

# A shape preserving $C^2$ non-linear, non-uniform, subdivision scheme with fourth-order accuracy

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The objective of this study is to present a shape-preserving non-linear subdivision scheme generalizing the exponential B-spline of degree 3, which is a piecewise exponential polynomial with the same support as the cubic B-spline. The subdivision of the exponential B-spline has a crucial limitation in that it can reproduce at most two exponential polynomials, yielding the approximation order *two*. Also, finding a best-fitting shape parameter in the exponential B-spline is a challenging and important problem. In this regard, we present a method for selecting an optimal shape parameter and then formulate it in the construction of new refinement rules. As a result, the new scheme provides an improved approximation order *four* while maintaining the same  $C^2$  smoothness as the (exponential) B-spline of degree 3. Moreover, we show that the proposed method preserves geometrically important characteristics such as monotonicity and convexity, under some suitable conditions. Some numerical examples are provided to demonstrate the ability of the new subdivision scheme.

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