BALTIC JOURNAL OF LAW & POLITICS
A Journal of Vytautas Magnus University
VOLUME 16, NUMBER 3 (2023)
ISSN 2029-0454

Cite: Baltic Journal of Law & Politics 16:3 (2023): 2508-2517
DOI: 10.2478/bjlp-2023-00000190

Generating Symmetrical Batik Pattern by Fractal Model Based on Four Quadrants Generic Pattern in Four and Five Straight Lines Forms

Tedjo Darmanto
Informatics Engineering, Islamic University of Nusantara, Bandung, West Java, Indonesia
Email: tedjodarmanto@uninus.ac.id

Hamdi Hidayatuloh
Informatics Engineering, Islamic University of Nusantara, Bandung, West Java, Indonesia
Email: hamdihidayatuloh@uninus.ac.id

Farhan Fadhurrohman
Informatics Engineering, Islamic University of Nusantara, Bandung, West Java, Indonesia
Email: farhanfadhurrohman@uninus.ac.id

Firman Firdaus
Informatics Engineering, Islamic University of Nusantara, Bandung, West Java, Indonesia
Email: firmanfirdaus@uninus.ac.id

Fauzan Kifahayat
Informatics Engineering, Islamic University of Nusantara, Bandung, West Java, Indonesia
Email: fauzankifahayat@uninus.ac.id

Received: December 24, 2022; reviews: 2; accepted: January 16, 2023

Abstract

To design and generate symmetrical batik patterns by fractal model can be easily modified for future needs, as long as the fractal object generated by iterated function system (IFS) can be obtained by just decoding the code. The IFS code represents the coefficients of affine transformation, so can be modified by affine transformation such as translating, mirroring or flipping horizontally or vertically. Batik pattern in block form that is delimited by crossed lines can be filled by any color. There is a tricky way to build a straight line in

fractal form by normalizing the draft thick line. In this paper there are two generic quadrant patterns as examples, the patterns are built in four and five straight line forms crossing one or more other lines. To copy a pattern in quadrant to other quadrants relative to the center can be done horizontally first then vertically or vice versa.

Keywords

IFS fractal model, affine transformation, symmetrical batik pattern, generic quadrant pattern

Introduction

There are many researchers who studied the way to generate batik patterns. Iskandar, R.S.F et.al. studied to find out geometric concepts related to ethno-mathematics that are used for example in batik motifs and other areas [1]. Crystian, C. & Wahyono, W. built an application to generate geometrically symmetric patterns through symmetrical pattern enforcement based on generative adversarial network (GAN) to accelerate training processes efficiently [2]. Ramli, H. et.al. studied to examine the application of tritik technique in creating exquisite batik pattern design that is almost similar to the traditional "tie and dip" technique, but differs in the aspect of fabric treading with a more elegant pattern [3]. Tian, G. et.al. proposed the automatic generation method of batik flower patterns based on fractal geometry based on 2D iterated function system (IFS) and curve function [4]. Minarno, A.E. et.al. introduced the batik Nitik 960 dataset from Yogyakarta, Indonesia that is supplied by PPBI Sekar Jagad. There are 60 categories in which 16 photographs each, for a total 960 images [5]. Anggoro, P.W. et.al. introduced computer-based virtual design and manufacturing technology that are used to produce Kawung batik patterns for ceramic surfaces [6]. Atrinawati, A. studied Jlamprang batik motive through observation and interviewing the local people who understand the history well [7]. Kaewareelap, S. studied the modernizing batik clothes as a cultural heritage of Southeast Asia through creative design, color characterization and collection presentation [8]. Putri, C.F. & Sahbana, M.A. studied to measure the productivity by means of Objective Matrix (OMAX) method for BM Batik SME [9]. Hafiza, G.N. et.al. studied by combining two techniques to create marbling and block batik motifs by means of an application of marbling on block batik motifs in contemporary batik creation for entrepreneur and students who wish to enhance the creativity in batik creation [10]. Rachmayanti, S. studied the application Latohan as a special pattern in Lasem to residential interior in order to maintain the sustainability of the batik Lasem pattern with case study in vernacular building [11]. Li, D. & Yan, Y. N. summarized existing batik patterns and analyzed the general batik styles and features in accordance with the imitation of batik patterns in digital designing art to achieve an immediate printing result [12]. Yin, X. & Wang, J. proposed three methods to solve the problem of low production efficiency, environmental pollution, and industrialized imitation batik production

came into being [13]. Dinata, R. & Fan, Z. Offered a comparative study of three categories of development which applied philosophy, contemporary style and basic design principle approach to design a modern batik pattern [14]. There are more researchers studied in fractal geometry related to batik designs [15, 16]. There are more researchers studied in GAN and Neural Network methods related to batik designs [17, 18, 19, 20, 21].

