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# Preface

The International Conference on Applied Sciences Mathematics and Informatics (ICASMI) is an annual conference hosted by University of Lampung that brings together academics, scholars and researchers from around the world to meet and exchange the latest ideas and discuss issues concerning all fields of sciences, mathematics, informatics and their application. It also allows representatives of industry, government employers and postgraduate students to have an opportunity to discuss with experts on some issues they concern.

The theme for ICASMI 2018: "The Contribution of Sciences on Sustainable Valorization of Natural Resources" is to highlight the role of sciences tackling problems and creating synergies with other fields on sustainable valorization of natural resources. The conference will provide researchers and scientists from mathematics and computer science, researchers from various application areas such as physics, chemistry, life sciences, and engineering, as well as in education and social fields, to discuss problems and solutions in the area, to identify new issues, and to shape future directions for research.

We would like to acknowledge all of those who have supported ICASMI 2018. Each individual and institutional help were very important for the success of this conference. Especially we would like to thank the organizing committee for their valuable advices in the organization and helpful peer review of the papers.

We hope that ICASMI 2018 will be a forum for excellent discussions that will put forward new ideas and promote collaborative researches. We are sure that the proceedings will serve as an important research source of references and the knowledge, which will lead to not only scientific and engineering progress but also other new products and processes.

Dr. Junaidi, M.Sc.

IOP Conf. Series: Journal of Physics: Conf. Series 1338 (2019) 011002 doi:10.1088/1742-6596/1338/1/011002

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| | |
|---|---|
| Deadline for abstract submission | July 22$^{th}$, 2018 |
| Notification of acceptance | June 10$^{th}$ - July 26$^{th}$, 2018 |
| Registration payment (presenter) | August 2$^{nd}$, 2018 |
| Registration payment deadline (non presenter) | August 2$^{nd}$, 2018 |
| Conference | August 9$^{th}$ - 11$^{th}$, 2018 |
| Deadline for full paper | August 31$^{st}$, 2018 |

## Conference Schedule

- August 9, 2018

| Time | Activities |
|---|---|
| 07.30 am | Registration |
| 08.30 am | Opening Ceremony |
| 08.40 am | Indonesian National Anthem |
| 08.45 am | Al-Qur'an Recitation |
| 08.55 am | Traditional Dance |

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| Time | Activities |
|---|---|
| 10.50 am | Poster Session |
| 11.30 pm | Lunch Break |
| 01.00 pm | **Parallel Session 4**<br>Room A: Chemistry and Applied Chemistry<br>Room B: Biology and Applied Biology<br>Room C: Mathematics and Applied Mathematics<br>Room D: Informatics and Computer Science<br>Room E: Physics and Applied Physics |
| 03.00 pm | Coffee Break |
| 03.15 pm | **Parallel Session 5**<br>Room A: Chemistry and Applied Chemistry<br>Room B: Biology and Applied Biology<br>Room C: Mathematics and Applied Mathematics<br>Room D: Informatics and Computer Science<br>Room E: Physics and Applied Physics |
| 04.15 pm | Photo session & Closing remark |

Detail Parallel and Poster Session (http://icasmi.fmipa.unila.ac.id/2018/wp-content/uploads/2018/08/PARALLEL-SESSION.pdf)

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## Preface



## Papers

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| **Publisher** | Institute of Physics |
| **Publication type** | Journals |
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# The Implementationof Digital Text Coding Algorithm Through A Three Dimensional Mapping Derived From Generalized -mKdV Equation Using Mathematica

To cite this article: Notiragayu and L Zakaria 2019 *J. Phys.: Conf. Ser.* **1338** 012041

# The Implementationof Digital Text Coding Algorithm Through A Three Dimensional Mapping Derived From Generalized ΔΔ-mKdV Equation Using Mathematica

**Notiragayu**[1] **and L Zakaria**[1]

[1] Mathematics Department, University of Lampung, Bandar Lampung, Indonesia

**Abstract.** Encryption-decryption algorithm using a mapping can be done for encoding a digital text, such as two dimensional mapping ΔΔ-sine Gordon equation. In this article, we will be given an encryption-decryption algorithm to a digital text through a three dimensional mapping that derived from the generalized ΔΔ-mKdV equation. Implementation of Encryption-decryption algorithm in this article using MATHEMATICA.

## 1. Introduction

Cryptography is an attempt to secure digital data files (etc. text and images). Cryptography, based on security keys, can be classified into two types of keys, symmetric keys and asymmetric keys [1].

