Poster / origami exhibition

Abstract

Research Field / Mathematics

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3	Error estimates for nonlinear diffusion equations and the approximate problems	Shunsuke Kurima	Tokyo University of Science
4	Identification of factors as predictors of insider threat in e-learning model	Koichi Niihara, Kikuchi Hiroaki	Meiji University, MIMS
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Research Field / Origami, Technology, Mechanics, Architecture

	Poster title / Origami exhibition title	Authors / Name	Affiliation
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20	Comparison of Neural Networks in Feedback-Error Learning Control for Paper Folding Robots	Julian A. Romero L.A. Diago Chie Nara Junichi Shinoda Ichiro Hagiwara	Meiji University, MIMS Interlocus. Inc. Meiji University, MIMS Interlocus. Inc. Meiji University, MIMS
21	Origami-Based Modeling and Analysis	Hikari Tachino	Chiba University

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Out of the awards	Some observations of regular polygons in origami paper.	Haruo Hosoya	Ochanomizu University
	Japan Origami Academic Society	Jun Maekawa	National Astronomical Observatory of Japan
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	Origami loop strip for the regular tetrahedron	YukiMurakami RyotaYamamoto YoshikazuYamagishi	Ryukoku University

1

Poster

"Global existence and asymptotic behavior in two-species chemotaxis systems"

Masaaki Mizukami

Tokyo University of Science

In this work, we consider two-species chemotaxis systems which describe a situation in which two populations react on a single chemoattractant. We will report global existence and asymptotic stability of classical solutions to the systems under some condition.

2

Poster

"Fitting the Real World Tessellation by the Spherical Laugerre Voronoi Diagram Using Planar Photographic Images"

Supanut Chaidee
Meiji University, MIMS

Kokichi Sugihara
Meiji University, MIMS

We propose a method for fitting the spherical Laguerre Voronoi diagrams to spherical tessellations which are acquired from planar photographic images. The framework is applied using the properties of a polyhedron corresponding to the spherical Laguerre Voronoi diagram. The experiments were performed using fruit skin photos.

3

Poster

"Error estimates for nonlinear diffusion equations and the approximate problems"

Shunsuke Kurima

Tokyo University of Science

This work is concerned with nonlinear diffusion equations such as porous media equations and their approximations via Cahn-Hilliard systems. Colli and Fukao (2016) studied similar problems by subdifferential approach; however, they required two steps of approximations. The purpose of this work is to solve the original and approximate equations directly by subdifferential approach and to establish sharp error estimates for their solutions.

4

Poster

"Identification of factors as predictors of insider threat in e-learning model"

Koichi Niihara
Meiji University, MIMS

Kikuchi Hiroaki
Meiji University, MIMS

There have been recent incidents in which large amounts of personal information have been leaked by malicious insiders. Organizations are now required to prepare countermeasures to deal with insider threats. To identify the primary causes of malicious insider behavior, an experiment was conducted using a pseudo e-learning website. A total of 100 subjects were recruited by crowd-sourcing and divided into four groups with different hypothesized causes of insider threat. The number of malicious activities in each group was observed. The results show a correlation between the hypothesized causes of insider threat and malicious activities.

5

Poster

"Competitor-mediated coexistence: One of the ecological mechanisms behind biodiversity"

Lorenzo Contento
Meiji University, MIMS

Masayasu Mimura
Meiji University, MIMS

In theoretical ecology, the competitive exclusion principle (CEP) states that when two or more species are competing for the same limited resource only one can eventually survive. However, in nature many examples of rich biodiversity are observed. Several mechanisms that can lead to species coexistence are known, but most of them occur in situations where the CEP is not applicable. We are interested in studying how the indirect competition dynamics between three species can lead to coexistence (competitor-mediated coexistence), without any apparent contradiction with the CEP. We investigate mathematically this mechanism by a three-species competition-diffusion system displaying complex patterns of dynamical coexistence.

6

Poster

"Audio-CAPTCHA with Distinction between Random Phoneme Sequences and Words Spoken by Multi-speaker"

Michitomo Yamaguchi
Meiji University, MIMS

Kikuchi Hiroaki
Meiji University, MIMS

"Audio-CAPTCHA prevents malicious bots from attacking Web services and provides Web accessibility for visually-impaired persons.In this paper, we utilize the difficulty for recognizing voices spoken by multi-person as a CAPTCHA.Our proposal synthesizes various voices by changing voice speed and employing non-native speakers. Moreover, we employ semantic identification problems between random phoneme sequences and semantic words to improve the accuracy of humans, usability and security.We evaluated our scheme in several experiments."