Methods

To generate batik patterns in blocks separated by many straight lines that cross to each other can be done in three steps. First, design and generate four or five slim rectangles representing lines in the South-West quadrant, as the first object then duplicate the representation code of the first object by flipping horizontally into the South-East quadrant as the second object. Merge the two objects by merging the code of the two quadrants then duplicate by flipping vertically and translate to the other two quadrants on top of the first and second quadrants to have the third object. Finally merge the last two objects (in the bottom and on top) into a new single object (draft version) by merging the representation code of the objects. Actually the sequence can be reversed vertically first then horizontally with the same result.

The IFS code of fractal object consists of 6 coefficients affine (a, b, c, d, e and f), the coefficients '**a**' and '**c**' of the straight line object are zero [22]. In the second step, normalize the code of the last object by modifying the coefficient '**a**' and '**c**' of its IFS code to be zeroes and other coefficients by rounding up and save as IFS code of another new object (final version). The IFS code of the final version can be seen in Table-1 (model-1) and in Table-2 (model-2) in the Results section. In the last step, images of batik pattern in fractal form can be processed further by duplicating or multiplying the size by copying horizontally and vertically or converting the colors into the inverted colors version. The result of batik pattern model-1 and model-2 discussed in the next section.

Results

There are two models, the four lines model (model-1) and the five lines model (model-2). The design result of the model-1 can be seen in Figure-1, and the design result of the model-2 can be seen in Figure-2. Generating from the models to be objects, the two models can be generated by fractal decoding algorithm [22] and save the both objects form into IFS code format. The IFS code of the first model can be seen in Table-1 and the IFS code of the second model can be seen in Table-2.

The result from the third step of the method, the batik pattern phase-1 as generic form can be seen in Figure 3 (model-1) and Figure-6 (model-2). The result of phase-2 can be seen in Figure-4 (model-1) and Figure-7 (model-2) To have another palette of colors, the colors of image can be substituted by any color or

just invert the colors by inversion color process. The result of inverted colors versions can be seen in Figure-5 (model-1) and Figure-8 (model-2).

Table-1. IFS code of the final version of model-1 (4 lines). There are 4 (lines) times 4 (quadrants) equal 16 rows

a	b	c	d	e	f	Probability
0.0	-0.5	0.0	0.4	-0.5	0.0	1.0/16
0.0	0.4	0.0	0.5	-0.1	0.0	1.0/16
0.0	-0.4	0.0	-0.2	-0.5	-0.2	1.0/16
0.0	-0.1	0.0	-0.5	-0.2	-0.5	1.0/16
0.0	0.5	0.0	0.4	0.5	0.0	1.0/16
0.0	-0.4	0.0	0.5	0.1	0.0	1.0/16
0.0	0.4	0.0	-0.2	0.5	-0.2	1.0/16
0.0	0.1	0.0	-0.5	0.2	-0.5	1.0/16
0.0	0.5	0.0	0.4	0.0	-0.6	1.0/16
0.0	-0.4	0.0	0.5	-0.5	-0.5	1.0/16
0.0	0.4	0.0	-0.2	-0.1	-1.0	1.0/16
0.0	0.1	0.0	-0.5	-0.1	-1.0	1.0/16
0.0	-0.5	0.0	0.4	0.0	-0.6	1.0/16
0.0	0.4	0.0	0.5	0.5	-0.5	1.0/16
0.0	-0.4	0.0	-0.2	0.1	-1.0	1.0/16
0.0	-0.1	0.0	-0.5	0.1	-1.0	1.0/16

Table-2. IFS code of the final version of model-2 (5 lines). There are 5 (lines) times 4 (quadrants) equal 20 rows

a	b	c	d	e	f	Probability
0.0	0.5	0.0	0.1	0.0	-0.4	1.0/20
0.0	-0.5	0.0	0.3	-0.5	-0.1	1.0/20
0.0	0.4	0.0	0.1	-0.1	0.0	1.0/20
0.0	0.5	0.0	0.3	0.0	-0.1	1.0/20
0.0	-0.1	0.0	0.5	0.45	0.0	1.0/20
0.0	-0.5	0.0	0.1	0.0	-0.4	1.0/20
0.0	0.5	0.0	0.3	0.5	-0.1	1.0/20
0.0	-0.4	0.0	0.1	0.1	0.0	1.0/20
0.0	-0.5	0.0	0.3	0.0	-0.1	1.0/20
0.0	0.1	0.0	0.5	0.45	0.0	1.0/20
0.0	-0.5	0.0	0.1	-0.5	-0.5	1.0/20
0.0	0.5	0.0	0.3	0.0	-0.6	1.0/20
0.0	-0.4	0.0	0.1	-0.5	-0.9	1.0/20
0.0	-0.5	0.0	0.3	-0.5	-0.6	1.0/20
0.0	0.1	0.0	0.5	-0.35	-0.5	1.0/20
0.0	0.5	0.0	0.1	0.5	-0.5	1.0/20
0.0	-0.5	0.0	0.3	0.0	-0.6	1.0/20
0.0	0.4	0.0	0.1	0.5	-0.9	1.0/20
0.0	0.5	0.0	0.3	0.5	-0.6	1.0/20
0.0	-0.1	0.0	0.5	0.35	-0.5	1.0/20