An efficient and effective encryption-decryption algorithm is a necessity in cryptography for data security. A simple encryption-description algorithm is implemented into a computer programming and produces a high degree of difficulty in finding the security key for opening the data is an absolute thing in Cryptography. Encryption-decryption algorithm which involves mathematics in it can be found in ElGamal's article (1985) and the articles in the reference [2].

Among Cryptographic encryption-decryption algorithms that use mathematical concepts, there is a Cryptographic encoding algorithm that involves mapping. For encoding in an image for example, Rinaldi (2012) has introduced the use of Arnold Cat Map (ACM) linear mapping [3]. Meanwhile, Arinten and Hidayat (2017) use Logistic Map (LM). Likewise with Ronsen, Arwin, and Indra (2014), they used ACM and Nonlinear Choatic Algorithm (NCA) in coding for an image [4,5]. Thus a mapping can be used as a means of building cryptographic encoding for a digital data (image).

With regard to digital text data, popular cryptographic algorithms used are public key algorithms, commonly referred to as asymmetric keys, for example the ElGamal public key [6]. While the use of a mapping for cryptographic algorithms text data is relatively little published.

In this article, we will discuss an application of map in cryptographic algorithms for text data. The mapping is a part of the nonlinear mapping derived from a generalized traveling wave solution ΔΔ-mKdV [7].

This article is divided into four sections. In the first section an illustration of a descriptive algorithm is provided for cryptographic coding of text data using a 2-dimensional periodic nonlinear method. The second part, in the form of case studies, discusses cryptographic algorithms of text data using 2-dimensional mapping derived from the equation of a generalized traveling wave solution ΔΔ-sine Gordon. In the third part, the implementation of the cryptographic algorithm of text data into the Mathematic programming language. In the fourth section, the conclusions are briefly described in the results obtained in the previous section.

## 2. Encryption-Decryption Algorithm For Digital Text Submission Using Mapping:An Ilustration

Consider the following nonlinear mapping:

$$\mathbf{Y}_{n\ 1} \quad \mathbf{g}_{\boldsymbol{\theta}}(\mathbf{Y}_n) \tag{1}$$

where

$$\mathbf{g}_{\boldsymbol{\theta}}: \quad \mathbb{R}^2 \qquad\qquad \mathbb{R}^2$$

$$(x, y) \quad \mapsto \quad \frac{\quad}{x\, y}, \quad x \quad .$$

It can be examined that equation (1) is a 3-periodic nonlinear mapping with the parameter values and set as any but not zero.

Example:
Consider the following text data.

*FromWolfram: Mathematica's ex extensive base of state-of-the-art algorithms, efficient handling of very long integers, and powerful built-in language make it uniquely suited to both research and implementation of cryptographic number theory***.**

We are coding the text data using mapping (1) whose symmetrical key is selected from and . Descriptively, the encryption-decryption algorithm for example text like this can be done in the following way.

### *2.1. Encryption stage*

1. Grouping Text into two parts, for example parts $x(n)$ and $y(n)$ with $n \quad N$ are the values of numeric data associated with text data. And assume the length of the text data l is the same that is $l(x) \quad l(y) \quad m \quad \mathbb{N}$.
2. Convert text data to numeric data. The ASCII code can be used or uses a self-made encoding.
3. Do the mapping iteration process as much as $r$ times with the provisions of $g^0 \quad g^r; r \quad \mathbb{N}$.
4. Select the parameter value , $0$ and make it as the key value.

### *2.2. Decryption Stages*

1. Reuse the parameter value , $0$ which is the key value at encryption.
2. Perform the mapping iteration process provided until it reaches the $r$ iteration, that is $g^r; r \quad \mathbb{N}$.
3. Convert numeric data into text data.
4. Finish.

The implementation of the descriptive algorithm above using Mathematica is given in the next section.

