Discrete Triangle Transform based Compression and Communication with Triangular basis Function

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ABSTRACT
The non– sinusoidal transforms with orthogonal functions consists of Hadamard, Walsh, and Haar function. These non– sinusoidal orthogonal functions consists of either square or rectangular waves. The basis function of this transforms are not sinusoidal. A next level of advancement to the theory of transforms is given by the triangular basis function. The triangular basis function and its use in image transform is discussed in the paper and also the orthogonal matrix for the basis function is discussed for transform.

General Terms
Algorithm for Image transform based on triangular wave, data compression. Data sharing and watermarking.

Keywords
Tribas, basis function, triangular wave transform.

1. INTRODUCTION
The transform are subject to recovery or reconstruction of images from damages. Damages may occur due to scratches or unwanted noise, stain. While transmitting the image from transmitter to receiver end in wireless or any wired channel there are unwanted source of noise clutters which hamper smooth function of the transmission and the image at the receiver is damaged. The triangular waveform is elongated saw tooth waveforms and has same properties of linear rise and steep fall (ramp function). The wave function is a non – sinusoidal orthogonal one, and helps in reconstructing the damaged part of image by recomputed values by taking transform.

2. DERIVATION OF BASIS FUNCTION
The algebra for discrete cosine and sine (DCT and DST) transform explains the interaction between the signal frequency and its boundary conditions; it gives easy access to the transform's properties.
The formula given below represents generic fuzzy partitions with the Repetitive condition and triangular functions:
$A1\ (x) = \{1 - (x - x1)\ /\ h1\}$, $x \in [x\ 1, x2]$, 0, otherwise,

Where, h represents h – equidistant of x nodes from x1….xn.

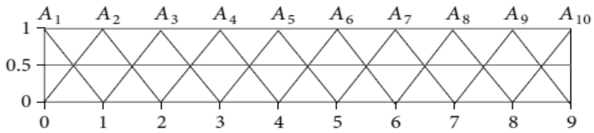

Figure1. Repetitive condition of triangular function.

Matrix for calculating basis function

1	1
-1	1

2 x 2 matrix

1	1	1	1
-1	1	-1	1
-1	-1	1	1
1	-1	-1	1

4 x 4 matrix

1	1	1	1	1	1	1	1
-1	1	-1	1	-1	1	-1	1
-1	-1	1	1	-1	-1	1	1
1	-1	-1	1	1	-1	-1	1
-1	-1	-1	-1	1	1	1	1
1	-1	1	-1	-1	1	-1	1
1	1	-1	-1	-1	-1	1	1
-1	1	1	-1	1	-1	-1	1

8 x 8 matrix

2.1 Basis function derived from the orthogonal matrices:

The shape of the basic functions can vary from non-decreasing, oscillating, or non-increasing. We choose basic functions with radius 2 in the first step of reconstruction and radius 4 in the second step and radius 8 in third step because of fully sufficient usage on the input set of testing images. In this paper, we focus on building shape of basic function step by step considering Root mean square error (RMSE).

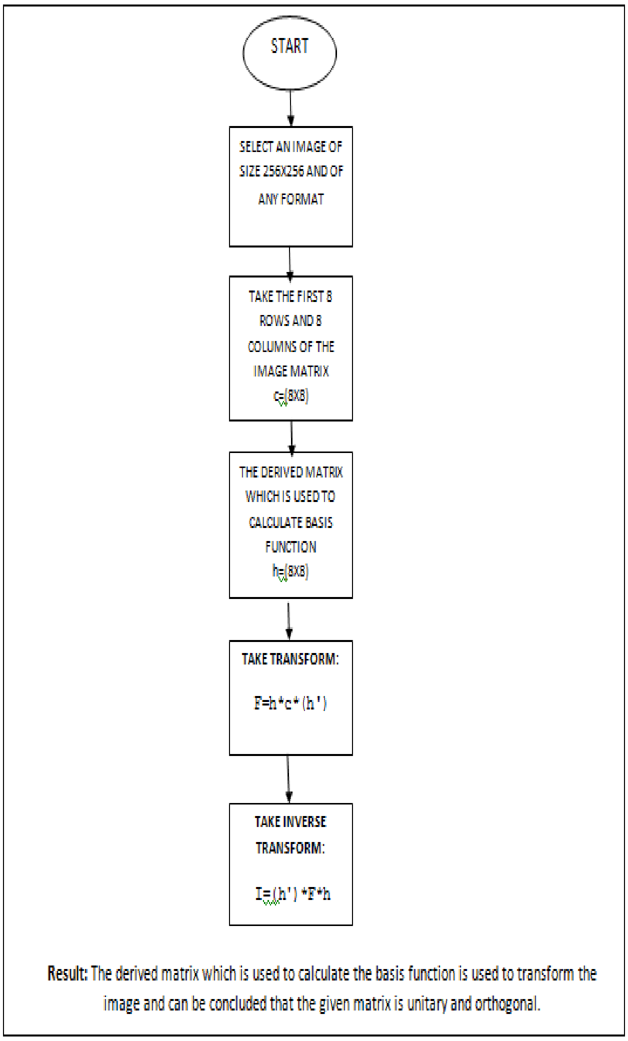

Figure2. Flowchart.

