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Preface

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PREFACE

The International Conference on Applied Sciences Mathematics and Informatics (ICASMI) is a biennial event hosted by University of Lampung that brings together academics, scholars and researchers from around the world to meet and exchange the latest ideas, networking, opening collaboration research 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. Due to the COVID-19 pandemic, this time the conference was held virtually.

This conference was held from 3rd to 4th of September 2020, in the Faculty of Mathematics and Natural Sciences, Universitas Lampung, Bandar Lampung, Indonesia. Zoom Meeting was utilized as a means of the conference. Each keynote speaker was given 30-minutes for his/her presentation with 15 minutes discussion, while for the oral presentation was held in a parallel session of three or four speakers where each participant was given 10 minutes for presentation and 15 minutes for panel discussion. The participants came from across several institutions and universities from 4 countries. Our initial target participants were 150, fortunately, on the closing date of registration, there were 178 participants who registered from 5 main fields of natural sciences. The main drawback of such virtual conference was the internet connection. A few numbers of speakers had this problem, so they were unable to give their best presentation, however, this drawback did not affect much the quality of this conference.

The theme of this year's conference is "Natural Sciences, Mathematics and Informatics in the Industrial Revolution (IR) 4.0 toward the Sustainable Development Goals (SDGs)." 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 the 3rd ICASMI. Each individual and institutional help were very important for the success of this conference. We would like to thank the keynote speakers who are competent in their field of study and come from different countries, such as, Japan, Malaysia, Turkey and Indonesia, and the organizing committee for their valuable advice in the organization and helpful peer review of the papers.

We hope that this conference would be a forum for excellent discussions that put forward new ideas and promote collaborative research. We are sure that the IOP proceedings publication 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.

Chair,

Prof. Dr. Rudy Situmeang

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Committee of the 3rd International Conference on Applied Sciences Mathematics and Informatics (3rd ICASMI) 2020

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Photos

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Figure 1 Keynote Speaker by Kenji Satou

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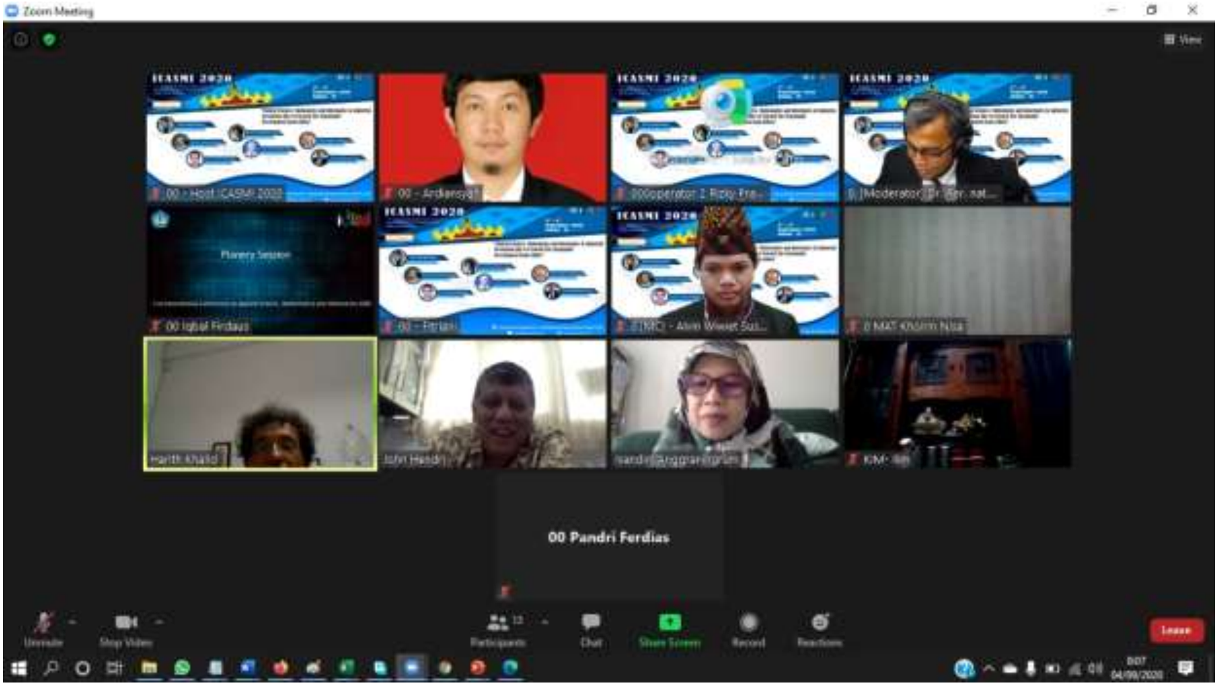

