Discrete wavelet transform based signal
stegnography & encryption

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Abstract: Stegnography and signal encryption are the most important tools that provide data and information
security by hiding the signal under cover signal. It is usually done through mathematical manipulation of the
data with on in comprehensible format for unauthorized user. Some time it is essential to transmit Real Time
signal through internet with appreciable confidentiality for preventing unauthorized information access, this is
prime consideration for growing use of signal stenography. Proposed algorithm based on Discrete Wavelet
Transform technique for signal stenography and one stage of encryption; both methods are used for secure
communication Cryptograph which deals with data or signal encryption at sender side and decryption at receiver
side [3] with help of key or password, stegnography used for secure data transmission.

Key word: Signal encryption, stegnography, DWT, decomposition.

1. Introduction
Before phone & before mail or other traditional method the secret message were send by the messenger by
hiding the signal on his memory, sometime later invisible ink were the best method to hide the secret message
later one spread spectrum techniques were also in use, present days stenography doesn’t mean for the text
message only but also for the signal & image[1], here in this approach little emphasis is given to the encryption
of stegnographic signal to improve the information security. here in “stego-encrypto”approach implements
stenographic and encryption method together in which the amount of security increased[2]. In this paper “stego-
encrypto” techniques based on DWT is presented.

2. Methodology:
Discrete Wavelet Technique (Dwt): The transform of a signal is just another form of representing the signal. It
does not change the information content present in the signal. The Discrete Wavelet Transform provides a
compact representation of a signal in time and frequency that can be computed efficiently [3]. In wavelet
analysis, we often speak of approximations and details. The approximations are the high-scale, low-frequency
components of the signal. The details are the low scale, high frequency components The DWT is defined by the
following equation:

\[ w(j, k) = \sum_l \sum_k x(l) 2^{-l/2} \phi(2^{-j} n - k) \] (1)

Where \( \phi(t) \) is a time function with finite energy and fast decay called the mother wavelet Equation(1) shows
that it is possible to build a wavelet for any function by dilating the function \( \phi(t) \) with a coefficient \( 2^{j/2} \), and
translating the resulting function on a grid whose interval is proportional to \( 2^{-j} \). The DWT analysis can be
performed using a fast, pyramidal algorithm related to multi rate filter banks [4]. In the pyramidal algorithm the
signal is analyzed at different frequency bands with different resolution by decomposing the signal into a coarse
approximation and detail information. The coarse approximation is then further decomposed using the same
wavelet decomposition step. This is achieved by successive high- pass \( h \) and low-pass \( g \) filtering of the time
domain signal and is defined by the following equations:

\[ y_{high}[k] = \sum_n x(n) g(2k - n) \] (2)
\[ y_{low}[k] = \sum_n x(n) h(2k - n) \] (3)

Where \( y_{high}[k] \) and \( y_{high}[k] \) are the outputs of the high pass \( g \) and low pass \( h \) filters, respectively after
down sampling.
3. Algorithm:
At transmitting end: First of all the payload (embedded) and cover signal both are decomposed by applying DWT, in this the signals are transformed from spatial domain to frequency domain and separate the approximation and detail coefficient $c1[]$, $c2[]$ & $l1[]$, $l2[]$ which is high and low frequency coefficient respectively at second stage fusion of approximate coefficient $C[]=c1[]+c2[]$ & detail coefficient $L[]=l1[]+l2[]$ for both signal, applying the inverse wavelet transform to construct the stenographic signal $ss[]$. At the third stage further decomposing of stenographic signal on $A[]$ & $D[]$ at level of 3 to perform encryption on it, the detail coefficient vector $d[]$ of the signal now combined vector $R[]=d[]+code$ with code value of the wave name used as wavelet to decompose the stenographic signal value, without which the reconstruction of a signal at the receiving end is impossible.

At receiving end: At very first requirement is detaching key $code=R[]-d[]$ from the detail coefficient vector & reconstruction of stenographic signal with help of key code and approximate & detail coefficient second stage apply IDWT on stenographic signal the reconstruction of payload signal from stenographic signal with help of approximate and detail coefficient $[1][2]$, table showing the encryption time and key code of the various wavelet.

4. Result: Proposed methods were tested for various type of wavelet and there signal encryption time also be analyzed, decryption technique at the receiver end can be successfully used to recovered the embedded signal from stegnographic signal.

5. Conclusion & Discussion: “Steno-encrypto” is proposed algorithm in this paper, the algorithm used, for the signal stenography with one stage of encryption, thereafter, here “stego-encrypto” approach implements stenographic and encryption method together In which the amount of information security may increased, using the function available in MATLAB, the process of signal encryption applied on the stenographic signal using DWT, where the code name of wavelet used for decomposition is used as key for encryption, result of the signal stegnography & cover signal, embedded signal shown in the fig.1 below & at the same time signal encryption time using different wavelet is also analyzed in the table 1, fig.1 showing the cover signal stegnographic signal & embedded signal respectively.

<table>
<thead>
<tr>
<th>Wavelet used</th>
<th>Key code for encryption</th>
<th>Time of encryption in sec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Db1</td>
<td>1</td>
<td>0.2500</td>
</tr>
<tr>
<td>Db2</td>
<td>2</td>
<td>0.2810</td>
</tr>
<tr>
<td>Db3</td>
<td>3</td>
<td>0.2500</td>
</tr>
<tr>
<td>Db4</td>
<td>4</td>
<td>0.2810</td>
</tr>
<tr>
<td>Db5</td>
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<td>Db6</td>
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<tr>
<td>Db7</td>
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<tr>
<td>Db8</td>
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<tr>
<td>Db9</td>
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<td>0.3290</td>
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<tr>
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<tr>
<td>Sym2</td>
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<tr>
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<tr>
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</tr>
<tr>
<td>Sym5</td>
<td>14</td>
<td>0.2960</td>
</tr>
</tbody>
</table>
Fig.1 (a) Embedded signal (b) Cover signal (c) Steganographic signal.

REFERENCES

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