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Multimedia Data Hiding using Fourier series on an Experimental Basis

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Abstract: ***The compressed data transmission to be implemented in this work with the help of Fourier series information hiding mechanism. In the proceeding step, the necessity requirement is the problem statement formulation for designing the system. It mainly focuses on the partitions or segmentations of the multimedia content into a compressed one. The compressed content will be hided to be maintained the originality during the data transmission over the network.***

Keywords: Data transmission, Fourier series, Information hiding, Segmentations.

1. Introduction

In order to communicate the compressed secure multimedia data over the internet by using the mechanism of information hiding. The concept of information hiding is actually interrelated with multimedia mining as well as the cryptographic issues. In this research mainly focus on the data compression on multimedia data in data mining and the way to transmit the secure manner with the help of Fourier series based cryptographic mechanism. The role of Fourier series analysis in information hiding mechanism and its basic characteristics related with partition of the content to be presented in the multimedia source. An Impact of Cryptography in the field of information hiding as well as the secure multimedia data transmission over the communication channel. To bring the experimental solution to achieve the goal of information hiding in multimedia content and enhance the secure way to conduct the information transaction over the data communication channel.

2. Related Work

Crypto graphic enabled Compression of Multimedia content [1][2] is the art of hiding and transmitting data through apparently innocuous carriers in an effort to conceal the existence of the data, the word Steganography literally means covered or hiding writing as derived from Greek. Steganography has its place in security. Hidden information in the cover data is known as the "embedded" data and information hiding is a general term encompassing many sub disciplines [3][4], is a term around a wide range of problems beyond that of embedding message in content.

The term hiding here can refer to either making the information undetectable or keeping the existence of the information secret. Information hiding is a technique of hiding secret using redundant cover data such as images, audios, movies, documents, etc. This technique has recently become important in a number of application areas. For example, digital video, audio, and images are increasingly embedded with imperceptible marks, which may contain hidden signatures or watermarks that help to prevent unauthorized copy[5][6].

Many different methods enable hiding information in audio and image. These methods may include hiding information in unused space in file headers to hold ‘extra’ information. Embedding techniques can range from the placement of information in imperceptible level [7][8] (noise), manipulation of compression algorithms, and the modification of carrier properties. The information may be hidden in two basic ways (Cryptography and Steganography).The methods of Cryptography does not conceal the presence of secret information but render it unintelligible to outsider by various transformations of the information that is to be put into secret form, while methods of Steganography conceal the very existence of the secret information [9].

In this research work comprised the major content of Multimedia hiding information is carried out with the help of Data mining, Data Compression and Crypto algorithm. In the aspect of Data mining to cover the general content illustration of the multimedia data representation and the Data compression mechanism to describe different category of compression algorithm specifications, analysis, comparisons. The Cryptography discipline plays an important role for the crypto mechanism of compressed data location in the appropriate servers. The entire work actually implemented with the help of N-type Fourier algorithm in the implementation. In the above specified sections to give the literature overview about compression, data mining content as well as the steganography.

3. Experimental Basis

3.1 Fourier series analysis

T Fourier series provides an alternate way of representing data: instead of representing the signal amplitudes a function of time, were present the signal by how much information is contained at divergent frequencies. If you ever watched the blinking lights on a stereo equalizer then you have seen Fourier analysis at work. The lights represent whether the music contains lots of bass or treble. This section will not provide rigorous derivations of Fourier series and its properties [equation 2.1].

$$f(t) = a_0 + \sum_{n=1}^{\infty}(a_n sin(2\pi nt) + b_n cos(2\pi nt)) \qquad (2.1)$$

$$\int_0^1 sin(2\pi nt)sin(2\pi mt)dt = 0;\ \text{n and m are integers, and n} \neq \text{m} \qquad (2.2)$$

$$\int_0^1 sin(2\pi nt)sin(2\pi nt)dt = 1/2;\ \text{n is an integer} \qquad (2.3)$$

$$\int_0^1 cos(2\pi nt)cos(2\pi mt)dt = 0;\ \text{n and m are integers, and n} \neq \text{m} \qquad (2.4)$$

$$\int_0^1 cos(2\pi nt)cos(2\pi nt)dt = 1/2;\ \text{n is an integer} \qquad (2.5)$$

$$\int_0^1 cos(2\pi nt)sin(2\pi mt)dt = 0;\ \text{n and m are integers} \qquad (2.6)$$

