Origami Generator

1 Introduction:

This software is developed based on an inverse origami design model, 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 software is built based on Matlab (2018a) GUI platform. Our paper "Inverse origami design model for soft robotic development" that illustrates this model has been submitted to an academic journal. We will update more information of this paper for your reference as soon as possible.

2 User guide

2.1 Installation method

The use of this software requires the installation of the version 9.4 (R2018a) of the MATLAB Runtime.

1) The user can run this file (Origami_Generator\for_redistribution\MyAppInstaller_web.exe) to complete the installation of Runtime version and the software simultaneously.
2) In addition, the user can download and install the Windows version of the MATLAB Runtime for R2018a from the following link on the MathWorks website: https://www.mathworks.com/products/compiler/matlab-runtime.html. Then, the user can directly run the software (Origami_Generator\for_testing\Origami_generator.exe).
3) If there is Matlab on the user's computer, the user can directly open the main function "Origami_Generator.m" and run it, and then enter the software interface.

2.2 Instruction

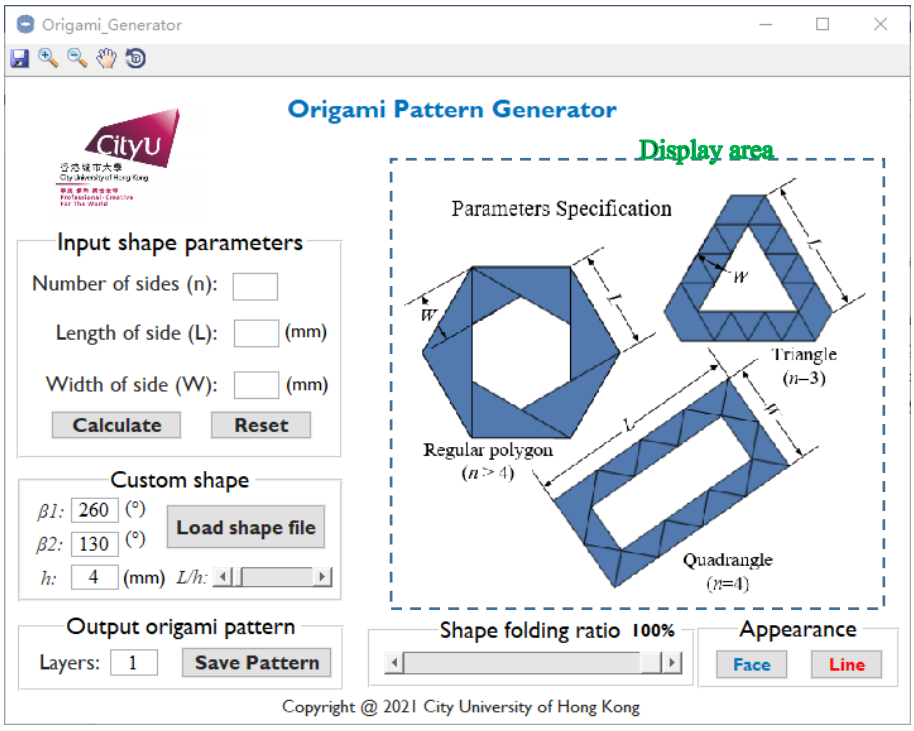


Fig. 1 Screenshot of "*Origami_Generator*" software

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 parameters specification of cross-sectional shapes with

different numbers of sides n is shown in start interface of the software. It should be noted that the actual side length for the regular triangle is equal to $(\mathrm{L}+1)\times 2\mathrm{W}/\sqrt{3}$ due to the constraints of coincidence of the folding points and the same side thickness. The corresponding origami will be generated and shown in the software, and the user can control the shape folding ratio and check the appearance of the origami. The number of layers can be changed in the input box at the lower left corner, and the flat origami pattern can be saved as an independent file.

2) If the user wants to generate the custom cross-sectional shapes, the user is required to provide a shape graphic file and manually load this file into this software. Then the shape graphics will be shown in a pop-up window, and the user needs to use the left mouse button to divide the shape into multiple line segments anticlockwise. As shown in Fig. 2, the division with different densities influences the level of detail of the generated origami. The auxiliary circle can be used to divide a curve into line segments with same length. The adjusted parameters of β_1 and β_2 are used to mix different crease patterns, and the parameters of h and L/h are used to adjust the actual length of the minimum dividing line segment. More information will be seen in the following paper.

- Qiqiang Hu, Junyang Li, Erbao Dong, and Dong Sun, "Inverse origami design model for soft robotic development", PREPRINT available at Research Square https://doi.org/10.21203/rs.3.rs-1545111/v1.

