

Parametric tuning of the Gielis Superformula for non-target based automated evolution of 3D Printable objects

Abstract

3D printing is an emerging trend fuelled by the rapid technology advancements in 3D printing technology. Printing out 3D designs is something new and interesting but the process of designing 3D objects is far from effortless. Researchers have recently forged ahead in conducting numerous studies on using mathematical formulas to create objects and shapes in 3D space. A mathematical encoding for geometric shapes called the Superformula was proposed by Johan Geilis through the generalization of the Supereclipse formula to generate 3D shapes and objects by extending its spherical products. The focus of this study is to investigate the ideal range of parametric values supplied to the Superformula in order to automatically generate 3D shapes and objects through the use of Evolution Algorithms (EAs). Thus, Evolutionary Programming was used as the EA in this study which serves as the main evolution component that uses a fitness function tailored in a way that it is able to evaluate the 3D objects and shapes generated by the Superformula. The values require by the Superformula to generate 3D objects or shapes are . To obtain the ideal range of values for the afore mentioned parameters, five different sets of experiments were carried out within the range set of $\{0 - 20\}$, $\{0 - 40\}$, $\{0 - 60\}$, $\{0 - 120\}$, and $\{0 - 240\}$. Each range set of numbers will be tested five times and the final objects from each of the runs were then analysed. From the observations obtained, the range set of $\{0- 20\}$, $\{0- 60\}$, and $\{0- 120\}$ shows the most promising results as the final objects produced were unique and it was surmised that within these range of numbers contain highly unique and novel 3D objects and shapes.