International Journal For Technological Research In Engineering
Volume 2, Issue 7, March-2015 *ISSN (Online): 2347 - 4718*

ANALYSIS OF ROBUSTNESS OF EMPIRICAL MODE DECOMPOSITION FOR SOUND SIGNAL

Miss. Kolekar S.S[1], Mr. Desai K.R[2]
[1]PG scholar, [2]Asst. Professor
Dept of E & Tc, BVCOE, Kolhapur

Abstract: Empirical mode decomposition provides a novel means of treating audio frames such that they provide orthogonal intrinsic mode functions. This method is examined for its robustness to different attacks. The data analysis parameters are obtained accordingly. The audio signal is subjected different noise attacks purposefully. The general data evaluation is done depending on each type of attack applied. This paper helps to show robustness extent of this method considering sound signal in particular.
Index Terms: Robustness, Intrinsic mode function, False positive and negative error, Normalized correlation.

I. INTRODUCTION

The theft of multimedia data is a crucial concern during its transmission. Intruders can cause hazard to sensitive real time data by misusing it. Data security has become need of age. Illegal copying and changing of data can incur financial losses. Today the vital signals need to be conveyed to and fro not only in secure manner but also taking its robustness in consideration. Applying subtle encryptions and decryptions are not sufficient. Watermarks [1] are the novel approaches in providing ownership to the data. Protection in terms of copyright has therefore come in existence. The context considers audio signal data in particular. So the watermark over here must not be audible to the analyst. Along with security data rate must also be considered. While satisfying these conditions the concerned method must provide sufficient robustness to the generated output [2]. At the very initial phase wavelets were developed as a means of security mechanism for any non stationary signals of real time. They were quite popular for providing proper robustness but the method had a lacuna of limiter rate of data. In addition there was problem of basis functions. Basis functions are of pre determined format. They also incurred choice of filters in prior stage of processing. Empirical mode decomposition (EMD) [3] helps to achieve this trade off by well providing robustness requirement. EMD changes input sound signal sample to special functions known as intrinsic mode functions (IMFs) [4], [5]. IMFs are quite symmetrical and contain AM and FM envelopes. In this method a watermark is merged in sound signal such that it is completely transparent to hear. Psychoacoustic system of man is such that it can adjust the broken chunks of sound heard. Encryption and decryption is done using same secret key. The method implemented can be called as robust if it provides same output even in presence of numerous hurdles in communication channel. The basic theme of this process is to insert the watermark in extrema of the final IMF. Different attacks are deliberately applied to the system to analyze how they affect different parameters like bit error ratio (BER), Normalized Correlation (NC), False Positive Error (FPE) and False Negative Error (FNE) [5].

II. SYSTEM UNDER CONSIDERATION

We consider a GUI as shown in fig 1 using Mat lab software that has encryption and decryption function units in it. Each push button has call back function is executed accordingly. We consider a .wav file and then browse for an image to be inserted as watermark. This watermark can be a logo or any image like standard lena image in Mat Lab. Thae watermark should have satisfy different conditions as mentioned below:

1) It must be robust
2) It should not be easily perceivable
3) It should be difficult to detect
4) It must be kept private
5) Insertion mechanism for watermark must not be straight forward and easy.

Watermark can be embedded as per method in [5]. While sending sound signal care is taken such that watermark inserted at encoder end is retrieved at decoder side. Practically there may be some minor losses incurred abruptly. As seen in fig1. the interactive push button allows user to select required input sound file. This file is played and plotted accordingly. Figure 2 shows input sound signal. As seen from fig3. the push button for browsing image is provided. The images from user database can used such as the ones shown in figures below.

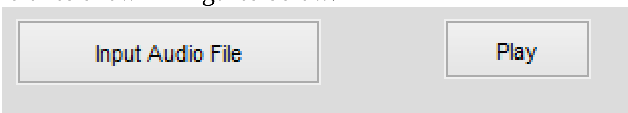

Fig 1 : Push buttons to take input sound sample and play it.

Mat Lab has standard image database like Lenna, rice grain etc. Each time we input an image we need to provide the attack which we need to examine resilience of watermarking method. Each time we apply an attack to the data we retain different data evaluation parameters.

