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Multi-degree smooth polar splines: A framework for geometric modeling and isogeometric analysis

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Highlights

- We develop a multi-degree polar spline framework with applications to both geometric modeling and isogeometric analysis.
- Multi-degree splines are introduced as piecewise NURBS of non-uniform polynomial degree, and a simple and practical algorithm for their construction is presented.
- An extension to two-dimensional polar configurations is provided by means of a tensor-product construction with a collapsed edge.
- A mathematically rigorous framework for construction of C^k smooth polar splines for any $k \geq 0$ is presented. Explicit constructions for $k \in \{0,\;1,\;2\}$ are given.
- We show that it is always possible to construct a set of smooth polar spline basis functions that form a convex partition of unity.
- Optimal approximation behavior is observed numerically and examples of applications to free-form design, smooth hole-filling, and high-order partial differential equations are shown.

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