Origami Generator 2.0 (*version 2.0*)

1. Introduction:

This software is developed based on an inverse origami design model [1], aiming to assist users with or without experience in origami design to produce the origami with the desired cross-sectional shapes. The generated origami is constructed based on General Miura origami pattern and keeps axial compression.

The last version: ***Origami Gnerator 1.0***	*https://github.com/Flourishingsky/Inverse-Origami-Design-Model.git*	15 *Sep*, 2022
The released version: ***Origami Gnerator 2.0***	*The new version is updated based on MATLAB R2022a App Designer, which can directly save the flat crease pattern as independent DXF files for laser machine and output the 3D model of the origami into STL files.*	26 *June*, 2023

2. Installation

Three use methods for this design software are illustrated as follows:

1) The user can run the Origami_Generator 2.0\for_redistribution\MyAppInstaller_web.exe to complete the installation of Runtime version and the software simultaneously.

2) A MATLAB app installer is provided, Origami_Generator.mlappinstall. The user can run the installer to load the software into the MATLAB Toolbox and use it.

3) The user can directly run the Source Code\Origami_Generator_App.mlapp on MATLAB and open the software, and then enter the start interface as shown in **Fig. 1**.

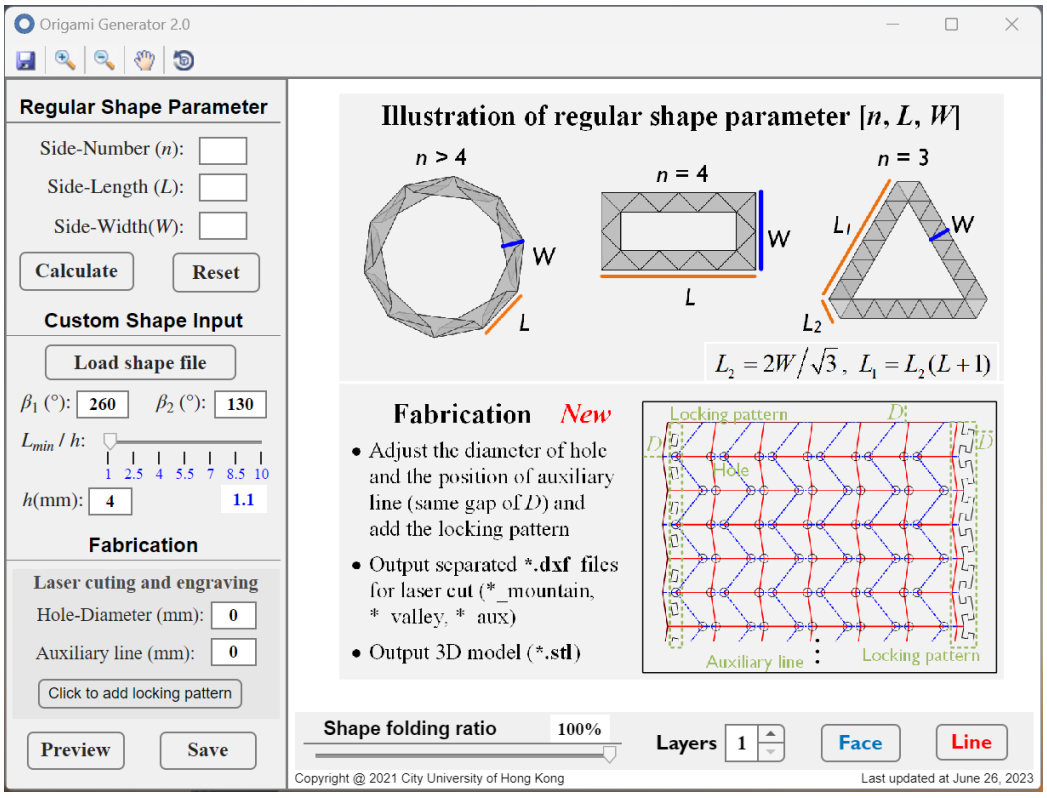

Fig. 1. Screenshot of "*Origami_Generator 2.0*" software

3. Function Information

1) If the user only wants to generate the regular cross-sectional shapes, the user can directly input the desired shape parameters [n, L, W] and then press "**Calculate**" button. The corresponding origami will be generated and shown in the right panel of the software. The explanation of shape parameters can be seen in the start interface of the software or citation **[1]**. The user can control the shape folding ratio, adjust the number of layers, and check the appearance of the origami.