7

Poster

"Asymmetric simple exclusion process with Langmuir kinetics with reflecting boundary"

Jun Sato
University of Tokyo, RCAST

Katsuhiro Nishinari
University of Tokyo, RCAST

"We consider the asymmetric simple exclusion process with Langmuir kinetics with reflecting boundary. We analytically obtain the exact stationary state of the system in a certain limit. The exact density profile in the stationary state is also obtained in this limit. "

8

Poster

"Local-Scale Noise Effects in Chaotic Models and Experimental Data"

Nina Sviridova
Meiji University, MIMS

Kazuyuki Nakamura
Meiji University, MIMS

Noise contamination in experimental data with underlying chaotic dynamics is one of the significant problems encountered in applied studies. Although numerous studies have been devoted to the investigation of different aspects of noise – nonlinear dynamics interactions, the effects produced by noise on chaotic dynamics are not fully understood. This study sought to analyze the local effects produced by noise on chaotic models and experimental green light photoplethysmogram time series. Results demonstrated that in chaotic models under noise induction and in experimental data local regions on the chaotic attractor and time-delayed-reconstructed trajectory with higher response to additive noise can be observed.

9

Poster

"Accumulation of eigenvalues in a stability problem"

Ayuki Sekisaka

Meiji University, MIMS

Traveling waves or nonlinear waves important object in many applications in physics, engineering and in other areas of science. these are affected by noise externally or internal fluctuations. Therefore the stability problem is fundamental for the observation of phenomena in nature. One of the methods for the stability of traveling wave is to study the linearized operator associated with traveling waves. In this poster, we show interesting phenomena which eigenvalues of such operator accumulate on the certain curve on the complex plane when the domain size tends to infinity.

10

Poster

"A Topological Study of Biological Motion"

Tsuyoshi Yoshioka
Teikyo Heisei University

Tomoyuki Yamamoto
Waseda University

The phenomenon, that the human brain recognizes to be the movement of the animal by expressing the positions such as the joints of the animal with a point and chasing movement (motion) of the point, is called biological motion. In the current study, the reason why the phenomenon is caused is verified by set-theoretical topology. A topological structure of biological motion has been confirmed to be perfect, 0-dim, compact T1 space.

11

Poster

“Mathematical model of flat origami’s arts”

Kosuke Nosaka

Kyoto University of Education

""“What is origami in mathematics?”- I considered the mathematical representation of flat origamis to solve the problem. As a result, I concluded that flat origami's arts are represented by the conbination of ""operation"" and ""partial order"". Concretely, the operation represents a method of folding and the partial order represents staking order of folded paper. Therefore, the method and staking order are important for representaiton of flat origamis.In this poster, I define the model clearly and show you how to fold a ""paper crane"" in accordance with the definition."

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Poster

"The optimization of gripper design in Origami-performing robot"

Phuong Thao Thai Meiji University, MIMS
Maria Savchenko Meiji University, MIMS
Ichiro Hagiwara Meiji University, MIMS

Gripping is a key task for robotic arms. The crease line length in forming process by the robot arms can be limited by the gripper sizes. Based on this, we consider an optimization of the geometry of the plane contact portion of gripper for forming the crease line with a given length. Required forces are applied to the object surface via a contact portion of the gripper.

13

Poster

"Impact characteristic of compact origami helmet"

Yang Yang Meiji University, MIMS
Chie Nara Meiji University, MIMS
Ichiro Hagiwara Meiji University, MIMS

The helmets play an important role in protecting the head of people when earthquake or tumble happens. The existing safety helmet has some disadvantages: expensive, take up space, and inconvenient to carry. Therefore, considering the foldable/deployable and impact characteristics of origami structures and the cheapness of recycled cardboard, it is an interesting challenge to design of a new folding helmet to satisfy the performances of safety, storability, light-weight, and low-price.

14

Poster

"The simplest and smallest locally-flat-foldable but not-flat-foldable crease patterns in the square/diagonal grid

Yoshihisa Matsukawa University of Tsukuba
Yohei Yamamoto GIKEN, LTD
Jun Mitani University of Tsukuba

The crease patterns of well-known basic origami shapes are within the 45 degrees grid system, i.e., the square/diagonal grid. We found two the simplest and smallest locally-flat-foldable but non-flat-foldable crease patterns in the grid. One has valid mountain/valley assignments, and the other does not. In this poster, we present how we concluded the two patterns are the simplest and smallest. This poster also shows origami shapes that are looked like letters, i.e. alphabet and numbers, that are created by folding the 5x3 gird patterns.

