Reconfigurable Periodic Surfaces Assembled from Strip Modules

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Cellular structures composed of a shell of periodic surfaces have been attracting attention for their properties such as high stiffness for low density and partitioning space into two subvolumes. Since they have negative Gaussian curvature, they cannot be constructed by simply bending sheet material. This study aims to efficiently construct periodic surfaces from sheet material by assembling a single type of developable pieces. The existing method [1] allows dividing some of the triply periodic minimal surfaces (P, D, and G surfaces) into a single type of narrow strip by periodic geodesic net connecting monkey saddles on them. We apply this division method to P, D, and G surfaces of constant negative Gaussian curvature, a family of surfaces with different slenderness (Figure 1), by assuming their existence. Due to the local isometry of the family, some elements of the family can consist of the congruent strip, enabling reconfiguration between surfaces with different topologies or slenderness (Figure 2). We fabricate physical models by approximating the strip with a developable surface (Figure 3). The straight strip allows for a high efficiency of material and can be cut from a roll of sheet. We believe this reconfigurable modular system can be a new geometric basis for self-build and self-assembly assuming disassembly and reconstruction.

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[1] M. E. Evans, V. Robins, S. T. Hyde, *Acta Crystallographica*, **A69** (2013).

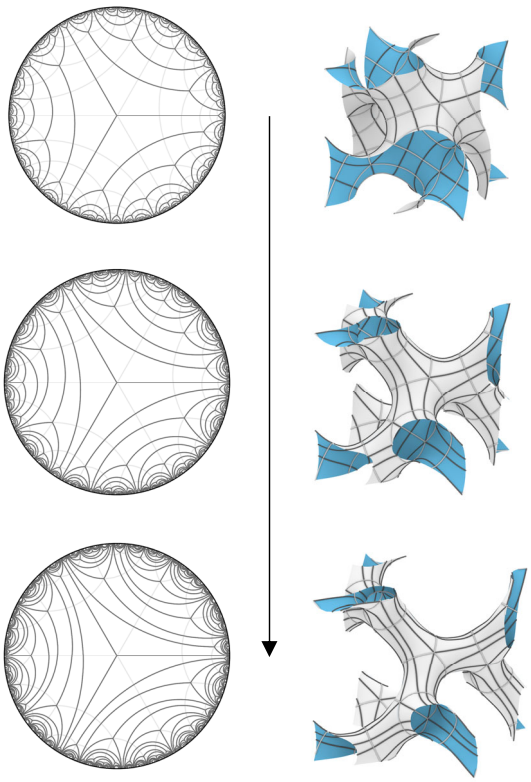

Figure 1 Varying slenderness of G surface by transforming base grid on hyperbolic plane.

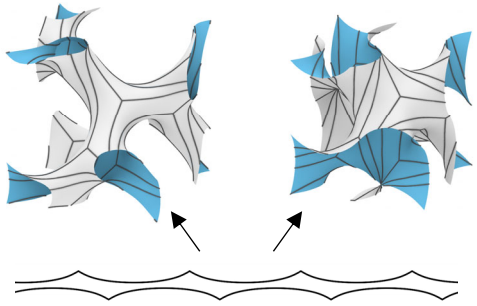

Figure 2 Reconfigurable pair of G surfaces with different slenderness and their flattened strip module.

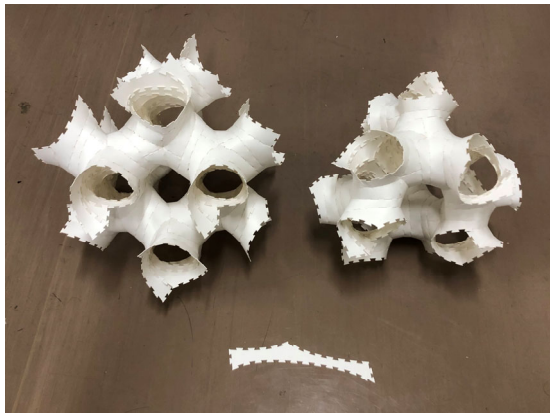

Figure 3 Physical prototype. Both D and G surfaces are assembled from single type of strip module.