

Nature Inspired Shapes and Design of Engineering Applications

Asutosh P* and Raj C Thiagarajan*

*ATOA Scientific Technologies Pvt Ltd, 204, Regent Prime, 48 Whitefield Main Road, Whitefield, Bengaluru 560066, India, www.atoa.com, corp.hq@atoa.com.

Introduction: Nature evolved over millions of years to produce remarkable surfaces and shapes. Nature inspired, equation based mathematical surfaces were developed over many centuries. But Engineering design is dominated by orthogonal Cartesian principles. Equation based mathematical surfaces are under renewed interest due to their innovative design potential and practical viability by 3D printing. Sample complex mathematical Surfaces are shown in figure 1.

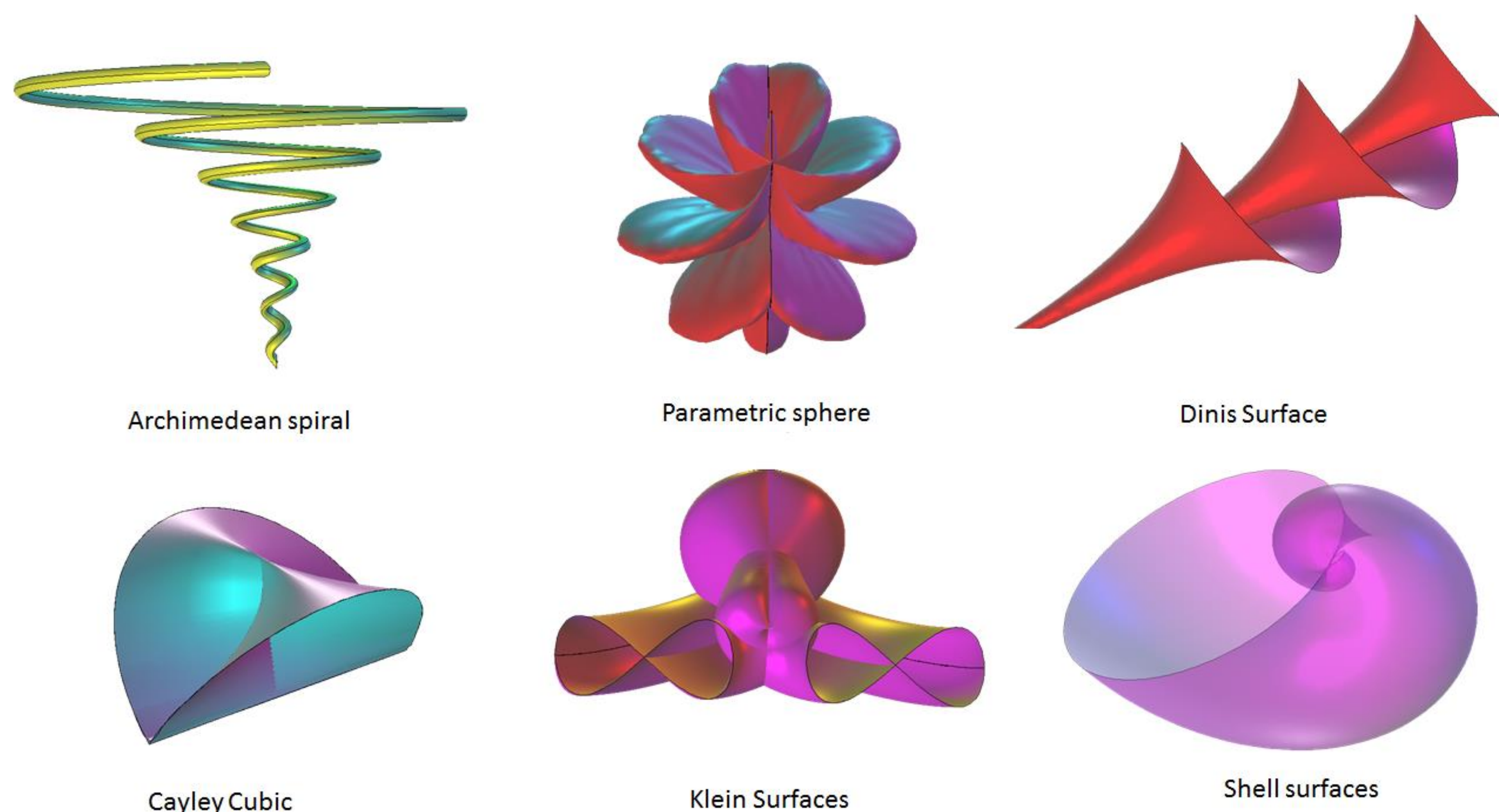


Figure 1. Nature inspired Surfaces

Equation based Surface and applications: Developed parametric models of more than 25 surfaces. Fresnel's Wave, Klein, and Gyroid surface and applications are detailed. This wave surface is then converted into 3D print models with patterns of nature inspired structures as shown in figure 2 for multitude of Fresnel wave structure based applications.