2) If the user would like to generate a custom cross-sectional shape, a shape graphic file is requested. The user can press "**Load shape file**" button to load the shape into the software. Then, the shape graphics will be shown in a pop-up window, and the user requires to use the left mouse button to divide the shape into a combination of numerous line segments (***L***) anticlockwise. The auxiliary circle is used to divide a curve into line segments with similar length. As shown in **Fig. 2**, the densities of division considerably influence the level of detail of the generated origami. The parameters of β_1 and β_2 are adjusted to mix different crease patterns to fit the desired origami shape better, and the parameters of h and L_{min}/h are used to adjust the ratio between the actual length of the shortest line segment (L_{min}) and the half-layer height of h. The detailed illustration of the method and related parameters can be found in the citation **[1]**. The generated origami will be shown in the right panel of the software. The user can control the shape folding ratio, adjust the number of layers, and check the appearance of the origami.

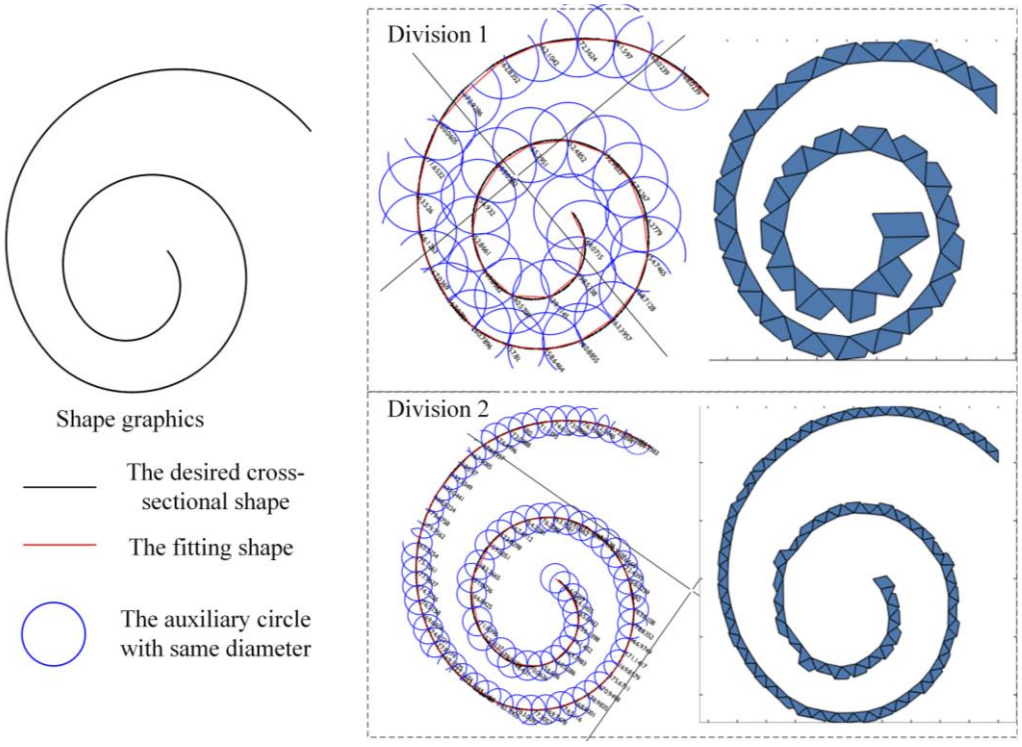

Fig. 2. The division of the custom shapes.

