility of video. As from literature survey we know that by increasing the payload of data the imperceptibility affected. This technique gives better results in after applying various types of attacks on video as compared to 3D-DCT. Table.1 show the images of watermark extracted after applying attack on video. Same size of watermark is tested for both of techniques and on the same video. The following results in tables 2 and 3 shows better results as compare to 3D-DCT technique. PSNR, SSIM, Correlation are the evaluation parameters used for evaluation.

Fig. 2(a) Wildlife.avi

Fig. 2(b) Watermark

(a) Mean Square Error: MSE is simply a method of obtaining estimates which measures the average of square of the errors. An error is simply the difference between estimator and what is to be estimated. MSE can be measured as

$$MSE(x,y) = \frac{1}{N}\sum_{i=1}^{N}(x_i - y_i)^2 \qquad (4)$$

Where x_i is the original image and y_i is the noisy image we get after watermarking that is $(x_i - y_i)^2$ is known as squared error image and N is the total number of elements horizontally as well as vertically.MSE values approaches to zero which states that low values of MSE of an image has good quality.

(b) Peak Signal to Noise Ratio: PSNR is byte by byte comparison of data. It is statistical expression to find the ratio between the maximum possible value of original signal and power of noisy signal that affects the quality of video PSNR is expressed in logarithmic decibel scale. PSNR can be measured as

$$PSNR = 20\log_{10}\left(\frac{MAX_f}{\sqrt{MSE}}\right) \qquad (5)$$

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MAX_f is the maximum value of matrix data of original image. The value of PSNR approaches to infinity i.e. large value of PSNR better the quality of image. We compared our technique with the existing technique and PSNR obtained of proposed video is 31.02db.and of existing technique is 29.73db.

(c)Structural Similarity Index: SSIM is sensitive to the distortion like blur of image, compression and noise of image [1]. This type of distortion breaks down natural spatial correlation of video. SSIM achieve three main properties which are Symmetry, Boundedness, Unique Maximum where Symmetry mean S(x, y) should be equal to S(y, x).In Boundedness S(x, y) should be less than 1.Maximum value should be 1 which can be achieved if and only if x=y. Suppose we have two images i.e. x is the Original image and y is the distorted image where

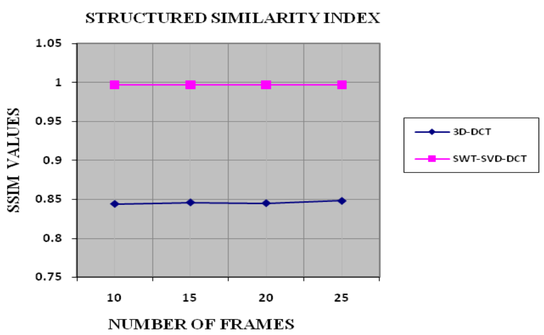
$$S(x,y) = \frac{2\mu_x\mu_y + a_1}{\mu_x^2 + \mu_y^2 + a_1} * \frac{2\sigma_x\sigma_y + a_2}{\sigma_x^2 + \sigma_y^2 + a_2} * \frac{\sigma_{xy} + a_3}{\sigma_x * \sigma_y + a_3} \qquad (6)$$

We compared our technique with the existing technique and find SSIM using equation (6). SSIM obtained of proposed video is 0.997.and of existing technique is 0.844.

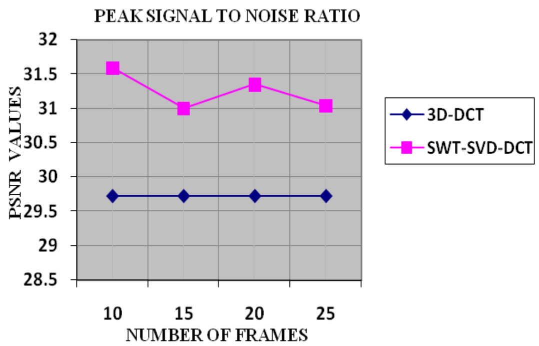
Correlation: Correlation peak value is 1 i.e. when original watermark and extracted watermark are identical and zero if the original watermark and extracted watermark are different from each other. Proposed technique has value near to 1.To check the robustness and imperceptibility of the algorithm; the watermarked video was attacked by applying rotation, cropping, median filtering, and noise. We find correlation values of both techniques after applying attacks on video using equation (7). The results of these attacks are shown in table1.

$$Correlation = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2}\sqrt{\sum(y-\bar{y})^2}} \qquad (7)$$

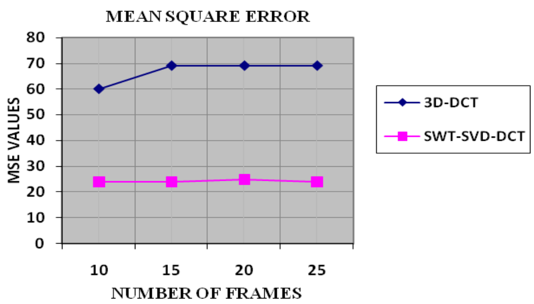
Following graphs (i), (ii) and (iii) shows the PSNR, MSEM SSIM comparison of both techniques. Graphs (iv), (v), (vi), (vii) and (viii) shows the results of attacks of both the techniques.