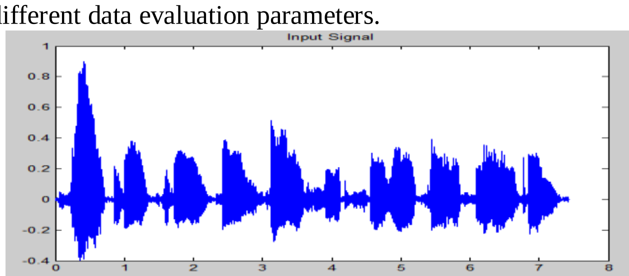

Fig 2: Input sound signal

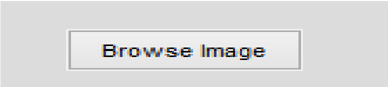

Fig3: Push button to select watermark

Fig 4: Images that can be used as watermarks

We can select desired attack and apply on the signal and check for its robustness. Each attack will correspond to different data evaluation parameters. Further encryption is done using a secret key.EMD is applied to real time sound signal. EMD [4] is an iterative adjustable technique which is generally used to deal with non stationary signals. Each attack will correspond to different data evaluation parameters. Further encryption is done using a secret key.EMD is applied to real time sound signal. EMD [4] is an iterative adjustable technique which is generally used to deal with non stationary signals. Each attack will correspond to different data evaluation parameters. Further encryption is done using a secret key.

EMD is applied to real time sound signal. EMD [4] is an iterative adjustable technique which is generally used to deal with non stationary signals.

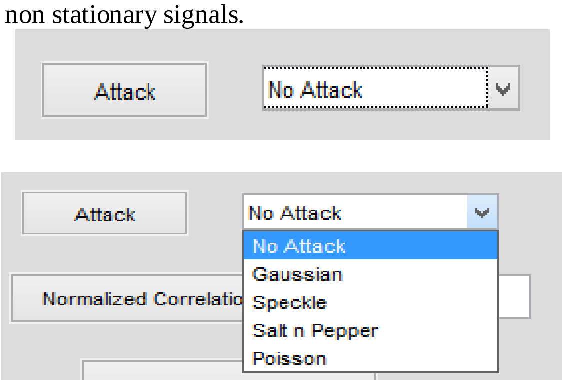

Fig5: Push button for attack.

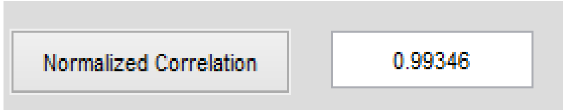

Fig6: Value of NC corresponding to No attack

Each attack will correspond to different data evaluation parameters. Further encryption is done using a secret key. EMD is applied to real time sound signal. EMD [4] is an iterative adjustable technique which is generally used to deal with non stationary signals. The maximum and minimum local values in a signal are tracked and depending on that upper and lower envelopes are obtained. Spline interpolation decides extremities of local envelopes. It implements equations of tridiagonal matrix. Sifting process plays a vital role in EMD. Final outcome of EMD over any non stationary signal is IMF. After number of iterations a monotonic slope curve called residue remains. It can be referred as last IMF.

III. RESULTS

The section presents different simulation results obtained in waveform and table formats. Embedding of data is at the rate of 100bits per second. The sampling rate of input signal is taken as approximately 44kHz. Frame length in size of 256 samples. Embedding strength is taken as 0.01. If the sample rate is insufficient we can up sample to 44kHz and further process is carried out. Normalized correlation is measure to calculate amount of data extracted from images. It is a simple and useful means to examine similarity between inserted watermark and one that is extracted. We have considered parameter like NC, BER, SNR, FPE and FNE for analyzing robustness of EMD while providing authentication of owner.