When it’s working with the data that we have acquired with discrete data points, not an analytical function that can analytically integrate. It turns out that taking a Fourier transform of discrete data is done by simply taking a discrete approximation to the integrals (2.1, 2.2, 2.3, 2.4, 2.5, and 2.6). In recent researches Coding techniques are used in information hiding approach improve Signal-to-Noise Ratio (SNR) of the encrypted multimedia information’s. For example, the use of Fourier series in conjunction with in information hiding approach can be effectively used to enhance the Signal-to-Noise Ratio (SNR) of the backscattered detected light without sacrificing the spatial resolution;

In particular, Fourier series have been demonstrated to be the most efficient among other suitable coding techniques, allowing for a good improvement in SNR even at short code lengths. Coding techniques based on Fourier series a set of different sequences (i.e. codes) of short (about 10 ns) NRZ laser pulses to increase the launched energy without impairing the spatial resolution using longer pulse width. The basic idea is to periodically sense the probing information hiding with a multi pulse pattern, the repetition period of which is equal to the round trip time.

This way, the pattern results as a code spread along with a bit time inversely proportional to the code length. The pulse width can be kept in the order of 10 ns to guarantee a meter-scale spatial resolution and the peak power can be set close to the nonlinear effect threshold. The main task performed by the is to decode Stokes and anti-Stokes trace samples and each module varies with respect to each other in terms of their functionality. The total operation of the system is performed in a single clock cycle. It is referred to as Top Module because it is the outer interface interacting with compressed multimedia information Hide. It takes averaged coded Stoke and Anti-Stoke trace data and code word bit pattern, and then it returns the decoded Stoke and Anti-Stoke sampled trace data.

All compressed multimedia information Hide operations are performed in a single clock cycle. It is referred to as Read-Code word Module because we have code word bits stored in the register. It takes code patterns and returns the code words bit by bit. All compressed multimedia information Hide operations are performed in a single clock cycle.

4. Data Hiding in Content Representation

All compressed multimedia information Hide operations are performed in a single clock cycle. It is referred to as Decoder Module because it decodes averaged coded Stoke and Anti-Stoke sampled traces. It takes both single bit code word and single averaged Coded Stoke and Anti-Stoke sampled trace data and returns the Decoded Stoke and Anti Stoke trace data. The energy of the probing laser pulse cannot be freely increased. The energy of the launched pulse is indeed bounded by the targeted spatial resolution, which implies a small pulse width. Fourier series analysis is the typical solution adopted to address the issues of averaging.

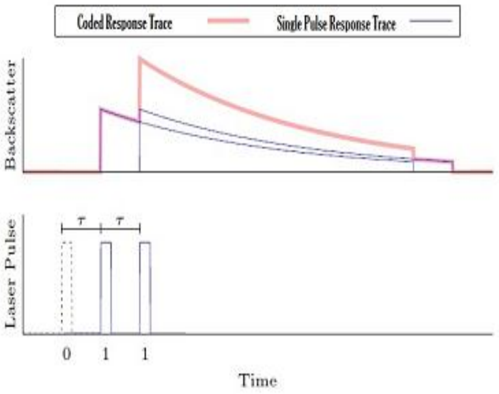
Its basic principle is, launching proper laser pulse sequences instead of a single pulse, so as to increase the probing energy without impairing the spatial resolution in compressed multimedia information Hide. These sequences are the optical representation of binary linear algebraic codes, which are widely used in communication theory for error detection and correction. Different codes families are grouped in to classes, each of them containing codes of the same length. Once a code class of length M is selected, a code set of M codes is built. Then, each code of the set is launched, and its Stokes and anti-Stokes responses are acquired.

