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Universal Natural Shapes - new models for the sciences

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Abstract. In his Habilitationsschrift Riemann mentioned the geometric tangent 2D-indicatrix $x^4 + y^4$ as a relevant extension of the Euclidean unit circle, thus conceiving the simplest Riemann-Finsler metrics. However, in 1818, Gabriel Lamé (1795-1860) had already provided a systematic treatment of supercircles and superellipses, with the aim of describing crystals geometrically.

The generalization of Lamé curves to the Superformula, a generic geometric transformation generalizing conic sections, turns out to be an excellent scientific tool for the study of natural shapes and phenomena, from the very small to the very large [1]. These developments have found their way in numerous applications in technology and science [2]. It also connects many fields of science in a simple way, for example linking form and development, and inequality in economics and biology.

In a dynamic and kinematic setting, recent developments include a complete differential geometry apparatus, adapted to these shapes [3]. This aligns with Lamé's Unique Rational Science: find the best fitting coordinate systems and then solve the relevant boundary value problems.

Keywords: Superellipses, superformula, natural shapes

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References

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