## 3. Digital Text Description-Encryption Algorithm Using A Mapping Derived From Generalized ΔΔ-mKdV Equation

### *3.1. The 2-Dimensional Periodic Mapping Formulation Derived from Generalized ΔΔ-mKdV Equation*

In this section, we will follow a technique for a generalized sine-Gordon equation (see [8]).
Look at the family of four mapping parameters derived from the generalized *ΔΔ-mKdV* equation follows:

$$_1V_{l,m}V_{l,m\ 1}\quad _2V_{l\ 1,m}V_{l\ 1,m\ 1}\quad _3V_{l,m}V_{l\ 1,m}\quad _4V_{l,m\ 1}V_{l\ 1,m\ 1}\quad 0, \tag{2}$$

with $_1\quad _1\ _2p,\ _2\quad _4\ _2p,\ _3\quad _2\ _1q$ and $_4\quad _2\ _4q$.
Using the following transformation

$$V_{l,m}\quad V_n \text{ where } n\quad z_1l\quad z_2m,$$

where the parameter values of $z_1$ and $z_2$ are relatively prime integers, we can reduce the form of the current wave solution (2), namely

$$_1V_nV_{n\ z_2}\quad _2V_{n\ z_1}V_{n\ z_1\ z_2}\quad _3V_nV_{n\ z_1}\quad _4V_{n\ z_2}V_{n\ z_1\ z_2}\quad 0 \tag{3}$$

Equation (3) is a form of traveling wave solution from *ΔΔ-mKdV*. It can be examined that the equation (3) is invariant for a transformation $z_1$™ $z_1, p$™ $p$, and $z_1$š $z_2$. Besides that it also fulfills the periodic nature, namely $i\quad z_2, j\quad z_1$ . Equation (3) is equivalent to mapping

$$\begin{aligned} V'_{z_1\ z_2\ 1} &\quad \frac{V_0\quad _3V_{z_1}\quad _1V_{z_2}}{_4V_{z_2}\quad _2V_{z_1}} \\ V'_{z_1\ z_2\ 2} &\quad V_{z_1\ z_2\ 1} \\ &\vdots \\ V'_1 &\quad V_2 \\ V'_0 &\quad V_1\% \end{aligned} \tag{4}$$

Select $z_1\quad 1$ and $z_2\quad 2$. The third order difference equation of equation (4) can be stated as follows:

$$_1V_nV_{n\ 2}\quad _2V_{n\ 1}V_{n\ 3}\quad _3V_nV_{n\ 1}\quad _4V_{n\ 2}V_{n\ 3}\quad 0$$

which is equivalent to the following three-dimensional mapping:

$$\begin{aligned} V_{n\ 2} &\quad \frac{V_n\quad _3V_{n\ 2}\quad _1V_{n\ 1}}{_4V_{n\ 1}\quad _2V_{n\ 2}} \\ V_{n\ 1} &\quad V_{n\ 2} \\ V_n &\quad V_{n\ 1} \end{aligned} \tag{5}$$

The equation in (5) is usually given a three-dimensional mapping derived from the generalized **ΔΔ-***mKdV* equation.

Look at equation (5). Suppose that $\boldsymbol{\zeta}_n$ is a line in $\mathbb{R}^2$ that is defined as

$$\boldsymbol{\zeta}_n\quad \begin{matrix} \dfrac{V_{n\ 2}}{V_{n\ 1}} \\ \dfrac{V_{n\ 1}}{V_n} \end{matrix}$$

Suppose that $\boldsymbol{\theta}$ is a parameter vector in $\mathbb{R}^4$: $(\ _1,\ _2,\ _3,\ _4)$. Therefore, three-dimensional statements can be reduced to a two-dimensional mapping, namely:

$$\boldsymbol{\zeta}_{n\ 1}\quad \mathbf{g}_{\boldsymbol{\theta}}(\boldsymbol{\zeta}_n)$$

where

$$\mathbf{g}_{\boldsymbol{\theta}} : \quad \mathbb{R}^2 \qquad\qquad \mathbb{R}^2$$
$$(x, y) \;\mapsto\; \frac{1}{xy}\frac{{}_3x \quad {}_1}{{}_2x \quad {}_4}, x \;. \tag{6}$$

where $y \quad \frac{V_{n\ 1}}{V_n}$ and $x \quad \frac{V_{n\ 2}}{V_{n\ 1}}$. It can be checked that the mapping in equation (6) has an integral (there is a function $S : \mathbb{R}^2 \quad \mathbb{R}$ so that $S(\boldsymbol{\zeta}_{n\ 1}) \quad S(\boldsymbol{\zeta}_n)$ for all $n \quad \mathbb{N}$) [8]. If $\frac{1}{4}$, $\frac{2}{4}$, and $\frac{3}{1}$, then the map in equation (6) can be written as

$$\mathbf{g}_{\ ,\ ,} : \quad \mathbb{R}^2 \qquad\qquad \mathbb{R}^2$$
$$(x, y) \;\mapsto\; \frac{\quad}{xy}\frac{1 \quad x}{x \quad 1}, x \;. \tag{7}$$

### *3.2. Implementation of Digital Text Data Encryption Algorithms Based on 2-Dimensional Mapping Using Mathematica*

To implement a cryptographic algorithm into a computer program, a number of software can be used, such as ***Matlab*** and ***Mathematica***. In this article, we will use ***Mathematica*** that its rules and technical writing of this program in full in a reference written by Shifrin (2008) [9].