The generated origami will be shown in the display area of the software, and the user can control the shape folding ratio and check the appearance of the origami. The number of layers can be changed in the input box at the lower left corner, and the flat origami pattern can be saved as an independent file.

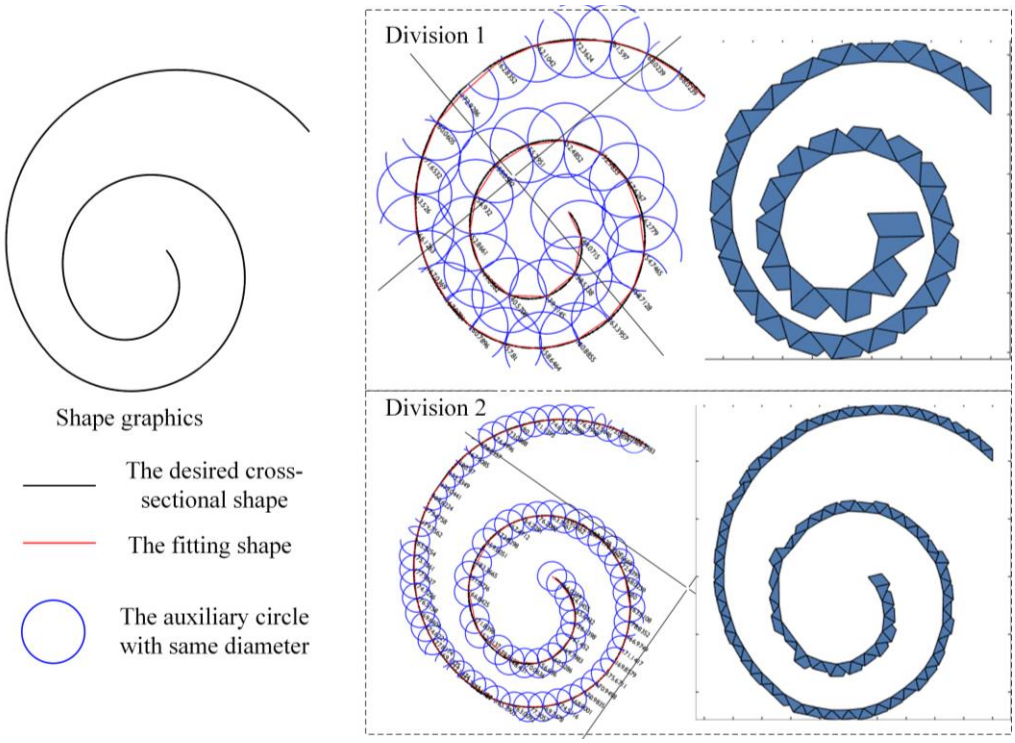
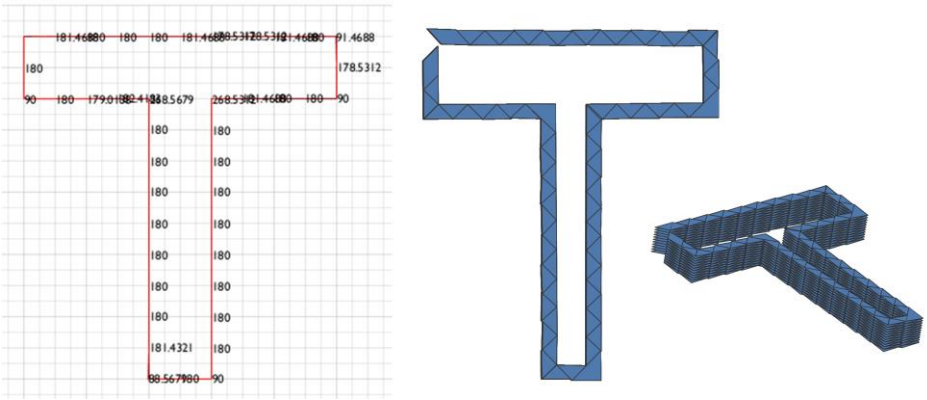