15

Poster

"Nonlinear Mechanics of Non-rigid Origami: A Simplified Approach"

Ke Liu

Georgia Institute of Technology

Glaucio H. Paulino

Georgia Institute of Technology

In reality, due to the flexibility of thin sheets, additional soft modes of origami might influence its mechanical properties. To investigate such changes, a general approach for analyzing the nonlinear mechanical responses of non-rigid origami structures is essential. We introduce here a fully nonlinear, displacement-based implicit formulation for static/quasi-static analyses of origami structures based on a bar-and-hinge simplified modeling. The formulation leads to an efficient and robust numerical implementation for predicting large global deformations of origami structures. Agreement between real models and numerical simulations hints the ability of the proposed approach in capturing key features of origami behaviors.

16

Poster

"Continuous Flattening of Regular Dodecahedron and Regular Icosahedron"

Takashi Horiyama — Saitama University
Jin-ichi Itoh — Kumamoto University
Naoki Katoh — Kwansei Gakuin University
Yuki Kobayashi — Tokyo Institute of Technology
Chie Nara — Meiji University, MIMS

The second and the fifth author discussed with the forth author the continuous flattening of all Platonic polyhedra; however, a problem was encountered in the case of the dodecahedron and the icosahedron. To complete the study, we explicitly show a continuous folding of a regular dodecahedron and a regular icosahedron.

17

Poster

"A generation method of origami model for CG"

Shinichi Tanaka
University of Tsukuba

It is not easy to create geometrical models like origami, which consist of thin sheets overlapping in layers. Therefore, it takes much time and effort to make realistic CG of origami. In this research, we propose a new method for generating geometrical models of reversely symmetrical origami. We develop an interface for 3D modeling of origami from 2D images . Our approach makes it easier to create geometrical models of origami for CG.

18

Poster / origami exhibition

"Design and Manufacture of Honeycomb Construction Based on Origami Technology"

Lijun Wang University of Tokyo
Kazuya Saito University of Tokyo
You Gotou Shiroyama Industrial Co., Ltd
Yoji Okabe University of Tokyo

Nowadays honeycomb constructions are widely used in many different engineering fields especially in the transport industry and aerospace field where weight reduction and strength maintenance are two of the most significant design parameters. Multifarious honeycomb cores can be designed based on the space geometry. In this study, the hexagonal honeycomb cores (core angles 120°) were designed and developed by according to the traditional origami technology, and the aluminum honeycomb construction were manufactured by a new process.

19

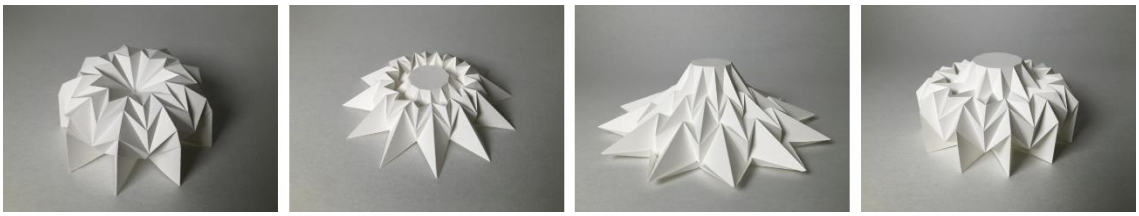
Poster / origami exhibition

"Simulation of Triangle -based Axisymmetric Rigid Origami"

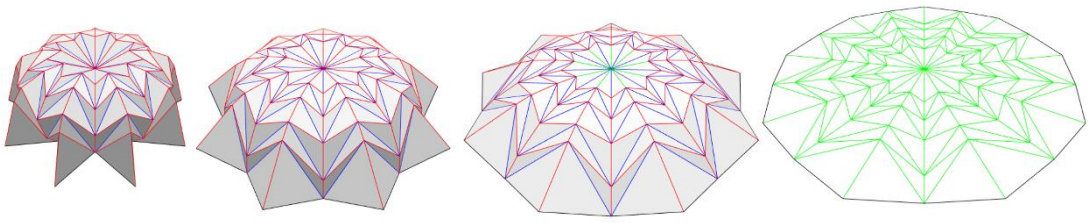
Yan Zhao University of Tsukuba
Yoshihiro Kanamori University of Tsukuba
Jun Mitani University of Tsukuba

We focus on a category of origami that is constructed with triangle facets with axisymmetric structure. Our method generates a rotationally-symmetric crease pattern and then calculates the shape of 3D origami. Our prototype system enables us to simulate the deformation of the 3D origami axisymmetrically by changing one parameter. By changing another parameter, our system simulates a folding motion called "along-arc flat-folding," to flatten the shape along the arc. Several 3D origami pieces and folding sequences are presented to demonstrate the validity.

