Empirical Evaluation of Mutation Step Size in Automated Evolution of Non-Target-Based 3D Printable Objects

Abstract

Evolutionary algorithms (EA) currently play a central role in solving complex, highly non-linear problems such as in engineering design, computational optimization, bioinformatics and many more diverse fields. Implementation of EAs in the field of 3D printing is still in its infancy since 3D printing itself is a relatively new technology that has only become main stream due to its significant decrease in acquisition cost in the past 2-3 years.

Due to the rapid uptake by everyday hobbyists and the significant advancements being made in material diversity, 3D printing will only continue its rapid expansion into our everyday lives. In this study, an EA in the form of Evolutionary Programming (EP) is used to automatically evolve 3D objects generated by Geilis's Superformula. The focus of this study is to explore the mutation step size in hoping to create more diverse populations in the evolution of the generated 3D printable objects. In EP, the operator responsible for offspring generation is through the mutation process solely. Hence, the mutation step size has a direct and very significant impact on the diversity of the offspring generated. A fitness function was design to evaluate the 3D objects and shapes generated by the Superformula. The parameters for the Superformula to generate 3D objects or shapes are These parameters serve as a representation in EP and the mutation step size will affect the chances of these parameters' values to change. To carry out this study, five different mutation step sizes were used and each mutation step size will be run for five times. The mutation step sizes are 0.1, 0.2, 0.4, 0.6 And 0.8. From the results obtained, a mutation step size 0.1 shows a more stable population pool and were able to generate diverse and distinctive 3D objects.