Look at the descriptive algorithms presented in section two. Against the text and 4-periodic mapping given in that section, the implementation of algorithms using Mathematica is as follows.

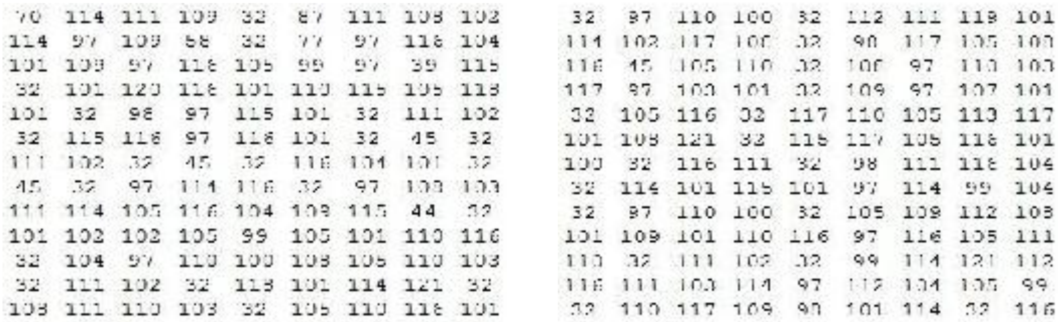
```
str1=”FromWolfram:Mathematica’s extensivebaseofstate-of-the-artalgorithms,
     efficienthandlingofverylongintegers,”;
str2=”andpowerfulbuilt-inlanguagemakeituniquelysuitedtobothresearchand
     implementationofcryptographicnumbertheory.”;
StringLength[str1]
StringLength[str2]
A=ToCharacterCode[str1];
B=ToCharacterCode[str2];
AccountingForm[Grid[Partition[A,10]]] ;
AccountingForm[Grid[Partition[B,10]]]
x=A;y=B;r=3;α=0.0001523;          8.1037277
```

*THIS SECTION IS A SUBRUTIN PROGRAM NAMED **coding1** FOR ITERATION PROCESSES g (A, B) TO THE r- ITERATION.*

```
xx=SetPrecision[coding1[[r−1,2]],10];
yy=SetPrecision[coding1[[r−1,1]],10];
AccountingForm[Grid[Partition[xx,5]]] ;
AccountingForm[Grid[Partition[yy,5]]] ;
```

*THIS PART IS A SUBRUTIN PROGRAM NAMED **recoding1** FOR ITERATION PROCESSES $g^{-1}$ (AA, BB) TO R-ITERATION.*

*Flatten[FromCharacterCode[Round[recoding1[[r −1]]]]]*



| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 70 | 114 | 111 | 109 | 32 | 87 | 111 | 108 | 102 |
| 114 | 97 | 109 | 58 | 32 | 77 | 97 | 116 | 104 |
| 101 | 109 | 97 | 116 | 105 | 99 | 97 | 39 | 115 |
| 32 | 101 | 120 | 116 | 101 | 110 | 115 | 105 | 118 |
| 101 | 32 | 98 | 97 | 115 | 101 | 32 | 111 | 102 |
| 32 | 115 | 116 | 97 | 116 | 101 | 32 | 45 | 32 |
| 111 | 102 | 32 | 45 | 32 | 116 | 104 | 101 | 32 |
| 45 | 32 | 97 | 114 | 116 | 32 | 97 | 108 | 103 |
| 111 | 114 | 105 | 116 | 104 | 109 | 115 | 44 | 32 |
| 101 | 102 | 102 | 105 | 99 | 105 | 101 | 110 | 116 |
| 32 | 104 | 97 | 110 | 100 | 108 | 105 | 110 | 103 |
| 32 | 111 | 102 | 32 | 118 | 101 | 114 | 121 | 32 |
| 108 | 111 | 110 | 103 | 32 | 105 | 110 | 116 | 101 |