Figure 2 Keynote Speaker by Prof Harith, Prof John Hendri, and Prof Ivandini

Figure 3 Openning Speach by Chief of Committee

Figure 4 Speech by the Dean of Faculty of Mathematics and Natural Sciences, UNILA

Figure 5 Committee

Figure 6 Parallel Session

Figure 7 Closing Speech by Heri Satria

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Peer review declaration

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Peer review declaration

All papers published in this volume of Journal of Physics: Conference Series have been peer reviewed through processes administered by the Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

- **Type of peer review: Double-blind**

Conference submission management system: The submission process used was Google form

Number of submissions received: We received 171 papers submitted plus 7 keynote presentation but the keynote speakers were not ready on the due date to submit their full paper, so their papers were not reviewed

- **Number of submissions sent for review: 152**
- **Number of submissions accepted: 112**

Acceptance Rate (Number of Submissions Accepted / Number of Submissions Received X 100): The acceptance rate was: (112/152) x 100% = 73.68%

- **Average number of reviews per paper: 3.38**
- **Total number of reviewers involved: 45**

Any additional info on review process: The review process was carried using single-blind review process was to minimize the expenses we had to spent as the ICASMI committee, although not much, gave certain amount of payment for per article reviewed by reviewers, thus if we used double-blind review, it will cost double.

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A Two-Dimensional Map Derived From An Ordinary Difference Equation of mKdV and Its Properties

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A Two-Dimensional Map Derived From An Ordinary Difference Equation of mKdV and Its Properties

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Abstract. The discrete modified Korteweg–de Vries (mKdV) is a class of discrete integrable systems that may be distinguished as integrable partial difference equations (PΔE) and integrable ordinary difference equations (OΔE). By considering traveling wave solutions, the OΔE mKdV can be obtained from PΔE mKdV. Meanwhile, a mapping can be constructed from an OΔE mKdV. In this paper, we will focus on producing a new map using a process (replacement), the interchange of a single parameter, and an integral and investigate its properties.

Keywords: OΔE mKdV, PΔE mKdV, Anti measure-preserving.

1. Introduction

The theory of discrete dynamical system and difference equations has been being developed in the last thirty years of the twentieth century. Recently, there is much application of the discrete dynamical system, and difference equations have appeared in the areas of biology, economics, physics, resource management, and others [1]. One of the discrete dynamical system types is the discrete integrable system. In this type, the system can have an integral or invariant (for a two-dimensional case with invariants of high degree [2]. An example of this type is the discrete modified Korteweg–de Vries (mKdV) equation. The mKdV is a partial differential equation which known to has soliton solution; hence it is also called one of the soliton equation [3]. As a class of discrete integrable systems, discrete mKdV may be distinguished integrable partial difference equations (PΔE) and integrable ordinary difference equations (OΔE). Discrete mKdV is a class of QRT (Quispel-Roberts-Thompson) map[4,5].

The discretization of the mKdV equation has been done in various ways. One of them, the method by describing its Lax-pair, can be found in [3,4,5]. There is a connection between the two classes, namely that many integrable maps can be obtained from integrable PΔE by imposing periodic boundary conditions [6]. By using the staircase method, PΔE mKdV can be reduced into OΔE mKdV [3].To study the dynamics and also the bifurcation, we need to have a parameter in the system. By modifying the parameter, the system can be generalized. In 2019, Zakaria and Tuwankotta constructed a new map of a 2D double discrete sine-Gordon map by replacing a number of parameters in the original map[7].

The outline of this article is the following. In section 2, a three-dimensional mapping derived from generalized OΔE mKdV equation and its integral function will be described. In section 3, a new map will be constructed by re-parametrizing the parameters of the map. This technique is proposed by [8] and is also used by [7]. The properties of the new map are also explored.

