An Efficient Computational Approach for Computing Subdivision Depth of Non-Stationary Binary Subdivision Schemes

ABSTRACT

Subdivision schemes are equipped with some rules that take a polygon as an input and produce smooth curves or surfaces as an output. This presents the issue of how accurately the polygon approximates the limit curve and surface. What number of iterations/levels would be necessary to achieve the required shape at a user-specified error tolerance? In fact, several methods have been introduced in the case of stationary schemes to address the issue in terms of the error bounds (distance between polygon/polyhedron and limiting shape) and subdivision depth (the number of iterations required to obtain the result at a user-specified error tolerance). However, in the case of non-stationary schemes, this topic needs to be further studied to meet the requirements of new practical applications. This paper highlights a new approach based on a convolution technique to estimate error bounds and subdivision depth for non-stationary schemes. The given technique is independent of any condition on the coefficient of the non-stationary subdivision schemes, and it also produces the best results with the least amount of computational effort. In this paper, we first associated constants with the vectors generated by the given non-stationary schemes, then formulated an expression for the convolution product. This expression gives real values, which monotonically decrease with the increase in the order of the convolution in both the curve and surface cases. This convolution feature plays an important role in obtaining the user-defined error tolerance with fewer iterations. It achieves a trade-off between the number of iterations and user-specified errors. In practice, more iterations are needed to achieve a lower error rate, but we achieved this goal by using fewer iterations.