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Perform the CSI complex Sadik integral transform in cryptography

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Abstract

Recently, many researchers in mathematics have been interested in finding advanced ways to increase the strength of encryption and decryption processes using complex transformational integrals. In this paper, we will show the success and ability of CSI (complex Sadik transform) in the process of encryption and decryption through practical application.

Subject Classification: *44-XX Integral transforms.*

Keywords: *Complex Sadik integral transform, Inverse of CST, Cryptography, Encryption, Decryption.*

1. Introduction

With the increase in innovative and sophisticated methods of data penetration by attackers, researchers working in the field of data protection and preservation from penetration have to make double efforts in finding encryption methods that are sufficient and even superior to the methods of penetration in

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order to provide protection for the information of companies and governmental and non-governmental institutions. Where encryption plays an important role in data security and protection when she moved through servers for the objective of exchanging or storing the data. The idea of coding started a long time ago. The beginning was with simple ideas and later developed to become more complex at the present time. In 2010, In mathematics applications, a function with a specific variable h(t) can be converted to other functions with different variables h(s), and h(v) using transformational integration methods[1]. It was for integrative transformations their mark in many fields, the most important of which are engineering, applied mathematics, and natural sciences[2-6,10]. In[7], the ability of the SEE transform was discussed to solve Abel's integral equation. In[8,11,14] New integral transformations have been suggested to resolve the differential equations. In[9] using the SEE to get the generic solve of the differential equations of 1st-order. In the field of cryptography, integrated transformation has been applied to the exponential functions of prepositions in encryption and decoding operations[12,13,16-20].

In this work, Complex Integral Transform (complex Sadik transform), was applied as a new Integral transformation in the field of cipher, where it was applied in the encryption of the plain text, and then decoded this cipher, and returned it to the original text.

2. The Suggested complex Sadik transform is Known as [15]:

In the set A, we analyze functions using a new complex transform known for the functions of exponential order:

$$A=\{h(t)\exists C, I_1 \text{and} I_2>0 \text{such that } |h(t)|<Ne^{-jI_i|t|}, \text{ if } t\in(-1)^i\times[0,\infty),\ i=1,2\}$$

Where jis a complex numeral.

The constant C should be a limited numeral for a special function $h(t)$ in the group A, however I_1 and I_2 may be limited or unlimited.

The Suggested CST is defined as follows:

$$S_\omega^c[z(t)]=F^c(m^\omega,\delta)=\frac{1}{m^\delta}\int_0^\infty z(t)\ e^{-jm^\omega t}\ dt$$

Where $m\in\mathbb{C}$, $\omega\in\mathbb{R}^*$, $\delta\in\mathbb{R}$

2.1 *The CST & Its Inverse for several functions* [15]:

A. $S_\omega^c\{V\}=-\frac{jV}{k^{\omega+\delta}}$. V constant

B. $S_\omega^c\{t^s\}=(-j)^{s+1}\frac{s!}{k^{s\omega+(\omega+\delta)}}$. Where $s\in N$

C. $S_\beta^c\{e^{bt}\}=\frac{-1}{k^\delta}\left[\frac{b}{k^{2\omega}+b^2}+j\frac{k^\omega}{k^{2\omega}+b^2}\right]$. b constant

D. $S_\omega^c\{\sin(bt)\}=\frac{-b}{k^\delta(k^{2\omega}-b^2)}$.

E. $S_\omega^c\{\cos(bt)\}=\frac{-jk^\omega}{k^\delta(k^{2\omega}-b^2)}$.

F. $S_\omega^c\{\sinh(bt)\} = \frac{-b}{k^\delta(k^{2\omega} + b^2)}$.

G. $S_\omega^c\{\cosh(bt)\} = \frac{-jk^\omega}{k^\delta(k^{2\omega} + b^2)}$.

H. $\{S_\omega^c\}^{-1}\left[-\frac{jV}{k^{\omega+\delta}}\right] = V$.

I. $\{S_\omega^c\}^{-1}\left[(-j)^{k+1}\frac{s!}{k^{s\omega+(\omega+\delta)}}\right] = t^s$.

J. $\{S_\omega^c\}^{-1}\left[\frac{-1}{k^\delta}\left[\frac{v}{k^{2\omega}+b^2} + j\frac{k^\omega}{k^{2\omega}+b^2}\right]\right] = e^{bt}$.