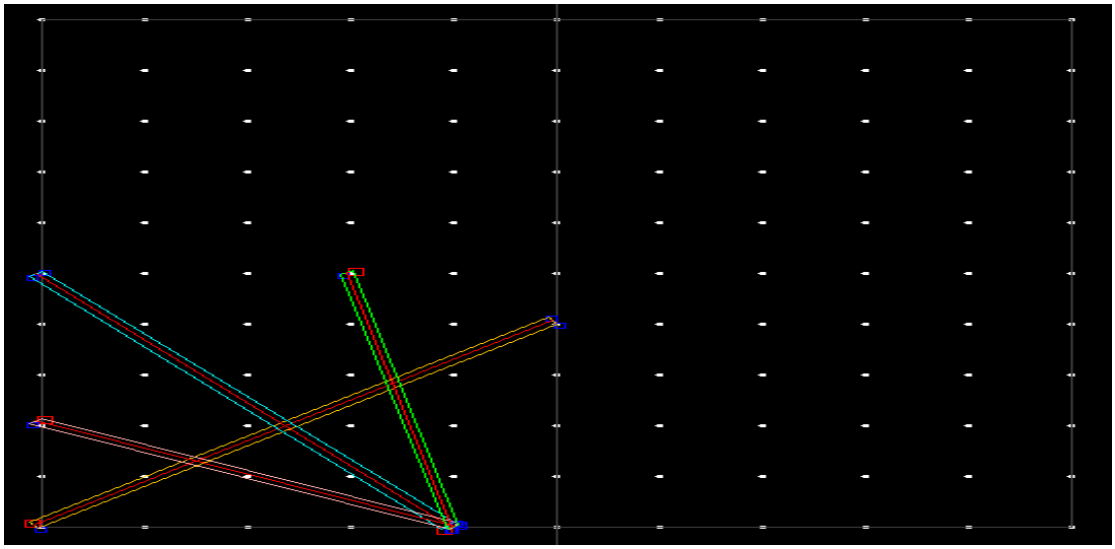

Figure-1. The design model of model-1 (x-v like)

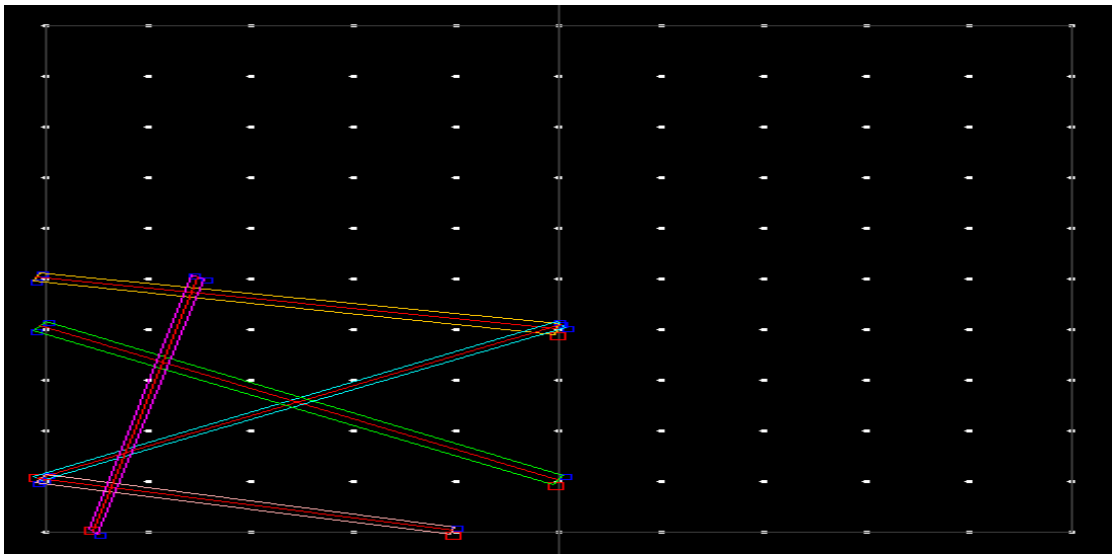

Figure-2. The design model of model-2 (x-z like)

