

Origami Design Using Parametric CAD Software

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Background













Uniaxial Designs

- Bases have flaps that can be made into appendages.
- Models that can be represented by trees or "stick figures"
- Flaps can be folded to lie along the main axis





Origami scorpion

Circle Packing

- A circle represent the smallest region of paper necessary to make a flap
- Appendages can be made from flaps
- Think of a folding umbrella; an open umbrella is like the circle, while the collapsed umbrella can be seen as a flap. The length of the flap is the radius of the circle.



Molecules

Where circles touch, draw a line to denote an axial crease

The region bounded by a connected region of axial creases is known as a "molecule"

The most simple molecule is a triangle



Rivers

- Separations between one group of circles and the next
- Becomes a "waist" segment between groups of flaps



Intro to Parametric Design Software: Onshape

Standard use: Mechanical designs

Parametric vs. non-parametric software





What does "Parametric" mean









Ukulele

One "file", various configurations for each of the standard ukulele sizes,

Sopranino

Soprano

Concert

Tenor



Sketches

Relations:

🔀 Coincident

- O Concentric
- N Parallel
- 🖌 Tangent
- Horizontal
- l Vertical
- L Perpendicular
- = Equal
- --- Midpoint
- ∑⊠ Symmetric



Partially constrained vs. fully constrained geometry

Partially constrained







Fully constrained





Example: Maple Leaf

Design Goals

Leaflets should come from corner or edge to allow for vein lines

Leaflets should be gradually increasing in size towards the center

There should be a minimum of "weird" reference points



The effect of shifting reference points

Balance foldability with good proportions



The effect of shifting reference points

Older example: Gecko, Salamander, Frog





Cyclommatus

Extended Example











draw a square



Basic circle packing



Circle packing showing relations and dimensions









Molecule details



Models designed with the aid of Parametric CAD

"S" Symbol

Non Uniaxial

Design Goals:

- Segments need to line up to form S
- Central segments should be on centerline
- There should be a minimal amount of "weird" reference points







Scorpion







Facehugger (From "Alien")



work in progress (sneak peek)

When to use Parametric CAD Software?

When you have a general plan for layout, but want to refine it for:

- Better model proportions
- Fewer odd reference points
- Very specific geometric requirements

References

OnshapeOnshape.comRhino3DRhino3D.comRobert LangLangorigami.com
Origami Design SecretsMebrianchandesigns.com