3. COMPRESSIONS IN TRIANGLE TRANSFORM.

The compression schemes for triangular function, such as images, from lossy and lossless modes of compression, they employ spectral methods to achieve lossy compression, on similar note the JPEG uses the discrete cosine transform. The data is expressed in linear combination of a set of orthogonal basis functions shown in algorithm implementation flow chart, each function is characterized by a Ultimate output of this relatively good approximation lies in using only the small number of lowest possible frequency of basis function. The coefficients from radius 2, 4, 8, of these selected basis functions are processed by simple sampling and quantizing process wherein compactness of encoder is achieved by using a variety predictive encoders, lossy quantizers and symbol encoders like Huffman compression or arithmetic encoder.

We have used this basic idea for the compression of triangle wave geometry. We use the formulation described in the previous section for decomposition of triangle geometry signal into its spectral components by calculating the MSE. And only a few low-frequency coefficients from the function are selected for achieving a high compression ratio.

For large size images with hidden information, computation of MSE is very expensive. Hence we partition the image into smaller sub images, each of which is then treated separately.

And the part which is damaged in the course of transmission is recalculated and easily recovered. This, of course, results in degradation of coding quality and can be seen after reconstruction in the form of “blur-effects” along the sub-image boundaries, but has the advantage that local properties of the image are captured better. In order to minimize the damage, the partitions should be well balanced, that is, each sub-image should contain approximately the same number of pixels, and also, the number of edges straddling the different sub-images, the edge-cut be minimized. Optimal solution to this problem is *tribas* function in MATLAB, where we can use triangle basis function to compute the image recovery via triangle transform.

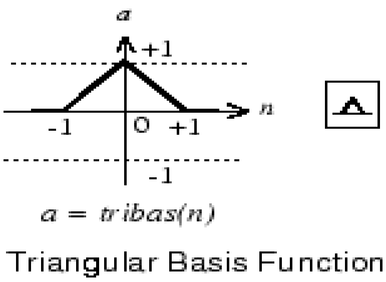

Figure3. Matlab tribas function.

We have also implemented the compression technique in Matlab for the image of “cameraman.tif” as an example and we got the results as follows:

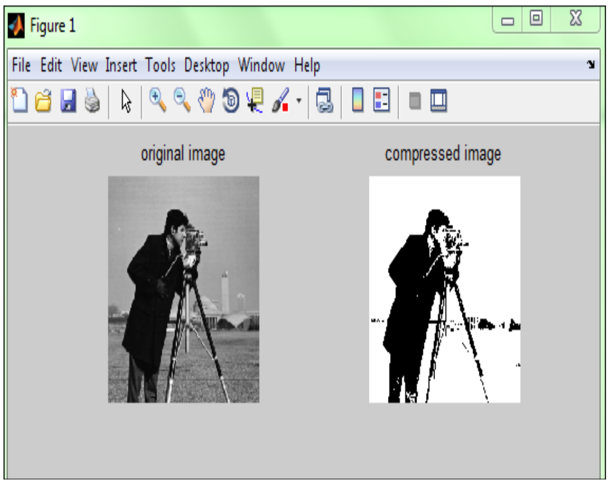

Figure3. Matlab output after applying Image transform by Triangular transform algorithm.

3.1 Cryptography and Communication

Watermarking is done on the transformed image to share secret information to end user which provides a robust method of cryptography, which in all helps in copyright protection of digital media by embedding in the data information with image identifying the owner. The research on digital watermarking of medical images where author. Ronak Vyas had focused on medium such as images, video and text. This could felicitate a all new robust watermarking techniques to survive a variety of "attacks", including resizing, cropping and filtering. For resilience to such attacks, recent watermarking schemes employ a *spread-spectrum* approach – they transform the document to the frequency domain and perturb the coefficients of the perceptually most significant basis functions this is where our basis function of triangle wave can be used. Extending this spread spectrum approach to work for watermarking of arbitrary triangle waveform images helps in adding some level of cryptography to the communication occurring between the users through image being the raw data as well as the source of transform. We transform the triangle waveform by decomposing it into the basis that is defined in the orthogonal matrix.

A watermark is chosen randomly from a large source bank and inserted by scaling the largest coefficients by small perturbations. We at the receiver took the suspect element, and extracted watermark which is computed as the difference on the same set of frequency coefficients between the suspect data and the original watermarked data. The watermark is declared to be present based on the statistical correlation of and the robustness of the receiver to inverse transforms and derive watermark hidden in the low-frequency components.

4. SUMMARY AND FUTURE ADVANCEMENT

We have considered and proved the triangular basis function in adding the security aspect in the communication occurring via the images. At the transmitter end the RMSE is calculated after adding the information and watermarking the image, whereas at the receiver the MSE is calculated as the image is prone to get affected due to unwanted noise. The recovery of damaged image is done recalculating the values using the derived basis function for smooth transformation from cluttered image to linear data and source image.

4.1 Future work

There is scope of improving the levels of cryptography using some of the properties of spread spectrum coding.
Also the channel improvisation can be realistic in near future by imbibing to the standard rule of transitional channels.

5. CONCLUSION

Image transforms being categorised as sinusoidal and non sinusoidal transforms, this triangular transform described in the paper uses is non sinusoidal one, based on triangular wave basis function derived by author and all the other co authors. The compression obtained is highly appreciative and can be used to share secretly useful information to end user using watermarking.

Image transform are basics of any compressor scheme and we have discussed possibly a totally new level to compression and communication via image transform using triangular basis function as primary concern remaining the transform of image and its compression.

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