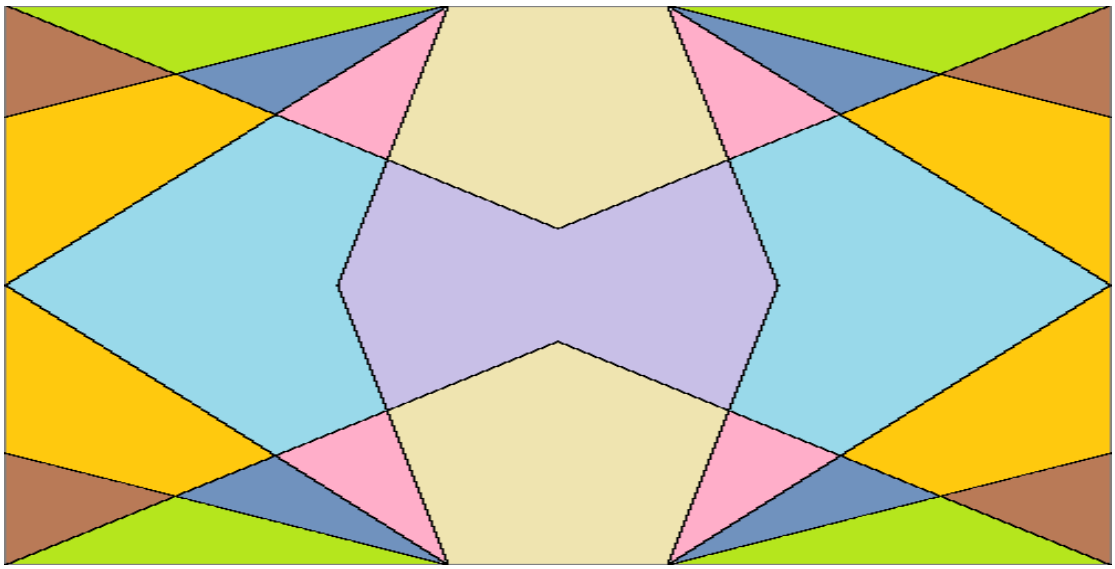

Figure-3. The fractal object of model-1 (4 lines) as final version phase-1

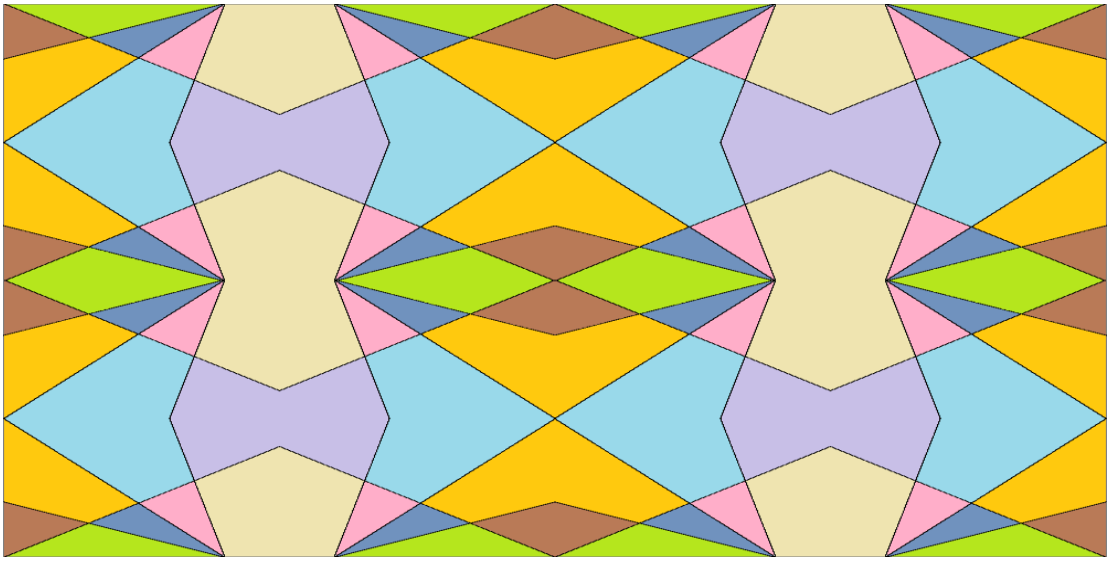

Figure-4. The fractal object of model-1 (4 lines) phase-2 (normal colors)