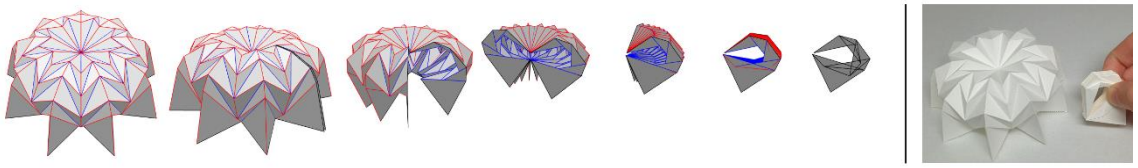
・Results of 3D origami



・Deformation of the 3D origami axisymmetrically



・Along-arc flat folding



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Poster / origami exhibition

"Comparison of Neural Networks in Feedback-Error Learning Control for Paper Folding Robots"

Julian A. Romero — Meiji University, MIMS
L.A. Diago — Interlocus. Inc.
Chie Nara — Meiji University, MIMS
Junichi Shinoda — Interlocus. Inc., MIMS
Ichiro Hagiwara — Meiji University, MIMS

"Creating complex spatial objects from a flat sheet of material using origami-folding techniques has attracted attention in science and engineering. It is extremely difficult to introduce highly versatile automation using machines to handle deformable objects such as a flat sheet of paper. This work proposes a new machine for origami folding that uses Feedback error learning (FEL) to perform precise and smooth manipulations of the paper.In this project a comparison between different types of Artificial Neural Networks (NN) is performed in order to analyze their performances in trajectory planning for paper-folding robots. Three NN are compared: An Adaptive Linear Network, an Adaptive Linear Network with Adaptive learning rate, and a Holographic Neural Network.The main objective is to analyze each of their performance in a Origami Robot device designed in our previous project in order to be used to performed smooth and precisely movements necessary in paper manipulation."

21 origami exhibition

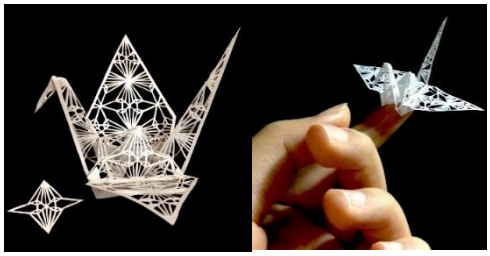
"Origami-Based Modeling and Analysis"

Hikari Tachino
Chiba University

Kururin-round and round
Based on Curved-Crease Sculpture by Erik D.Demaine

Kururin-round and round
Based on Curved-Crease Sculpture by Erik D.Demaine

Kururin-round and round
Based on Curved-Crease Sculpture by Erik D.Demaine



Cutout Origami Crane
(Pattern of crease pattern)
切り絵折り鶴(展開図文様)

A / **Out of the poster awards**

Poster

"Some observations of regular polygons in origami paper."

Haruo Hosoya

Ochanomizu University, Emeritus

The standard size of origami paper is 15cm x 15cm, for which many simple but heuristic drawing methods were found for cutting or folding regular polygons. These observations will be useful for teaching mathematics and origami to high school students. Practical origamists may also get interested in these problems.

B / **Out of the poster awards**

Poster

"Japan Origami Academic Society"

Jun Maekawa
National Astronomical Observatory of Japan

Introduction of the activities of the Japan Origami Academic Society.

Out of the poster awards

Origami exhibition

"Modeling by the infinite fold"

Tomoko Fuse
Origami Artist, Independent

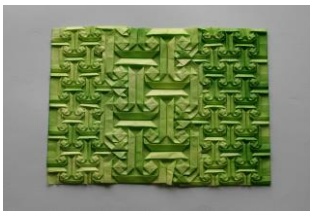
1. Introduction

Folding a sheet of paper sometimes results in unintentional discovery of an interesting shape, sometimes in finding a rhythm of folds. Modeling by folding paper is more constrained than other genres of art. That is the reason why the found shapes are usually geometrical.
As examples of such findings, the author reports some works with the infinite fold, where folding patterns can be repeated endlessly: two-dimensional tessellation pieces and three-dimensional accordion-like works.