Figure 2. Fresnel Wave surface and Organic Structure

Nature Inspired Surface to Structures: Architectural and civil structures, inspired from natural patterns for innovative and

functional forms. These innovative forms are engineered by integrating structural triangulation, hexagonal mesh patterns of mathematical surfaces. The mathematical expressions used to construct the shape in Figure 3. Figure 4 shows sample Gyroid surfaces and unit cell of various shapes and surfaces.

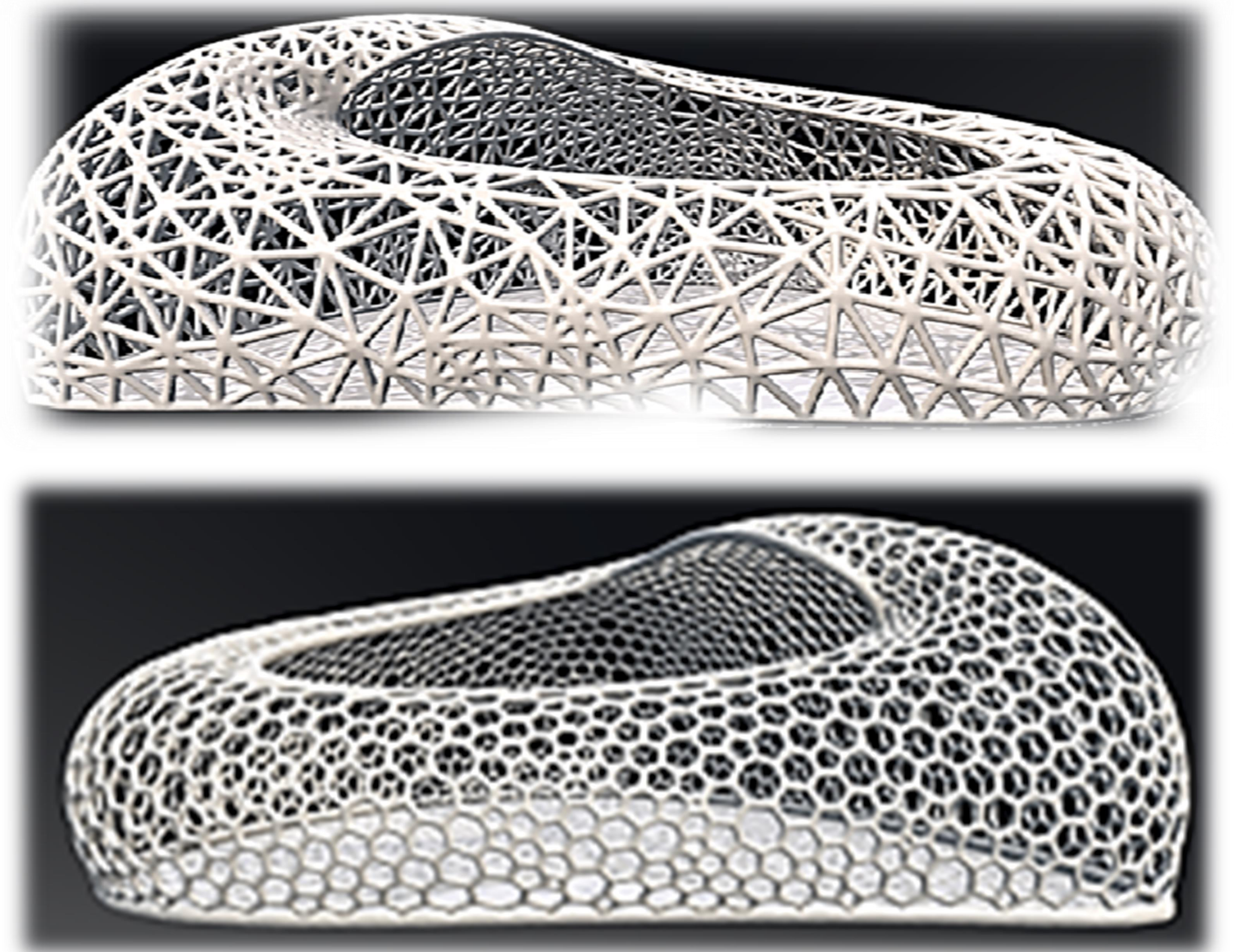


Figure 3 Klein Surfaces inspired Architectural form

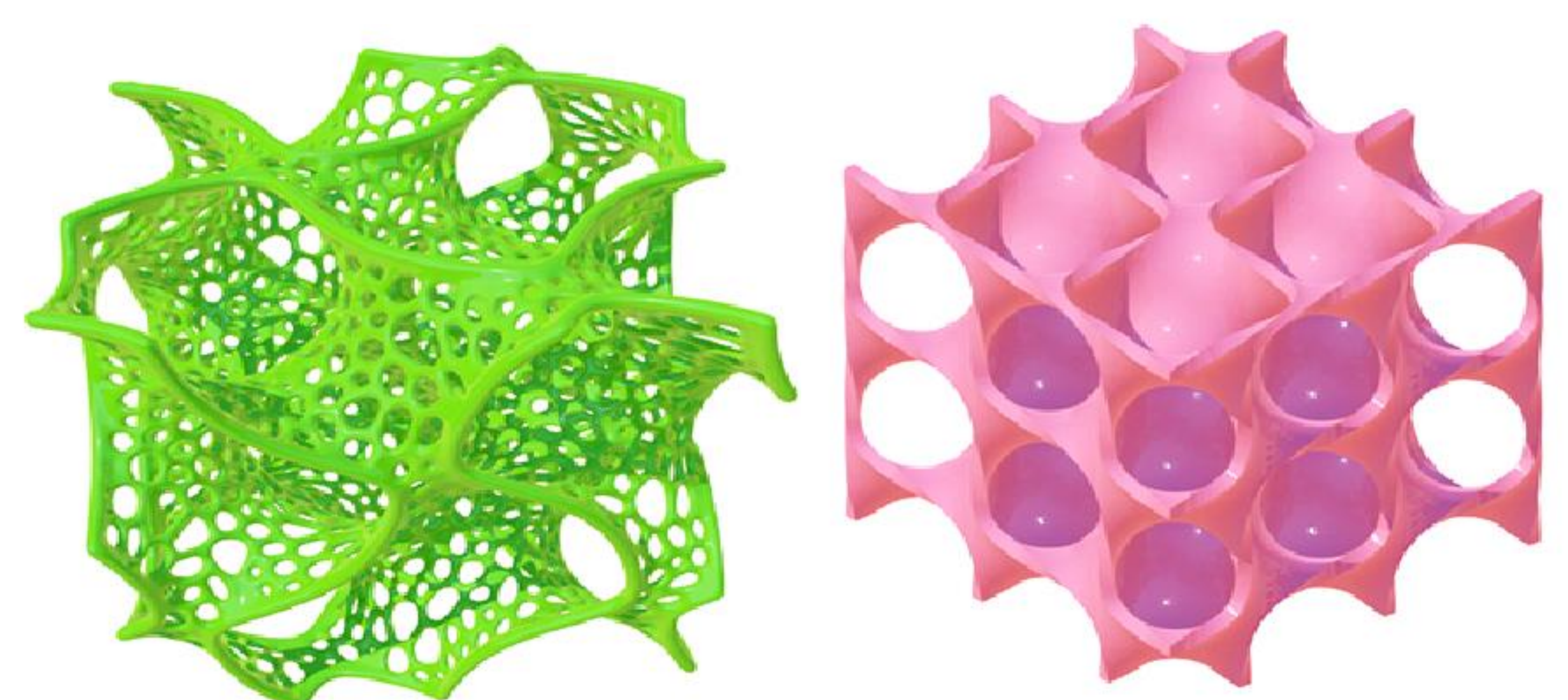


Figure 4. Gyroid type surfaces and Applications

Conclusions: Developed equation based mathematical surfaces into CAD models and innovative 3D printable engineering Structures away from Cartesian principles. The equation based surfaces, complex but functional 3D printable innovative engineering structure potential highlighted.