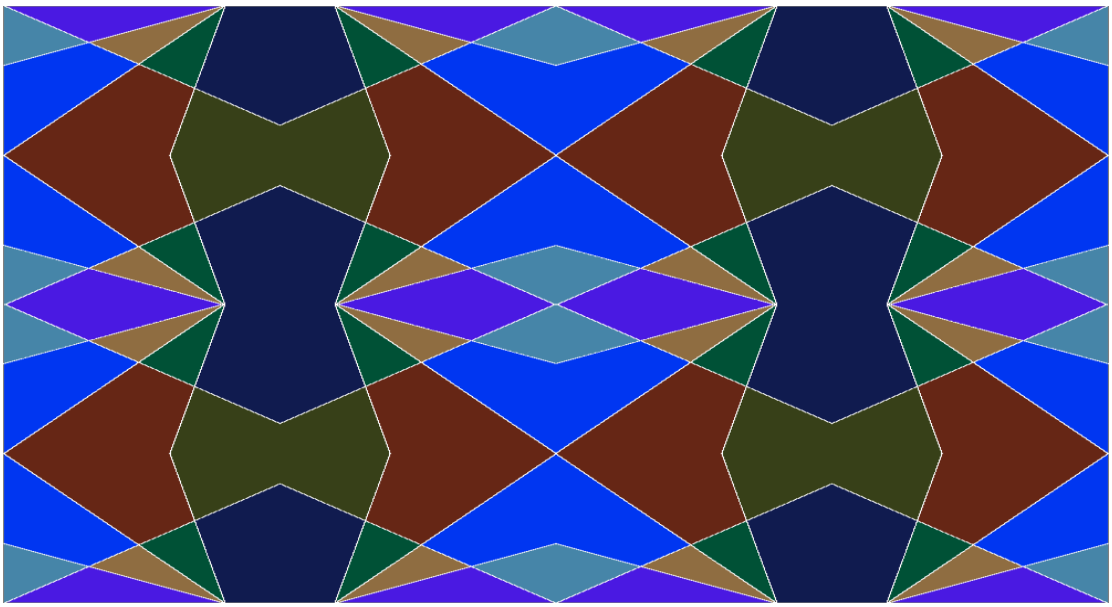

Figure-5. The fractal object of model-1 (4 lines) phase-2 (inverted colors)