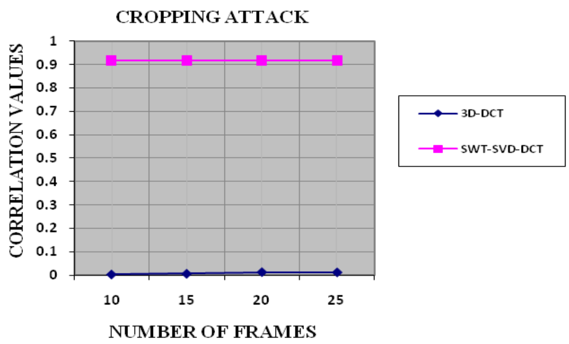
(i)



(ii)



(iii)



(iv)

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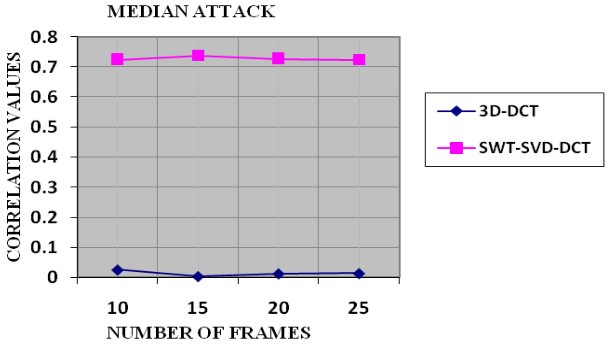
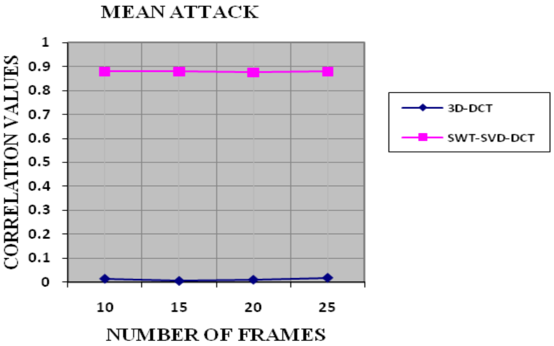
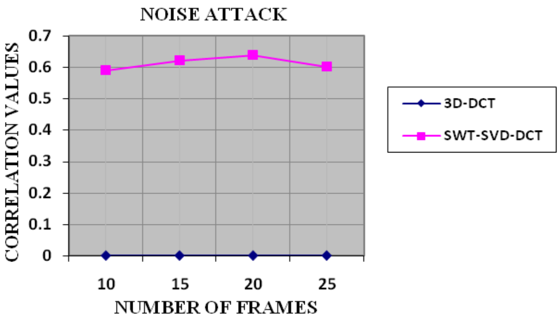


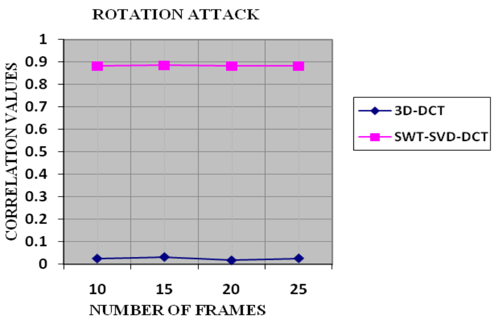
(v)



(vi)



(vii)



(viii)

Table.1 Images of Watermark After Apply on Various Attacks

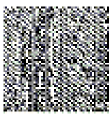
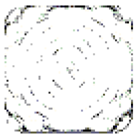
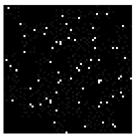
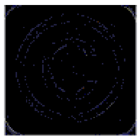
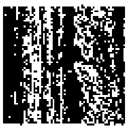
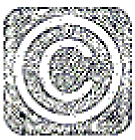
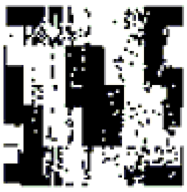
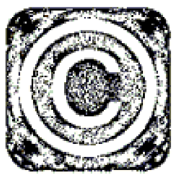
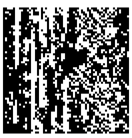
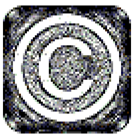
Watermark extracted after attacks in Base Method	Watermark extracted after attack in Proposed Method	Watermark extracted after attacks in Base Method	Watermark extracted after attack in Proposed Method
 Cropping		 Noise	
 Median		 Rotation	
 Mean			