2. Two-dimensional works

Most of origami pieces involve sequences of bisection. The most common technique is dividing into smaller parts (figure 1). In tessellation, the basic fold is the square twist (figure 2).

Figure 1. 

Figure 2. 

3. Three-dimensional works

Bisection is also the major technique in three-dimensional models. The author presents six types of pieces with their variations that can be closed flat (figure 3) (figure 4).

Figure 3. 

Figure 4. 

4. Conclusion

The infinite fold has various types, both two- and three-dimensional. Its pieces have shapes that emerge from the rules of origami, not that represent known shapes or nature. The most important thing is that a complete world can be perceived in the actual folding process.

Reference [1] Shuzo Fujimoto, Ajisai-ori, Seibundo Shinkosha, December 2010.

Out of the poster awards

Origami exhibition

Origami loop strip for the regular tetrahedron

Yuki Murakami, Ryota Yamamoto, Yoshikazu Yamagishi (Ryukoku University)

ICMMA Origami-based Modeling and Analysis, Meiji University, November 9-12, 2016

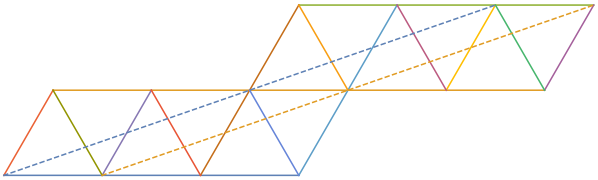


Fig. 1 An origami expansion of the loop strip for the regular tetrahedron with the index 1/2

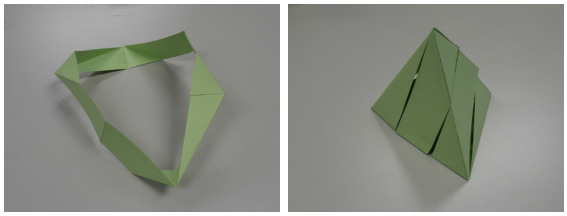


Fig. 2 Left: The loop strip with the index 1/2. Right: The folded strip is a regular tetrahedron.

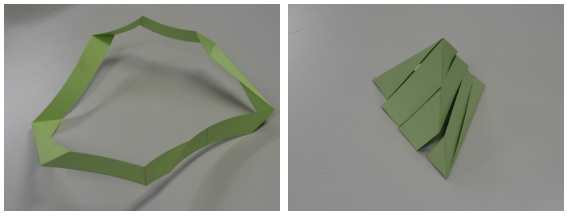


Fig. 3 Left: The loop strip with the index 1/3. Right: The folded strip is a regular tetrahedron.

Let M be a regular tetrahedron. There are countably many closed geodesics on M, each of which does not intersect itself. Geodesics on polyhedra are studied in [1, 3, 4]. From the viewpoint of origami, we are interested in the complement of the geodesic in M.

Let $u = (1, 0)$, $v = (1/2, \sqrt{3}/2)$. The lattice $\mathbb{Z}u + \mathbb{Z}v$ is the set of vertices of a regular tiling of the plane, consisting of equilateral triangles. Davis el al. [2] remarked that for each rational number p/q with p, q relatively prime, the line segment connecting the origin with the point $pv+qu$ represents a geodesic ℓ on M having two vertices as its endpoints.

M has four vertices. The remaining two vertices can be connected by another geodesic ℓ' parallel to ℓ. If we cut M along ℓ and ℓ', we obtain an untwisted loop strip. Conversely, for each rational number p/q, there exists a loop strip with an origami pattern that makes M.

Figs. 1, 2 show the loop strip corresponding to the rational number 1/2. Fig. 3 corresponds to 1/3. As p, q get larger, the strip becomes long and thin.

References

[1] A. Cotton, D. Freeman, A. Gnepp, T. Ng, J. Spivak, and C. Yoder, The isoperimetric problem on some singular surfaces, J. Aust. Math. Soc. 78 (2005), no.2, 167-197.

[2] D. Davis, V. Dods, C. Traub, J. Yang, Geodesic trajectories on regular polyhedra, arXiv:1508.0354, (2015).

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[4] Dmitry Fuchs, and Serge Tabachnikov, Mathematical omnibus: thirty lectures on classic mathematics, Providence, RI: American Mathematical Society (2007). (D. フックス, S. タバチニコフ 著, 蟹江幸博 訳, 本格数学練習帳 3, ヒルベルトの忘れられた問題, 第 20 講 曲率と多面体, 岩波, 2013.)