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| 32 | 97 | 110 | 100 | 32 | 112 | 111 | 119 | 101 |
| 114 | 102 | 117 | 108 | 32 | 98 | 117 | 105 | 108 |
| 116 | 45 | 105 | 110 | 32 | 108 | 97 | 110 | 103 |
| 117 | 97 | 103 | 101 | 32 | 109 | 97 | 107 | 101 |
| 32 | 105 | 116 | 32 | 117 | 110 | 105 | 113 | 117 |
| 101 | 108 | 121 | 32 | 115 | 117 | 105 | 116 | 101 |
| 100 | 32 | 116 | 111 | 32 | 98 | 111 | 116 | 104 |
| 32 | 114 | 101 | 115 | 101 | 97 | 114 | 99 | 104 |
| 32 | 97 | 110 | 100 | 32 | 105 | 109 | 112 | 108 |
| 101 | 109 | 101 | 110 | 116 | 97 | 116 | 105 | 111 |
| 110 | 32 | 111 | 102 | 32 | 99 | 114 | 121 | 112 |
| 116 | 111 | 103 | 114 | 97 | 112 | 104 | 105 | 99 |
| 32 | 110 | 117 | 109 | 98 | 101 | 114 | 32 | 116 |

**Figure 1.** Conversion results of text data *A* (left) and *B* (right) to numerical data before the mapping iteration process is carried out ( $g^0$ ).

Figure 1 shows the result of the conversion of program outputs text data into numerical data using ASCII code (based on $g^0$ ). Another output of the program, for parameter values 0.0001523 and 8.1037277 , we have the following numerical data.

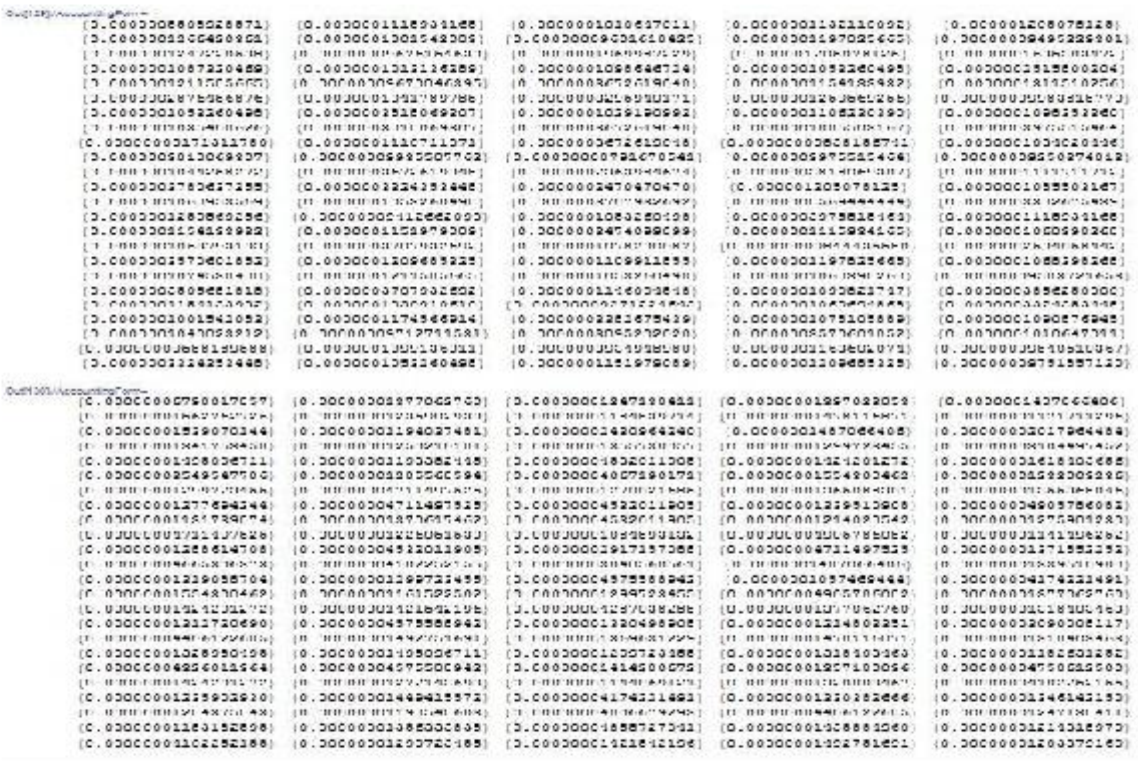

**Figure 2.** The results of the conversion of text data to numeric data with the choice of parameter values 0.0001523 and 8.1037277 , after the iteration of the mapping (7) process is carried out on $g^2$