Finally, the set of responses is decoded to obtain a couple of Stokes and Anti-Stokes traces to be used for the temperature assessment. As described in the above, the most important aspect of pulse coding is that the SNR of decoded traces increases with M. In particular, it had been shown that for such applications compressed multimedia information Hide provide the best performance in terms of coding gain, i.e. for a given M they allow to achieve the best SNR enhancement with respect to other coding schemes . It is possible to build a simplex code set for any M = 4n + 1, with n = 1, 2,3,4,....In Figure 1.1 a qualitative example for M = 3 is reported. The code set is [011], [101], [110]. Whenever a laser pulse is launched, i.e. whenever the code bit is 1, a new backscattered trace starts. This means that the response R (t) to the code c acquired by the receiver is given by the overlapping of some delayed replicas of the trace (t) to be recovered. The delay is a multiple of the chosen code bit time. In the reported example, the code responses are given by,

$$R_{011}(t) = \psi(t-\tau) + \psi(t-2\tau)$$

$$R_{101}(t) = \psi(t) + \psi(t-2\tau)$$

$$R_{101}(t) = \psi(t) + \psi(t-\tau)$$



In order to evaluate the performance of compressed multimedia information hide implementation, the algorithm was coded in Verilog hardware description language and implemented on Virtex4 (family using Xilinx ISE 10.0.3 tool). To test the new developed compressed multimedia information hide and to see the real SNR improvement provided by the cyclic coding, measurements with coding are compared to the ones obtained by the conventional technique using the same acquisition time and the same peak power.

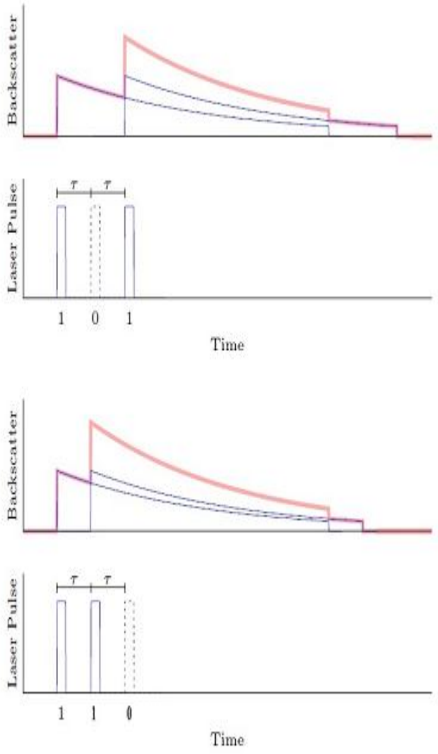


Figure - Example for Conventional Simplex Coding M = 3

Rearranging the above equations in matrix form, it follows,

$$\begin{bmatrix} R_{011}(t) \\ R_{101}(t) \\ R_{111}(t) \end{bmatrix} = S \begin{bmatrix} \psi(t) \\ \psi(t-\tau) \\ \psi(t-2\tau) \end{bmatrix} with S = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} \quad \text{.... [2.9]}$$

Figure 1 and 2 shows diagram of acquired coded Stokes and anti-Stokes trace. Most of the trace recovery blocks have been implemented using Lab VIEW and others software's the likes of Microsoft-Excel

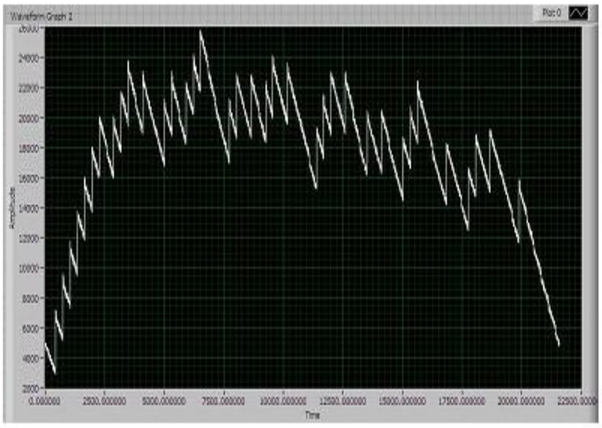


Figure 1 Acquired Waveform of Averaged Coded Stokes Trace, with 71 bit compressed multimedia information hide