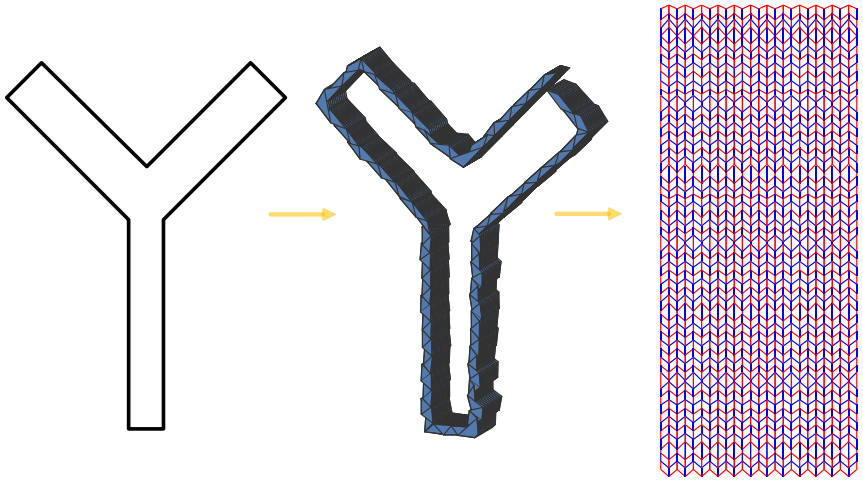
Fig. 2. The division of the custom shapes.

3) Suggestion for fabrication: It is noted that the saved flat pattern is usually scaled down or up but preserve the actual dimensional parameters. Before manufacturing such as paper printing, the user needs to manually enlarge or reduce the flat pattern to the same size as an actual reference size. This will ensure that the size of the produced origami is the same as expected, rather than an enlarged or reduced version.

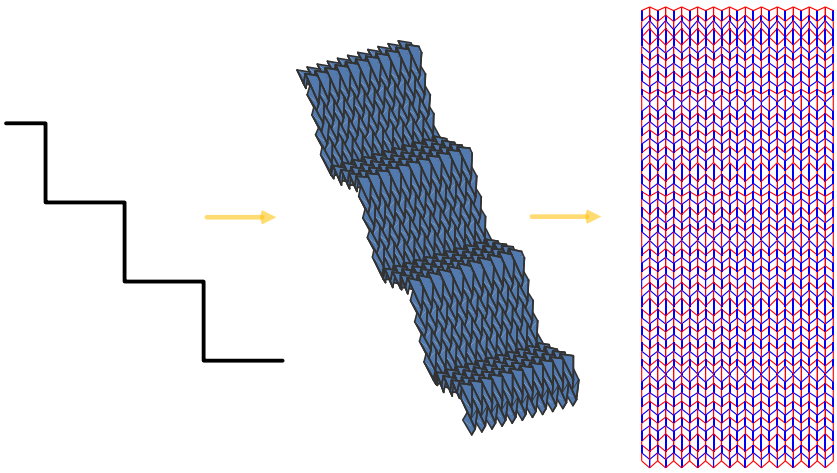
3 Example



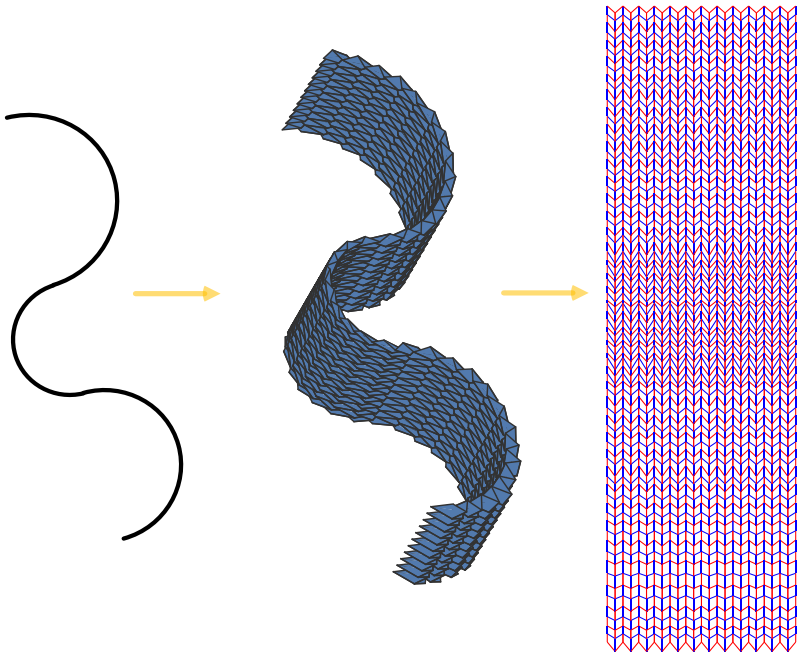
Example 1. “T” word



Example 2. “Y” word



Example 3. Stair shape



Example 3. The shape with multiple curvatures