2. Formulation of the Problem

Consider the standard PΔEmKdV equation on the 2D lattice (□ ^{2}) that defined as ([3],[7])

$$p\left(V_{l+1,m}V_{l+1,m+1}-V_{l,m}V_{l,m+1}\right)=q\left(V_{l,m+1}V_{l+1,m+1}-V_{l,m}V_{l+1,m}\right). \tag{4}$$

Suppose $\theta_3=\theta_4=p$ and $\theta_1=\theta_2=q$. The map in eq. (1) can be written as follow:

$$\theta_1 V_{l,m}V_{l,m+1}-\theta_2 V_{l+1,m}V_{l+1,m+1}-\theta_3 V_{l,m}V_{l+1,m}+\theta_4 V_{l,m+1}V_{l+1,m+1}=0 \tag{5}$$

In [9] has studied four parameters family of mappings, which is derived from the generalized PΔE mKdV equation (5). Note that a system of ordinary difference equations, OΔE mKdV, can be derived from Eq. (4) by restriction to traveling wave solution by setting

$$V_{l,m}=V_n, n=z_1 l+z_2 m, \tag{6}$$

where z_1 and z_2 are relatively prime integers (see [3,7] for applying on PΔE sine-Gordon). Substituting Eq. (6) into Eq. (5), the following discrete mapping can be obtained

$$\theta_1 V_n V_{n+z_2}-\theta_2 V_{n+z_1}V_{n+z_1+z_2}-\theta_3 V_n V_{n+z_1}+\theta_4 V_{n+z_2}V_{n+z_1+z_2}=0 \tag{7}$$

The map in equation (7) represents an infinite hierarchy of mapping labeled by z_1 and z_2. For fixed z_1 and z_2, the equation (7) is a mapping from $\Re^{z_1+z_2}$ ™ $\Re^{z_1+z_2}$.

Let $z_1=1$ and $z_2=2$. Therefore we have the following relation from the equations (7).

$$V_{n+3}=\frac{V_n\left(\theta_3 V_{n+2}-\theta_1 V_{n+1}\right)}{\left(\theta_4 V_{n+1}-\theta_2 V_{n+2}\right)}. \tag{8}$$

Discrete equation (8) can be written as follow:

$$\begin{aligned} V'_{n+2}&=\frac{V_n\left(\theta_3 V_{n+2}-\theta_1 V_{n+1}\right)}{\left(\theta_4 V_{n+1}-\theta_2 V_{n+2}\right)}\\ V'_{n+1}&=V_{n+2}\\ V'_n&=V_{n+1}\end{aligned} \tag{9}$$

If $\zeta_n^0=V_{n+2}/V_{n+1}$ and $\zeta_n^1=V_{n+1}/V_n$ then, Eq. (9) can be written as

$$\boldsymbol{\zeta}_{n+1}=\mathbf{h}_{\boldsymbol{\theta}}(\boldsymbol{\zeta}_n) \tag{10}$$

where

$$\begin{aligned}\mathbf{h}_{\boldsymbol{\theta}}: \quad &\Re^2 \quad ™ \quad \Re^2\\ &(x,y) \mapsto \left(\frac{-1}{xy}\frac{\left(\theta_3 x-\theta_1\right)}{\left(\theta_2 x-\theta_4\right)}, x\right).\end{aligned}$$

The discrete map in Eq. (10) is well known as a 3-dimensional mapping reduced to 2-dimensional mapping derived from Eq. (8). The mKdV map in Eq. (10) can be used to design text cryptography [10].

3. Results and Discussion

Let us assume that θ_2 not equal to zero. If $\alpha = \frac{\theta_3}{\theta_2}$ $\beta = \frac{\theta_1}{\theta_2}$, and $\lambda = \frac{\theta_4}{\theta_2}$ then the following special mapping can be derived from Eq. (10), namely

$$\boldsymbol{\zeta}_{n+1} = \mathbf{h}_{\alpha,\beta,\lambda}(\boldsymbol{\zeta}_n) \tag{11}$$

where

$$\mathbf{h}_{\alpha,\beta,\lambda}: \quad \Re^2 \quad ™ \quad \Re^2$$

$$(x,y) \mapsto \left(\frac{(\beta-\alpha x)}{x y (x-\lambda)}, x\right).$$

And its integral normal forms is [5,9]

$$H(x,y:\alpha,\beta,\lambda) = \alpha\left(\frac{1}{x}+\frac{1}{y}\right) + (x+y) - \beta\left(\frac{1}{x y}\right) - \lambda(x y) \tag{12}$$

where $\alpha,\beta,\lambda \in \Re$. Thus, for all $n \in \mathbf{N}$, the solution of Eq. (11) lies on a level set of $H(x,y:\alpha,\beta,\lambda)$. Note that a new mapping can be constructed by re-parametrizing the parameter of the original mapping Eq. (13). This technique is introduced in [8] and also used in [7].