3) In addition to the fabrication of paper printing proposed in the last version, the new version can save the crease pattern of the targeted origami as DXF format directly used to laser process film sheets, as shown in **Fig. 3**. The codes are achieved with the help of DXFLib by Grzegorz Kwiatek. The software can output three independent DXF files for laser cutting and engraving. The detailed fabrication process refers to the citation **[2]**. This software can adjust the diameter of holes that locate at the intersection of four creases.

The hole is adopted to eliminate the stress concentration there. A rectangular cut-line is added to assist the location of the film during fabrication, and the distance of the margin can be adjusted in the software. Meanwhile, the user can select whether the locking patterns are added for the regular origami according to demand, which can connect both ends of the origami solidly by using mechanical interlocking.

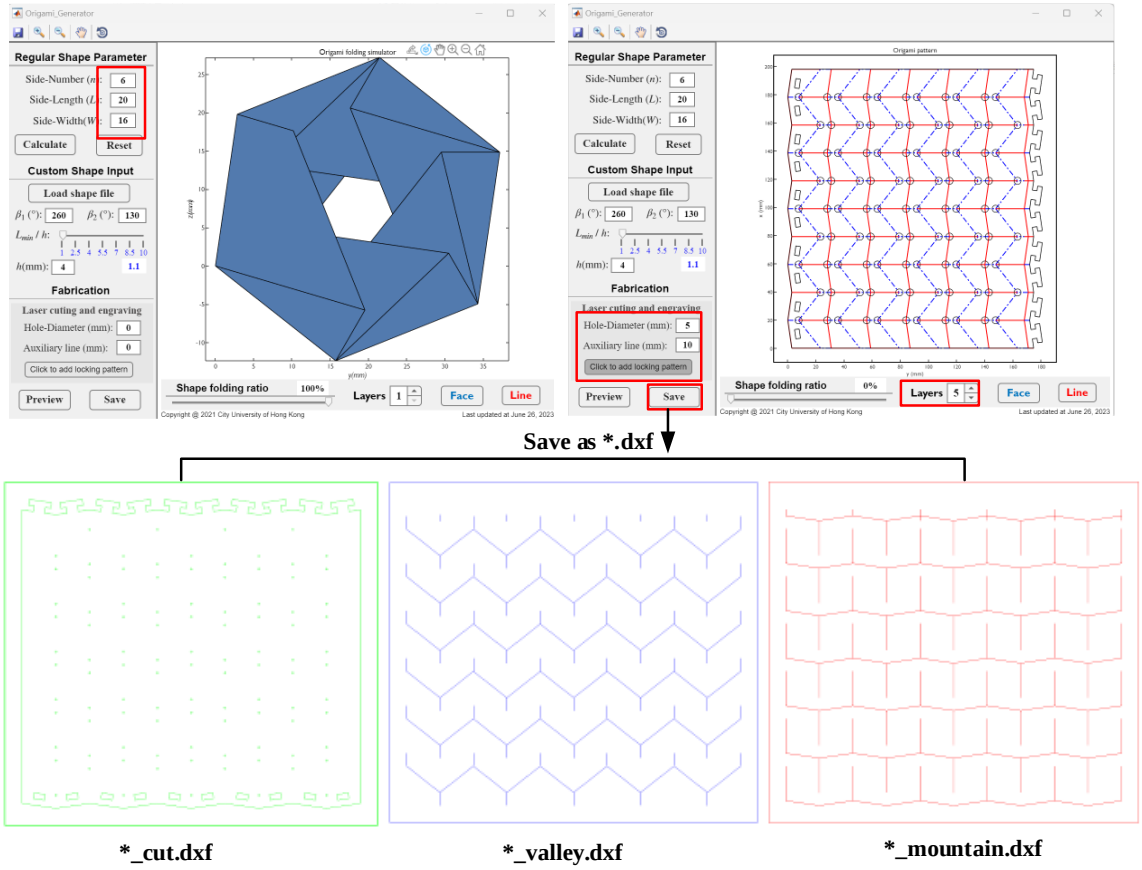

Fig. 3. Creating three independent DXF files for laser processing.