Table.2 Correlation Values After Apply of Various Attacks on Video Using 3D-DCT and SWT-SVD-DCT Techniques

Attacks	Frame 10		Frame15		Frame 20		Frame 25	
	3D-DCT	SWT-SVD-DCT	3D-DCT	SWT-SVD-DCT	3D-DCT	SWT-SVD-DCT	3D-DCT	SWT-SVD-DCT
Cropping	0.003	0.919	0.006	0.918	0.013	0.919	0.012	0.919
Median	0.025	0.725	0.003	0.738	0.012	0.728	0.013	0.724
Rotation	0.026	0.883	0.033	0.885	0.018	0.882	0.027	0.883
Mean	0.015	0.879	0.006	0.878	0.011	0.876	0.019	0.878
Noise	NaN	0.591	NaN	0.621	NaN	0.638	NaN	0.602

Table.2 Quality Assessment Parameters After Apply of Various Attacks on Video Using 3D-DCT and SWT-SVD-DCT Techniques

Quality Assessment Parameters	Frame 10		Frame 15		Frame 20		Frame 25	
	3D-DCT	SWT-SVD-DCT	3D-DCT	SWT-SVD-DCT	3D-DCT	SWT-SVD-DCT	3D-DCT	SWT-SVD-DCT
PSNR	29.73	31.59	29.73	31.00	29.73	31.35	29.73	31.04
MSE	60.03	24.06	69.03	24.06	69.03	25.05	69.03	24.05
SSIM	0.844	0.997	0.846	0.997	0.845	0.997	0.848	0.996

It can be seen from results, proposed method is better than 3D-DCT for all attacks. Also we can see the embedded watermark in HH for one layer and in all subband for other two layers is resistant to various attacks and watermark embedding in the HH subband makes it resistant to crop and noise attacks. Watermark embedding in LH subband makes it resistant to rotation attack. Since we can conclude that embedding watermark in all subbands can increase robustness against all attacks and also helps to increase the payload of watermark in digital media.

Proposed technique has a tendency to conjointly demonstrate the good correlation between the embedded and also the extracted watermark with the assistance of experimental results. One among the main benefits of the proposed scheme is the robustness of the technique on wide set of attacks. Experimental and analysis results show much improved performance of the proposed method in comparison with the 3D-DCT watermarking.

V. CONCLUSION

It can be seen from results, proposed method is better than 3D-DCT for all attacks. We embed watermark in HH for one layer and all subband for other two layers which are resistant to attacks and watermark embedding in the HH subband makes it resistant to crop and noise attacks. Watermark embedding in LH subband makes it resistant to rotation attack. So it concludes that embedding watermark in all subbands can increase robustness against all attacks.

REFERENCES

[1] Cox IJ, Kilian J, Leighton FT, Shamoon T. Secure spread spectrum watermarking for multimedia. IEEE Transactions on Image Processing 1997;6(12):1673e87.

[2] Bhatnagar Gaurav, Raman Balasubramanian. A new robust reference logo watermarking scheme. Multimedia Tools and Applications 2011;52(2):621e40.

[3] Liu R, Tan T. An SVD-based watermarking scheme for protecting rightful ownership. IEEE Transactions on Multimedia 2002; 4(1):121e8.

[4] Chang CC, Tsai P, Lin CC. SVD-based digital image watermarking scheme. Pattern Recognition Letters 2005;26:1577e86

[5] K A Navas, Mathews Cheriyan Ajay, M Lekshmi, Tampy S Archana, M Sasikumar " DWT-DCT-SVD Based Watermarking", 3rd International Conference on Communication Systems Software and Middleware and Workshops COMSWARE 08(2008).

[6] S. Lagzian, M. Soryani and M. Fathy, "A New Robust Watermarking Scheme Based on RDWT-SVD," International Journal of Intelligent Information Processing, vol. 2,no 1, pp. 22-29, 2011.

[7] Roselin Raju, Arun P. S," SSIM Based Video Coding Using 2D- DWT", International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT), vol. 2, pp. 14-20, 2014.

[8] Rathod Jigisha D, "A hybrid DWT-SVD Method for Digital Video Watermarking," International Journal of Advanced Research in Computer and Communication Engineering," Vol. 2, pp. 2771-2775,July 2013.

[9] Faragallah, Osama S, "Efficient video watermarking based on singular value decomposition in the discrete wavelet transform domain", AEU-International Journal of Electronics and Communications, Elsevier, Vol. 67, pp.189-196, 2013.

[10] Hemraj Saini, "Efficient hybrid Watermarking Approach by Using SVD, DWT, and Back Propagation Neural Network", IEEE International Advance Computing Conference (IACC), vol. 2, pp. 985-990, 2014.