











[9] Abel, Z., Hull, T. C. & Tachi, T. Locked rigid origami with multiple degrees of freedom. In *Origami<sup>6</sup>: Proceedings of the Sixth International Meeting of Origami Science, Math-*

*ematics, and Education* (submitted to ORIGAMI6, in review, 2014).

TESSELLATICA CODE

Download and run Tessellatica from:

<http://www.langorigami.com/science/computational/tessellatica/tessellatica.php>

to predefine all the appropriate functions/objects/attributes. Using Mathematica 9, the following code calculates energies of the facets, creases, as well as the value of the order parameter  $x/L$ .

```

TSquareTwistEnergy[phi_, Gamma_, L_]:=
Module[{v1, v2, v1rot, v2rot, verts, edges, faces, types, tobj, tobjff,
faspecs, foldangles, alpha, getverts3d},
v1 = L{1, 1};
v1rot = L{-1, 1};
v2 = L{Sin[phi] + Cos[phi], Cos[phi] - Sin[phi]};
v2rot = L{Sin[phi] - Cos[phi], Cos[phi] + Sin[phi]};
verts = {{0, 0}, v1, v1 + v1rot, v1rot, v2, v2 + v1, v2 + v1 + v2rot,
v1 + v2rot, v1 + v2rot + v1rot, v1 + v2rot + v1rot - v2, v1 + v1rot - v2,
v1rot - v2, v1rot - v2 - v2rot, v1rot - v2rot, -v2rot, v2 - v2rot};
edges = {{1, 3}, {1, 16}, {2, 5}, {2, 7}, {3, 8}, {3, 10}, {4, 11}, {4, 13},
{1, 14}, {1, 2}, {1, 5}, {1, 15}, {1, 4}, {2, 3}, {2, 8}, {2, 6}, {3, 4},
{3, 11}, {3, 9}, {4, 14}, {4, 12}, {5, 6}, {6, 7}, {7, 8}, {8, 9},
{9, 10}, {10, 11}, {11, 12}, {12, 13}, {13, 14}, {14, 15}, {15, 16}, {16, 5}};
(*definedwithfacefoldsfirst, theninternalcreases, thenboundaries*)
faces = {};
types = {U, U, U, U, U, U, U, U, U, M, V, M, M, M, V, M, M, V, M, V, M, V, M, B,
B, B, B, B, B, B, B, B, B, B, B}; (*MMMM central face*)
tobj = MakeTGraph[verts, edges, faces]//AddTAssigned[types]//AddTPlaneGraph;
Do[
alpha = i * .45 * pi/18.1;
faspecs = {{sqrt[2]Gamma, 0}, {sqrt[2]Gamma, 0}, {2GammaSin[phi/2], 0}, {sqrt[2]Gamma, 0},
{2GammaSin[phi/2], 0}, {sqrt[2]Gamma, 0}, {2GammaSin[phi/2], 0}, {sqrt[2]Gamma, 0},
{2GammaSin[phi/2], 0}, {1, -alpha}, {1, alpha}, {1, -alpha}, {1, -alpha}, {1, -alpha},
{1, alpha}, {1, -alpha}, {1, -alpha}, {1, alpha}, {1, -alpha}, {1, alpha}, {1, -alpha}, {infinity, 0},
{infinity, 0}, {infinity, 0}, {infinity, 0}, {infinity, 0}, {infinity, 0}, {infinity, 0}, {infinity, 0},
{infinity, 0}, {infinity, 0}, {infinity, 0}};
foldangles = MakeGraphFoldAngles[tobj, faspecs];
tobjff = FoldGraph3D[tobj, foldangles, StationaryFace -> 1];
getverts3d = GetValues[tobjff, {Vertices3D}];
FaceEnergy[[i]] = Sum [faspecs[[j, 1]] * foldangles[[j]]^2, {j, 1, 9}];
CreaseEnergy[[i]] = Sum [(foldangles[[j]] - faspecs[[j, 2]])^2, {j, 10, 21}];
ShapeList[[i]] = FoldedFormGraphics3D[tobjff]/.OrigamiStyle[];
Folds[[i]] = foldangles;
Deltas[[i]] =
sqrt(((getverts3d[[1, 14]] - getverts3d[[1, 8]]).
(getverts3d[[1, 14]] - getverts3d[[1, 8]]));,
{i, 1, 40}
]

```