The new version also supports the output of STL format, which can covert the simulated origami into a 3D STL file, as shown in **Fig. 4**. The file can be imported into SOLIDWORKS and thickened to create a 3D model for various purposes.

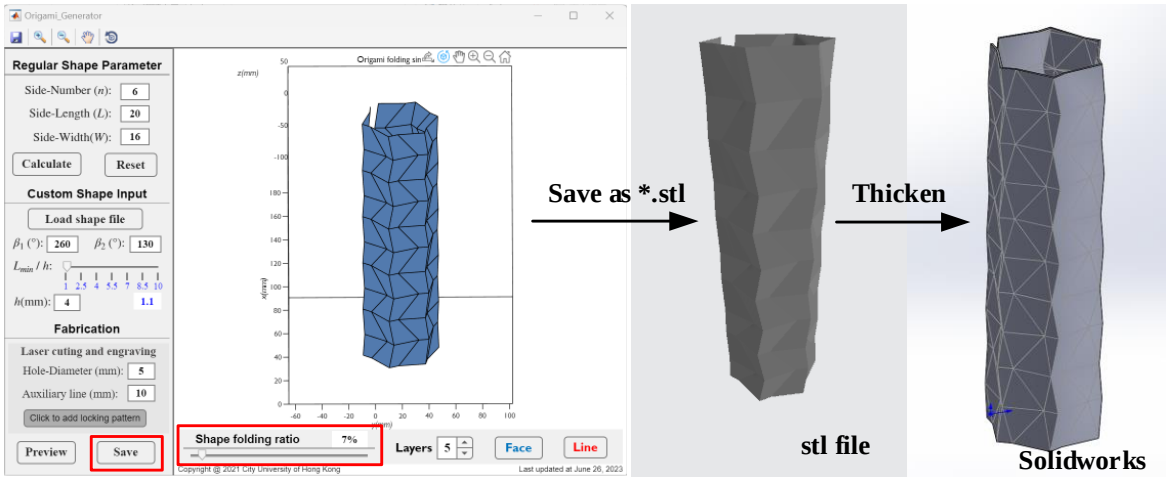

Fig. 4. Creating STL file for 3D model.

4. Citations

The related references are listed as follows:

Theoretical model:

[1] Q. Hu, J. Li, J. Tao, E. Dong, and D. Sun, "Inverse origami design model for soft robotic development," *Soft Robotics*, vol.11, no.1, pp. 131-139, 2024.

Robotic applications:

[2] Q. Hu, J. Li, E. Dong, and D. Sun, "Soft scalable crawling robots enabled by programmable origami and electrostatic adhesion," *IEEE Robotics and Automation Letters*, vol. 8, no. 4, pp. 2365-2372, 2023.

[3] J. Tao, Q. Hu, T. Luo, and E. Dong, "A soft hybrid-actuated continuum robot based on dual origami structures," *IEEE International Conference on Robotics and Automation (ICRA)*, London, UK, 2023.

[4] Q. Hu, Z. Chen, E. Dong, and D. Sun, "Design and control of a modular, untethered soft origami robot driven by SMA coils," *IEEE Transactions on Industrial Electronics*, Early Access, 2025.

[5] J. Tao, T. Li, Q. Hu, and E. Dong, "Soft origami continuum robot capable of precise motion through machine learning," *IEEE Robotics and Automation Letters*, vol. 10, no. 2, pp. 1034-1041, 2025.

YOUR COMMENTS AND CITATION ARE WELCOME.

THANKS!

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