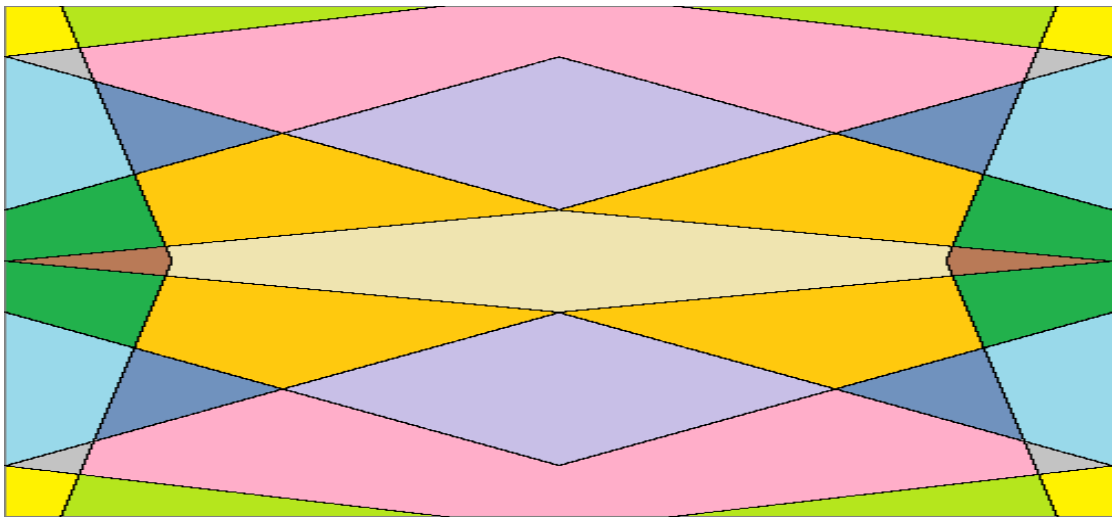

Figure-6. The fractal object of model-2 (5 lines) as final version phase-1

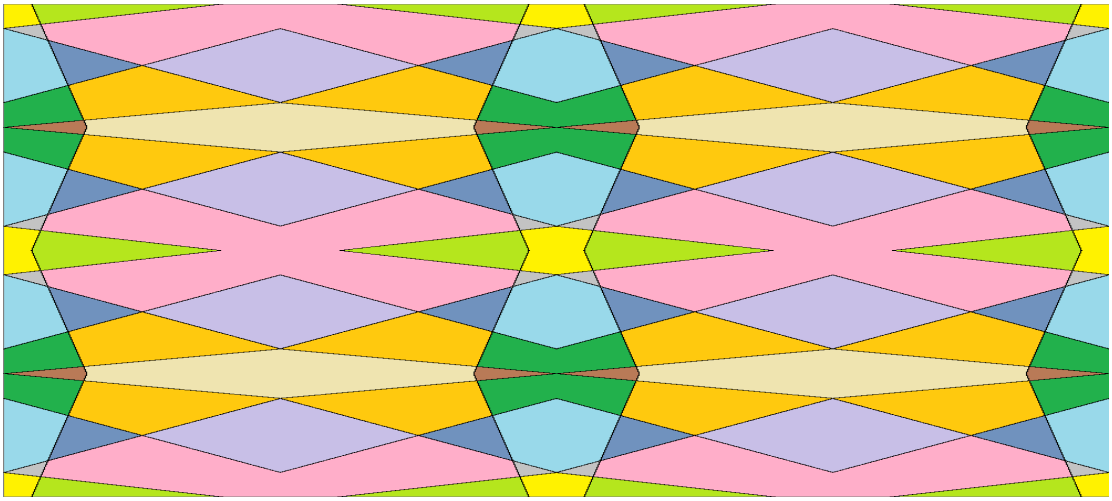

Figure-7. The fractal object of model-2 (5 lines) phase-2 (normal colors)

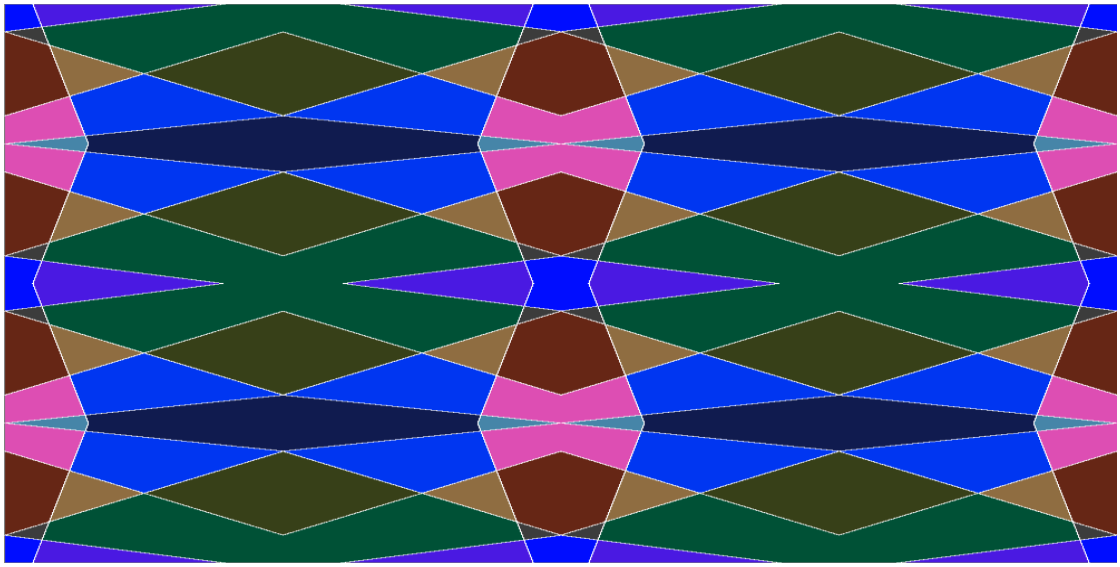

Figure-8. The fractal object of model-2 (5 lines) phase-2 (inverted colors)

For further need, the image of batik pattern in phase-2 can be continued to next phase. The example result of phase-3 of model-2 in inverted version can be seen in Figure-9.

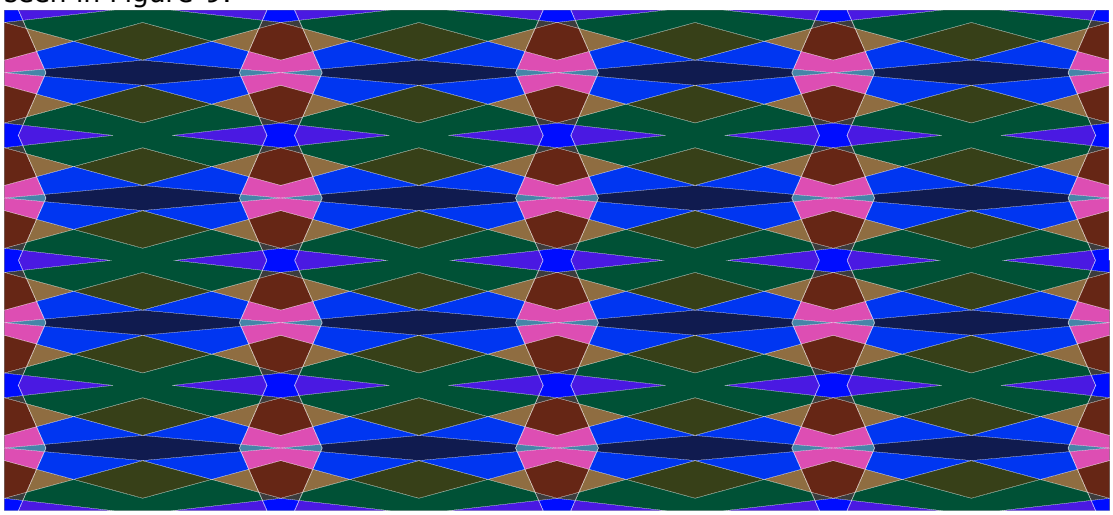

Figure-9. The fractal object of model-2 (5 lines) phase-3 (inverted colors)