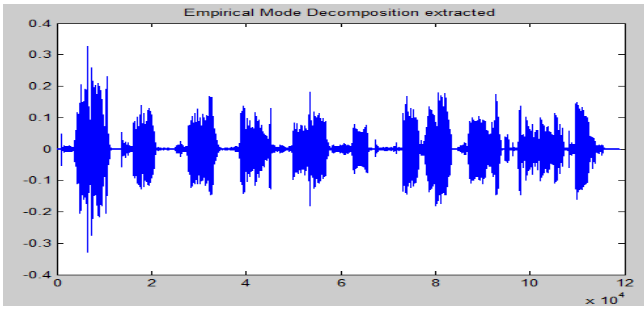

Fig 7: EMD extracted

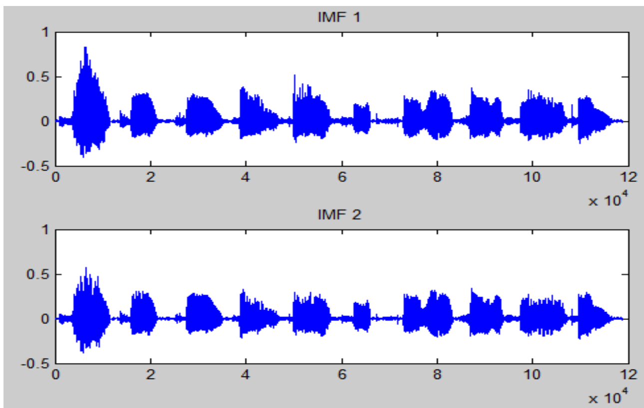

Fig 8: IMFs obtained

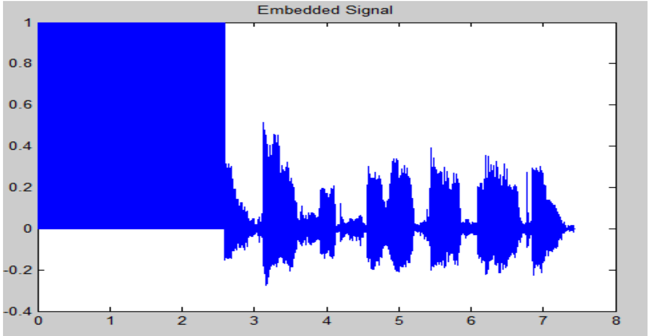

Fig 9: Embedded signal

Normalized correlation is measure to calculate amount of data extracted from images. It is a simple and useful means to examine similarity.

Fig 10: Watermark obtained after extraction

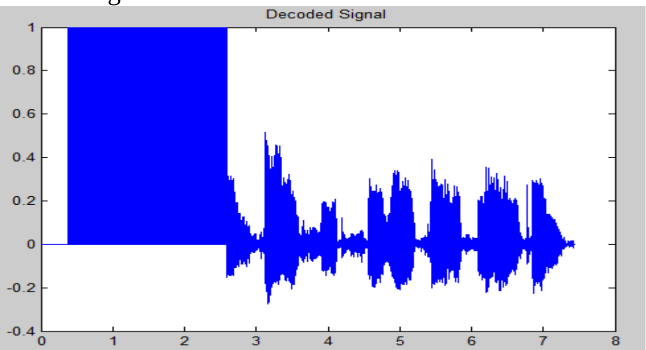

Fig 10: Decoded Output

Attack	Value
No attack	0.99346
Gaussian	0.99377
Speckle	0.99361
Salt n pepper	0.99411
Poisson	0.99344

Table no1: Normalized Correlation

Attack	Value
No attack	2.2732
Gaussian	2.241
Speckle	2.2543
Salt n pepper	2.2081
Poisson	2.2638

Table no2: BER

Attack	Value
No attack	-8.2292
Gaussian	-6.5608
Speckle	-7.2110
Salt n pepper	-5.1328
Poisson	-7.6911

Table no 3: FPE

Attack	Value
No attack	9.2292
Gaussian	7.5608
Speckle	8.2110
Salt n pepper	6.1328
Poisson	8.6911

Table no 4: FNE

Attack	Value
No attack	17.9070
Gaussian	19.1506
Speckle	19.177
Salt n pepper	19.0846
Poisson	19.2165

Table no 5: SNR

IV. CONCLUSION

In this paper we analyze the resilience of EMD to different noise attacks. It can be concluded that the method is robust to different communication intrusions. Yet the data rate is limited to certain extend which needs to focused while investigating future techniques in authentication and security concerns. There is a need of further analysis of effect of variation of embedding rate adaptively conserving the robustness of that particular method. SNR values need to be raised to much more extent for reliable transmission of data.

REFERENCES

[1] Hwai-Tsu Hu, Hsien-Hsin Chou, Chu Yu and Ling-Yuan Hsu, "Incorporation of perceptually adaptive QIM with singular value decomposition for blind audio watermarking," Hu et al. EURASIP Journal on Advances in Signal Processing , 2014

[2] S. Wu, J. Huang, D. Huang, and Y. Q. Shi, "Efficiently self-synchronized audio watermarking

for assured audio data transmission," IEEE Trans. Broadcasting, vol. 51, no. 1, pp. 69–76, Mar. 2005.

[3] N. E. Huang et al., "The empirical mode decomposition and Hilbert spectrum for nonlinear and non-stationary time series analysis," Proc. R. Soc., vol. 454, no. 1971, pp. 903–995, 1998.

[4] Sangjin Cho, and Yejin Seo, "Extraction of Significant Features using Empirical Mode Decomposition and Its Application," in Proc. WCECS, vol. 1, 2013

[5] Kais Khaldi and Abdel- Ouahab Boudraa, "Audio watermarking via EMD", IEEE Trans. Audio, Speech, and language processing, VOL. 21, NO. 3, MARCH 2013