K. $\{S_\omega^c\}^{-1}\left[\frac{-b}{k^\delta(k^{2\omega} - b^2)}\right] = \sin(bt)$.

L. $\{S_\omega^c\}^{-1}\left[\frac{-jk^\omega}{k^\delta(k^{2\omega} - b^2)}\right] = \cos(bt)$.

M. $\{S_\omega^c\}^{-1}\left[\frac{-b}{k^\delta(k^{2\omega} + b^2)}\right] = \sinh(bt)$.

N. $\{S_\omega^c\}^{-1}\left[\frac{-jk^\omega}{k^\delta(k^{2\omega} + b^2)}\right] = \cos h(bt)$.

3. Practical Application of The (Complex Sadik Integral Transform) Proposed in Cryptography

Here, we show the practical application of the CST in the cryptographic planner in terms of encryption and decryption.

3.1 *Encryption Stage*

This stage is implemented through the transmitter, encryption is applied to the information to convert it from consistent to inconsistent information.

- Transformation of any character in the plaintext into the corresponding serial number of them in the alpha_bet, hence:

  A=:0, B=:1, C=:2, D=:3, …, Z=:25.

- Arrangement of the text as a bounded series of numerals depending on the transmutation mentioned above transformation, by instance, the characters of text {TEASHERS} are transformed into their corresponding numbers in the alpha_bet to be:

  T=:20, E=:5, A=:1, H=:8, R=:18, S=:19.

  So, the limited series of the text is: (20,5,1,3,8,5,18,19).

- If we consider that the number of terms can be represented in the plain text as follows $(x + 1)$, then we can form a polynomial $p(y)$ of degree (x) with an operand considered as a given sequence term. in the above instance, the bounded series contains (7+1) from terms, so the $p(y)$ of degree (7).

$$p(y)=20+5y+y^2+3y^3+8y^4+5y^5+18y^6+19y^7.$$

- Take the (complex Sadik transform) for the $p(y)$

$$p(y)=S_\omega^c\{p(y)\}=S_\omega^c\{20\}+5S_\omega^c\{y\}+S_\omega^c\{y^2\}+3S_\omega^c\{y^3\}+8S_\omega^c\{y^4\}$$
$$+5S_\omega^c\{y^5\}+18S_\omega^c\{y^6\}+19S_\omega^c\{y^7\}.$$

$$S_\omega^c\{p(y)\}=-\frac{20j}{k^{\omega+\delta}}+\frac{5}{k^{\omega+(\omega+\delta)}}-\frac{2!j}{k^{2\omega+(\omega+\delta)}}+3.\frac{3!}{k^{3\omega+(\omega+\delta)}}$$
$$-8\frac{4!j}{k^{4\omega+(\omega+\delta)}}+5\frac{5!}{k^{5\omega+(\omega+\delta)}}-18\frac{6!j}{k^{6\omega+(\omega+\delta)}}+19\frac{7!}{k^{7\omega+(\omega+\delta)}}$$

$$S_\omega^c\{p(y)\}=-\frac{20j}{k^{\omega+\delta}}+\frac{5}{k^{\omega+(\omega+\delta)}}-\frac{2!j}{k^{2\omega+(\omega+\delta)}}+\frac{18}{k^{3\omega+(\omega+\delta)}}-\frac{192j}{k^{4\omega+(\omega+\delta)}}$$
$$+\frac{600}{k^{5\omega+(\omega+\delta)}}-\frac{12960j}{k^{6\omega+(\omega+\delta)}}+\frac{95760}{k^{7\omega+(\omega+\delta)}}=\sum_{s=0}^{7}\frac{-j^{s+1}Q_s}{k^{s\omega+(\omega+\delta)}}.$$