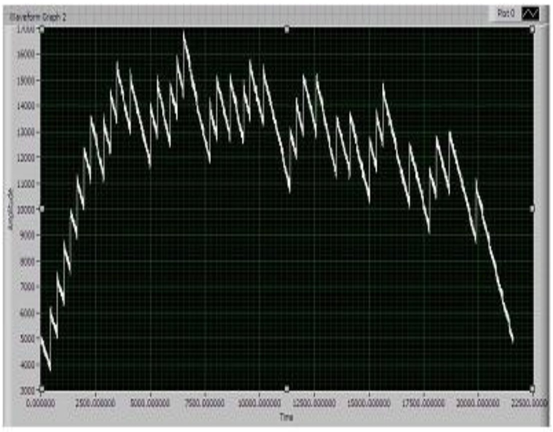


Figure 2 Acquired Waveform of Averaged Coded Anti-Stokes Trace, with 71 bit compressed multimedia information hide

The new compressed multimedia information hide modules have been developed using the Verilog hardware description language. Each step of the design flow, i.e. the logical synthesis thesis, the functional simulations, the implementation and the final post place and route simulations; have been carried out within the Xilinx Integrated Software Environment (ISE) 10.1.03.

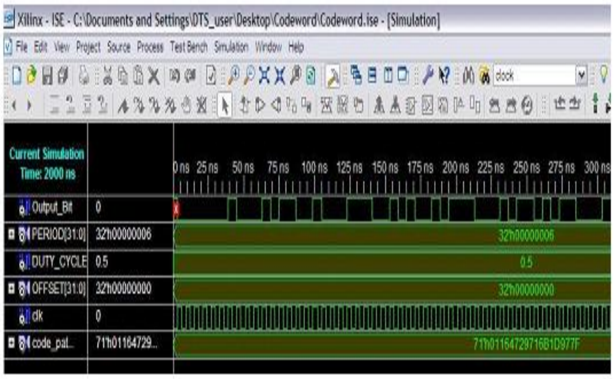

Xilinx - ISE - C:\Documents and Settings\DTS_user\Desktop\Codeword\Codeword.ise - [Simulation]
File Edit View Project Source Process Test Bench Simulation Window Help
clock
Current Simulation Time: 2000 ns
0 ns 25 ns 50 ns 75 ns 100 ns 125 ns 150 ns 175 ns 200 ns 225 ns 250 ns 275 ns 300 ns
Output_Bit 0
PERIOD[31:0] 32'h00000006
DUTY_CYCLE 0.5
OFFSET[31:0] 32'h00000000
clk 0
code_pat... 71'h01164729...
32'h00000006
0.5
32'h00000000
71'h01164729716B1D977F

Figure 3 Simulation Waveform of Read-Code word Module of compressed multimedia information hide

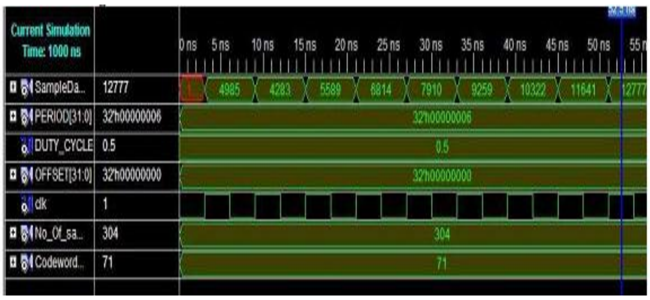

Current Simulation Time: 1000 ns
0 ns 5 ns 10 ns 15 ns 20 ns 25 ns 30 ns 35 ns 40 ns 45 ns 50 ns 55 n
SampleDa... 12777
PERIOD[31:0] 32'h00000006
DUTY_CYCLE 0.5
OFFSET[31:0] 32'h00000000
clk 1
No_Of_sa... 304
Codeword... 71
4985 4283 5589 6814 7910 9259 10322 11641 12777
32'h00000006
0.5
32'h00000000
304
71

