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Parametrizability and Nonlocal Isotopy: An Approach to Efficient Approximation of Nonsingular Curves

We consider domain subdivision algorithms for computing isotopic approximations of nonsingular curves represented implicitly by an equation $f(X, Y) = 0$. Two algorithms in this area are from Snyder (1992) and Plantinga and Vegter (2004). We introduce a new algorithm that combines the advantages of these two algorithms: like Snyder, we use the parametrizability criterion for subdivision, and like Plantinga-Vegter we exploit non-local isotopy. We further extend our algorithm in two important and practical directions: first, we allow subdivision cells to be rectangles with arbitrary but bounded aspect ratios. Second, we extend the input domains to be regions $R_0$ with arbitrary geometry and which might not be simply connected. Our algorithm halts as long as the curve has no singularities in the region, and intersects the boundary of $R_0$ transversally. We report on very encouraging preliminary experimental results, showing that our algorithms can be much more efficient than both Plantinga-Vegter's and Snyder's algorithms.