Finding g_s so that: $Q_s \equiv g_s \ mod\ 26$ for all s, $\{s=0,1,2,\dots,s+1\}$.
Therefore:

$$g_0 \equiv 20\ mod\ 26,\ g_1 \equiv 5\ mod\ 26,\ g_2 \equiv 2\ mod\ 26,$$
$$g_3 \equiv 18\ mod\ 26,\ g_4 \equiv 192\ mod\ 26,\ g_5 \equiv 600\ mod\ 26,$$
$$g_6 \equiv 12960\ mod\ 26,\ g_7 \equiv 95760\ mod\ 26.$$

- So $\{Q_s=26f_s+g_s\}$

  So, the key f_s for $\{s=0,1,2,\dots,s+1\}$ is :

  $f_0=f_1=f_2=f_3=0$ and $f_4=7$, $f_5=23$, $f_6=498$, $f_7=3683$.

- The encryption operation created a novel bounded series:

  $\{g_0, g_1,\dots, g_{s+1}\}$= {20, 5, 2, 18, 10, 2, 12, 2}.

3.2 *Decryption Stage*

This stage is implemented by the addressee, the decryption is implemented on the encrypted text to convert it to consistent information.

- The encrypted text is received from the transmitter, which has previous knowing of the encryption clef received via a secure route. In the above instance, the encrypted text is TEBRJBLB and the key is {0,0,0,0,23,498,3683}.

  Transformation of the received encrypted text to the equivalent finite sequence of the numbers: $\{g_0, g_1,\dots, g_{s+1}\}$= {20, 5, 2, 18, 10, 2, 12, 2}

  Hence ($\{Q_s=26f_s+g_s\}$for all{j= 0,1,2, … , s + 1}) Then: $g_0=20$, $g_1=5$, $g_2=2$, $g_3=18$, $g_4=192$, $g_5=600$, $g_6=12960$, $g_7=95760$.

- Implement the inverse of the CSIT of the $p(x)$:

$$\{S_\omega^c\}^{-1}\{p(x),y\} = \{S_\omega^c\}^{-1}\left(-\frac{20j}{k^{\omega+\delta}}\right)+\{S_\omega^c\}^{-1}\left(\frac{5}{k^{\omega+(\omega+\delta)}}\right)$$
$$-\{S_\omega^c\}^{-1}\left(\frac{2!j}{k^{2\omega+(\omega+\delta)}}\right)+\{S_\omega^c\}^{-1}\left(3.\frac{3!}{k^{3\omega+(\omega+\delta)}}\right)-\{S_\omega^c\}^{-1}\left(8\frac{4!j}{k^{4\omega+(\omega+\delta)}}\right)$$
$$+\{S_\omega^c\}^{-1}\left(5\frac{5!}{k^{5\omega+(\omega+\delta)}}\right)-\{S_\omega^c\}^{-1}\left(18\frac{6!j}{k^{6\omega+(\omega+\delta)}}\right)+\{S_\omega^c\}^{-1}\left(19\frac{7!}{k^{7\omega+(\omega+\delta)}}\right)$$

  Then : $p(y)=20+5y+y^2+3y^3+8y^4+5y^5+18y^6+19y^7$.

- If we look closely at the polynomial coefficients that we obtained p(y) they can be considered finite sequences, and thus the numerals of the above limited sequence can be converted to their equipollent of the alphabet characters, to get the genuine text {TEASHERS}.

4. Discussion and Conclusion

In this work, the strength and success of the complex Sadik integral transform in the field of cipher has been proven, as it was applied in encrypting the plain text and converting it to an ambiguous and unclear ciphertext, and when using its inverse proved successful and the ability to return the ciphertext to the original understandable text.

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