Figure 4 Simulation Waveform of Read-RAM Module of compressed multimedia information hide

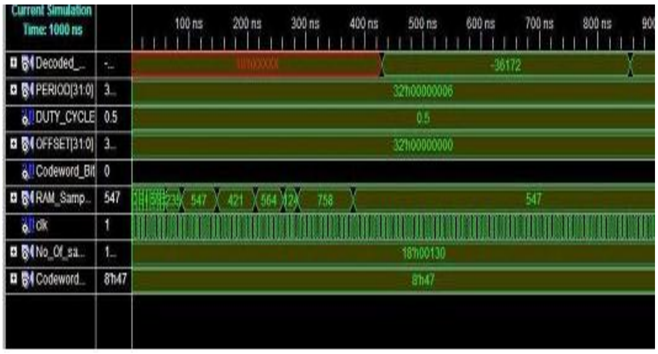


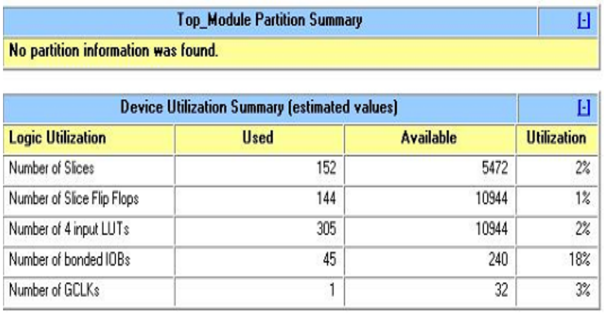
Figure 5 Simulation Waveform of Decoder Module of compressed multimedia information hide

Figure 3 , shows Simulation Waveform of Read-Code word Module compressed multimedia information hide, which comprises input of code word bit patterns (e.g. 71 code word bit pattern) and single bit output called output-bit.

In Figure 4, Simulation Waveform of Read-RAM Module compressed multimedia information hide is shown. It has 3 input called Number code word bit pattern which is defined in the design phase of this thesis report, Number of Sample per Slot, (e.g 304) and clock frequency (clk). It has one output called Sample Data-out which will serve as an input for Decoder Module.

Figure 5, shows Simulation Waveform of Decoder Module which is the core of the new developed FPGA architecture. It takes an input from the output of the other two modules, Read-Code word Module and Read-RAM Module compressed multimedia information hide. Finally it returns an output called Decoded Data, final decoded data of Averaged coded stoke and anti-stoke trace data. As a common all the three modules have an input called clock frequency (clk) which is 150 MHz (6 ns).

In figure 6, the compressed multimedia information hide utilization statistics of the Top Module of compressed multimedia information hide are shown. It can be noted that the IO Blocks are the most used which is 18%, whereas only the 2% of the available slices are occupied. This means that there is still a great room for the future development of other functionalities.



Top_Module Partition Summary
No partition information was found.

Device Utilization Summary (estimated values)			
Logic Utilization	Used	Available	Utilization
Number of Slices	152	5472	2%
Number of Slice Flip Flops	144	10944	1%
Number of 4 input LUTs	305	10944	2%
Number of bonded IOBs	45	240	18%
Number of GCLKs	1	32	3%

Figure 6 compressed multimedia information hide utilization Summary

5. Conclusion

In depth discussion of compression techniques, Fourier series following inferences are drawn: It will helps to make intelligent decisions when creating programs that use data compression. It focuses on the compatibility of both the high compression rate and high speed processing of compressed multimedia information hide. The above experimental basis work gave an idea that how to implement Fourier series in successful way to hide information in multimedia files.

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