The advantages of fractal model over other models is the simplicity of the recycle process by just applying the affine transformation such as the delate transformation operation horizontally or vertically on the IFS code. The example of horizontally squeeze version of model-2 can be seen in Figure-10.

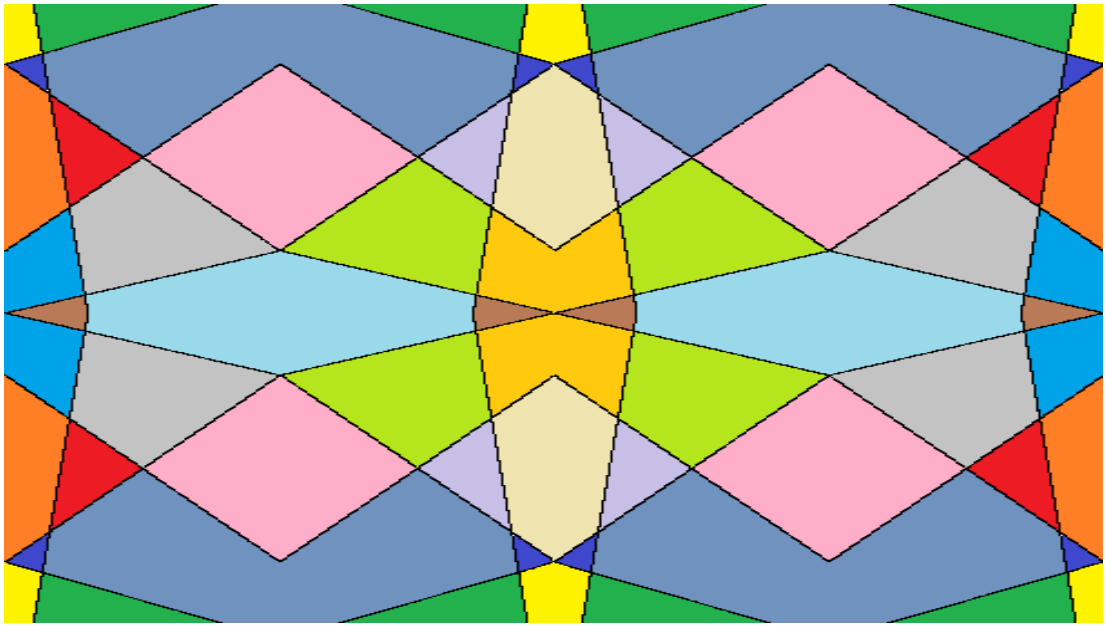

Figure-10. The fractal object of model-2 (squeeze version)

Image of batik pattern in figure-10 as the result of squeeze version of model-2 can be compared with the normal version of model-2 in Figure-6 above, in which is looked like there are two images of normal version squeezed horizontally.

Conclusion

The colorful symmetrical batik pattern in blocks can be generated by fractal models by modifying the IFS code of many line objects. Modify the batik pattern by duplicating the images horizontally and vertically in quadrant fashion to reserve the symmetric pattern. The colors of the results also can be substituted by any colors or inverted. Additionally, the fractal model of batik pattern can be recycled by just simply transforming the IFS code of the batik pattern by one or combination of affine transformation operations.

References

1. Iskandar, R.S.F., Karjanto, N., Kusumah, Y.S., Ihsan I.R. "A Systematic Literature Review: Ethnomathematics in Geometry". 2022. https://arxiv.org/pdf/2212.11788.pdf
2. Crystian, C. & Wahyono, W. "SP – Batik GAN: An Efficient Generative Adversarial Network for Symmetric Pattern Generation". 2023. https://arxiv.org/pdf/ 2304.09384.pdf

