

Title: gasket origami.

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Abstract

I invented gasket origami in approximately the year 2021 to leverage pixel unit origami in order to make objects that scale to life size, with greater structural integrity than merely skin type objects.

In other words, while pixel units can make boxes (using what I'd refer to as a "skin" approach), the results are akin to padded envelopes rather than cardboard boxes. The reason why is due to the lack of a skeletal infrastructure.

Gasket origami solves this problem by creating an internal grid of what I call gaskets. I call them gaskets because the resulting objects remind me of fractal structures like the Sierpiński carpet (and gasket).

Here is a 2D Sierpiński carpet from my Haskell program to generate fractals; different colors represent different instantiations/levels of the algorithm.

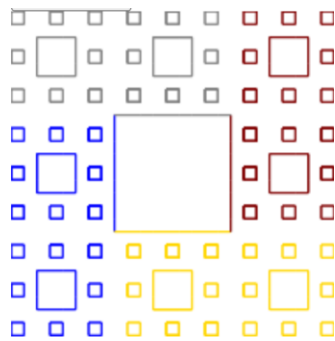


Figure 1: 2D Sierpiński carpet from my Haskell fractal program.

Here is the 3D counterpart to the 2D Sierpiński carpet:



Figure 2: 3D analog of the Sierpiński carpet, call the "Menger Sponge" [https://en.wikipedia.org/wiki/Menger_sponge].

Note that while the size of the holes varies in the fractals shown above, they are constant in size in the gasket origami generation 1, which will be shown in this article; however, creating different size gaskets in gasket origami is possible. In other words, it should be possible to create a gasket origami replica of the above diagram at any generation.

Pixel Units

I create pixel units from rectangles with a ratio of 11:15, which is approximately a 73% ratio; however other ratios are possible (but may be less desirable).

Pixel units can be thought of as being a rival system to Sonobe units, except that pixel units are doubly locked (whereas Sonobe units rely purely on friction to keep them together). Pixel units can aptly replicate most Sonobe designs.

Pixel units were originally invented by Max Hulme (of the UK). Max originally created pixel units to enable the creation of tapestries/mosaics that can express arbitrary colors via using differently colored pixel units. At the BOS (British Origami Society) 40th convention in 2007, Max showcased the use of pixel units for creating such tapestries. It was only as an afterthought that Max realized their use in creating realistic 3D objects, like animals, sandals, hats, purses, boxes, etc.. Sadly, Max passed away on 12 June 2020; leaving some of his pixel unit works undiagrammed.

How gasket origami works

Gasket origami features a clever (but possibly counter intuitive) trick using pixel units: by having holes in a structure, you can gain greater structural integrity; because the holes allow going 3D rather than remaining 2D. Hence, you get a skeleton rather than a skin covering. Think of this as an origami analog to cardboard.

A gasket is created by having 4 inside corners as a starting point. Each of these inside corners will ultimately create a hole in the structure. You can think of it as being like a donut hole; except that donut holes are round, and gasket holes are square in shape.

Examples of gasket origami



Figure 3: shoebox I designed, with 12" ruler for perspective.

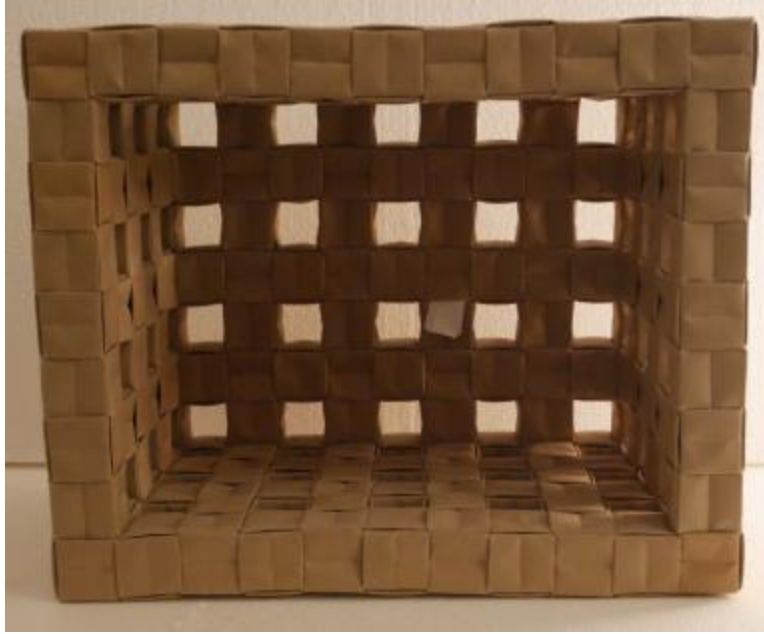


Figure 4: gasket crate (16.5 x 13.5 x 10.5 inches) I designed (white tag is for documentation).



Figure 5: gasket bookshelves (34 x 24 x 13.5 inches) I designed for storing origami.



Figure 6: my pixel unit version of the Kasahara Sonobe horse.

Fiberglass doping

The strength of bookshelves created via gasket origami objects is sufficient for supporting lightweight objects (like origami); but support for heavier objects should be possible via fiberglass doping techniques (which could potentially make pixel unit-based objects waterproof and structurally strong enough for significant weight bearing).

Exotic papers

As we get more exotic papers with which to fold origami, pixel units could have greater durability. For example, so called “elephant hide” paper would allow creating very strong boxes.

Diagrams

A next step in this project is to diagram the idiom of creating gaskets; which can then be used to create arbitrarily large objects (such as crates and bookshelves).

Robots

The compositional nature of pixel unit origami, which joins simple units to create structure, lends itself to robotic creation of the units, and also robotic assembly of units into composite objects.

Pixel Unit Zoom course

André is currently teaching two pixel unit courses via Origami USA: one that is PST time zone friendly, and one which is GMT friendly. These typically appear on the Origami USA calendar (but don't require

membership in Origami USA to attend). For more information on these offerings, you can write André at vanmeule@roadrunner.com .

Conclusion

Gasket origami leverages pixel unit origami in order to create scalable (up to life size and monument size) objects that have some semblance of structural integrity (especially if post-folding techniques akin to fiberglass doping are used). It is now possible to scale origami to monument size; and the resulting objects should “blow you away” (and the wind will physically blow the origami objects away, unless doped and secured =:0) .