### *3.3. Encryption-Description Algorithm For Setting Digital Text Using Mapping Generalized ΔΔ-mKdV Equation*

Review the implementation of the algorithm using Mathematica which was given in the previous section. By using the transparent properties found in mapping (6), the periodic mapping iteration process can be replaced by an iteration invers mapping process, namely:

*THIS SECTION IS A SUBRUTIN OF NAMED **recoding1** PROGRAMS*
*FOR ITERATION PROCESSES $g^{-1}$ (AA, BB) TO r-ITERATION.*

*Flatten[FromCharacterCode[Round[recoding1[[r −1]]]]].*

Out[29]//AccountingForm=

| | | | | |
|---|---|---|---|---|
| 0.0001854904308 | 0.0001524393045 | 0.0001571055130 | 0.0001587254614 | 0.0001494793100 |
| 0.0001507254614 | 0.0001466320929 | 0.0004011365540 | 0.0001315929039 | 0.0001399669970 |
| 0.0001494793180 | 0.0001430913061 | 0.0001507254614 | 0.0001374675071 | 0.0001507254614 |
| 0.0001399669970 | 0.0004011365540 | 0.0001350558750 | 0.0001587254614 | 0.0001330014761 |
| 0.0001507254614 | 0.0004011365540 | 0.0001330014761 | 0.0001272427252 | 0.0001315929039 |
| 0.0001430913061 | 0.0001316020039 | 0.0001350558750 | 0.0004011365540 | 0.0001430913061 |
| 0.0001524393045 | 0.0001480420169 | 0.0001587254614 | 0.0001539636975 | 0.0001466320929 |
| [illegible] | 0.0001587254614 | [illegible] | 0.0004011365548 | [illegible] |
| 0.0001425509792 | 0.0001475589792 | 0.0001587254614 | 0.0001480420169 | [illegible] |

Out[27]//AccountingForm=

| | | | | |
|---|---|---|---|---|
| 0.0001330014761 | 0.0001524393045 | 0.0001480420169 | 0.0001587254614 | 0.0001350558750 |
| 0.0001315929039 | 0.0001330014761 | 0.0001399669970 | 0.0001272427252 | 0.0001507254614 |
| 0.0004011365548 | 0.0001438913061 | 0.0001466320929 | 0.0001372273256 | 0.0001587254614 |
| 0.0004011365548 | 0.0001571058138 | 0.0001587254614 | 0.0001399669978 | 0.0001272427252 |
| 0.0001587254614 | 0.0001438913061 | 0.0004011365548 | 0.0001571058138 | 0.0001524393045 |
| 0.0001350558750 | 0.0001571058138 | 0.0001315929039 | 0.0001587254614 | 0.0001272273256 |
| 0.0004011365540 | 0.0001507254614 | 0.0001425510967 | 0.0001587254614 | 0.0001425509792 |
| 0.0004011365540 | 0.0001430913061 | 0.0001524393045 | 0.0001571050130 | 0.0001507254614 |
| 0.0001466320929 | 0.0001430913061 | 0.0001507254614 | 0.0001399669970 | 0.0003347036903 |

**Figure 3.** The results of the conversion of text data to numeric data with the value of the choice parameter  0.05234, $\alpha = 0.7125$, and  =6.7111, after the iteration of the mapping (7) process is carried out on $g^9$.

With algorithms and implementation of similar algorithms, for mapping (7) with a choice of key values in the form of the choice parameter value  = 0.05234,  = 0.7125,  = 6.7111 as given in figure 3.

## 4. Conclusion

From the results obtained and discussed in the previous section, it can be concluded that the 3-dimensional mapping reduced to 2-dimensional mapping derived from the ΔΔ-mKdV equation can be used to design a text cryptography relatively easily. As the purpose of cryptography is data security, then the choice of a reversible mapping option can be used as an alternative choice of digital text encoding with a symmetric key selected non-zero parameter values. The results of this study, because the statement involved is a mapping that is reversing symmetry, then for the mapping and procedure of cryptographic algorithms used for an image, the request requires a measure preserving nature, and this will be an interesting advanced topic to study.

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