Consider the mKdV map in Eq. (11). Let fix the parameters $\alpha = (\mu_0 + \mu_1 \alpha)$ and $\beta = \lambda = 1$. It follows immediately that the map

$$\tilde{\zeta}_{n+1} = \tilde{\mathbf{h}}_{\mu_0,\mu_1,\alpha}\left(\tilde{\zeta}_n\right) \tag{13}$$

where

$$\tilde{\mathbf{h}}_{\mu_0,\mu_1,\alpha}: \quad \Re^2 \quad ™ \quad \Re^2$$

$$(x,y) \mapsto \left(\frac{(1-(\mu_0+\mu_1\alpha)x)}{x y (x-1)}, x\right).$$

and possesses the following integral

$$\begin{aligned}\tilde{H}_{(\mu_0,\mu_1,\beta_0,\beta_1,\alpha)}(x,y) &= (\mu_0+\mu_1\alpha)\left(\frac{1}{y}+\frac{1}{x}\right)+(x+y) \\ &- \left(\frac{1}{x y}\right)-(x y)+(\beta_0+\beta_1\alpha).\end{aligned} \tag{14}$$

Since $\tilde{H}_{(\mu_0,\mu_1,\beta_0,\beta_1,\alpha)}(x,y)$ is linear in α. And because of

$$\tilde{H}(x,y:\alpha)=0 \quad \Rightarrow \quad \tilde{H}\left(\frac{(1-(\mu_0+\mu_1\alpha)x)}{x y (x-1)}, x:\alpha\right)=0,$$

therefore, we have

$$\alpha = \alpha(x,y) = \frac{1-\mu_0(x+y)-\beta_0 xy-(x^2 y+xy^2)+x^2y^2}{\mu_1(x+y)+\beta_1 xy} \tag{15}$$

And it follows that $\tilde{h}_{(\mu_0,\mu_1,\alpha)}$ with the replacement $\alpha = \alpha(x,y)$ satisfies

$$\alpha\left(\frac{(1-(\mu_0+\mu_1\alpha)x)}{x y (x-1)}, x\right) = \alpha(x,y) \tag{16}$$

Explicitly, $\tilde{h}_{(\mu_0,\mu_1,\alpha)}$ with the replacement $\alpha = \alpha(x,y)$ yields the map,

$$\hat{h}_{(\mu_0,\mu_1,\beta_0,\beta_1)} : \mathbb{R}^2 \to \mathbb{R}^2$$
$$(x,y) \mapsto \left(\frac{\beta_1 x(1-\mu_0 x) + \mu_1\left(1+\beta_0 x^2 + x^3 + x^2 y - x^3 y\right)}{(-1+x)x\left(\beta_1 xy + \mu_1(x+y)\right)}, x \right) \tag{17}$$

The mapping Eq. (17) have some properties:

- The mapping $\hat{h}_{(\mu_0,\mu_1,\beta_0,\beta_1)}$ has an integral Eq. (15).
- $\hat{h}_{(\mu_0,\mu_1,\beta_0,\beta_1)}$ is anti-measure-preserving, i.e.

$$\left|D\hat{h}_{(\mu_0,\mu_1,\beta_0,\beta_1)}\right| = -\frac{\rho(x,y)}{\rho\left(\frac{\beta_1 x(1-\mu_0 x) + \mu_1\left(1+\beta_0 x^2 + x^3 + x^2 y - x^3 y\right)}{(-1+x)x\left(\beta_1 xy + \mu_1(x+y)\right)}, x \right)}$$

where

$$\rho(x,y) = \frac{1}{xy}\left[\partial_\mu \tilde{H}(x,y)\right]^{-1} = \frac{1}{\mu_1(x+y) + \beta_1 xy}.$$

- There exists a reversing symmetry $L(x,y) = (y,x)$ such that

$$L \circ \hat{h}_{(\mu_0,\mu_1,\beta_0,\beta_1)} \circ L = \hat{h}^{-1}_{(\mu_0,\mu_1,\beta_0,\beta_1)}.$$

It means that $\hat{h}_{(\mu_0,\mu_1,\beta_0,\beta_1)}$ is reversible ($\hat{h}_{(\mu_0,\mu_1,\beta_0,\beta_1)} \circ L \circ \hat{h}_{(\mu_0,\mu_1,\beta_0,\beta_1)} = L$).

4. Conclusions

Based on the results in the previous section, we have described in detail that a mapping derived from an OΔE mKdV has (anti) measure-preserving and reversing symmetry properties.

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