3. Ramli, H., Shuhaizam, T. & Hazman, M.N.H. "The Beauty of Tritik Technique in Creating Batik-textile Pattern Designs". *Journal of Advance Research in Dynamical & Control Systems*, Vol.11, No.05 special issue, 2019
4. Tian, G., Yuan, Q., Hu, T. & Shi, Y. "Auto-Generation System Based on Fractal Geometry for Batik Pattern Design". *MDPI Applied Sciences,* 9,2383. 2019. Doi:10.3390/app9112383
5. Minarno, A.E., Soesanti, I. & Nugroho, H.A. "Batik Nitik 960 Dataset for Classification, Retrieval, and Generator". MDPI Data, 8.63, 2023. Doi:10.17632/ sgh484jxzy.3
6. Anggoro, P.W., Krishnayuda, M.B., Bawono, Y.B., Suharyanti, Y., Felasari, S., Setyohadi, D.B., Widyanarka, O.K.W. & Bayuseno, A.P. "Virtual Design and Machining of Core and Cavity for Fabrication of Dining Plate Tableware with Kawung Batik Pattern". *Cogent Engineering*, 9:1, 2084985. Taylor & Francis. 2022. Doi:10.1080/23311916.2022. 2084985
7. Atrinawati, A. "Jlamprang Batik Patterns as Pekalongan Local Wisdom of Using Batik Technique". E3S Web of Conference. *JCENIS*. 2022. Doi:10.1051/e3sconf/ 202235904003
8. Kaewareelap, S., Sirisathitkul, Y. & Sirisathitkul, C. "Modernizing Batik Clothes fro Community Enterprises Using Creative Design and Colorimetry". *Emerging Science Journal*, ISSN:2610-9182, 2021. https:// www.researchgate.et/publication/363739408
9. Putri, C.F. & Sahbana, M.A. "Productivity Measurement Analysis using OMAX and AHP Method on Batik SME". *Journal of Industrial Engineering management* (JIEM), ISSN:2508-1430, Vol-7, No.3, 2022. Doi:10.33536/jiem.v7i3.1028
10. Hafiza, G.N., Marzuki, I. & Soliana, W.M.Z. "The Application of Batik Block Motifs and Marbling Technique as Pattern Designs in Cotemporary Batik". AIP Conference Proceedings 2347, 020122, 2021. Doi:10.1063/5.0052330
11. Rachmayanti, S., Salim, P., Roesli, C. & Hartono H. "Vernacular Architecture Residential in Lasem with Batik Pattern Latohan in Interior". The 6th International Conference on Eco Engineering Development (ICEED), 2022. Doi:10.1088/ 1755-1315/1169/1/012060
12. Li, D. & Yan, Y. N. "Design of Dig-Art Imitating Batik Pattern". *Advanced Materials Research*, Vol-214:260-264. International Conference on Key Engineering Materials, Vol-214. 2011. Doi:10.4028/www.scientific.net/AMR.214. 260
13. Yin, X. & Wang, J. "Application of Computer Simulation Technology in In Traditional Batik Pattern Design". *Wool Textile Journal* 45(9):56-59. 2017. Doi: 10.19333/j.mfkj.2016090230904
14. Dinata, R. & Fan, Z. "Elaboration of Batik Pattern Design Application in Indonesia". 2019. Doi: 10.22441/ihasj.2019.v2i2.06
15. Yuan, Q.N., Lv, J., Huang, H.S. "Auto-Generation Method of Butterfly Pattern of Batik Based on Fractal Geometry". *International Journal on Signal Process, Image Process, Pattern Recognition*. 2016, 9, 369–392
16. Wang, S.H., Yang, X.H. "Generation of fractal image on complex plane and its application in textiles". *Journal Silk* 2017, 54, 56–61

17. Ihsan, A.F. "A study of batik style transfer using neural network," the 9th International Conference on Information and Communication Technology (ICoICT), 2021, pp. 313–319
18. Chu, W.T. & Ko, L.Y. "BatikGAN: A Generative Adversarial Network for Batik Creation," in Proceedings of the 2020 Joint Workshop on Multimedia Artworks Analysis and Attractiveness Computing in Multimedia–Association for Computing Machinery (MMArt-ACM), 2020, pp. 13–18
19. Abdurrahman, M., Shabrina, N.H. & Halim, D.K. "Generative adversarial network implementation for batik motif synthesis," the 5th International Conference on New Media Studies (CONMEDIA), 2019, pp. 63–67
20. Ecstexela, S. & Bae, S.H. "A new batik pattern generation method for creative photography using deep neural networks," in Proceedings of the Korean Society of Information Sciences, 06, 2019
21. Amalia, A.N., Huda, A.F., Ramdania, D.R. & Irfan, M. "Making a batik dataset for text to image synthesis using generative adversarial networks," the IEEE 5th International Conference on Wireless and Telematics (ICWT), 2019, pp. 1–7
22. Darmanto, T. "Animating Fractal of Things: Based on IFS Fractal Model", ISBN: 978-3-659-86851-1, Lambert Academic Publishing (OmniScriptum GmbH & Co. KG) Germany, www.lap-publishing.com, 2016