

Accepted Manuscript

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PII: S0377-0427(17)30315-1

DOI: <http://dx.doi.org/10.1016/j.cam.2017.06.015>

Reference: CAM 11193

To appear in: *Journal of Computational and Applied Mathematics*

Received date: 14 June 2016

Revised date: 26 May 2017



Please cite this article as: Q. Fu, Z. Wu, X. Wang, M. Zhou, J. Zheng, An algorithm for finding intersection between ball B-spline curves, *Journal of Computational and Applied Mathematics* (2017), <http://dx.doi.org/10.1016/j.cam.2017.06.015>

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An Algorithm for Finding Intersection between Ball B-Spline Curves

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Abstract

A ball B-spline curve (BBSC) is a skeleton based solid model representation, which consisting of a B-spline curve and a B-spline function serving as the (varying) radius of a ball moving along the B-spline curve. The surface shape specified by the BBSC is the envelope of the moving ball and thus the BBSC is very suitable for representing vascular shapes. To apply this good representation in various fields as CSG-to-boundary conversion, Boolean operations, geometric design, pattern recognition, scientific visualization, this paper proposes an efficient algorithm to solve their common fundamental intersection problem. The surface of each BBSC is decomposed into a starting spherical patch, a set of lateral surfaces defined by ball Bézier curves (BBC), and an ending spherical patch. The intersection algorithm proceeds in four steps: (1) tessellating both BBSCs into triangular meshes and computing the intersection curves between the triangular meshes, which serve as the initial intersections for later refinement; (2) parameterizing the surfaces/patches of one BBSC and implicitizing the surfaces/patches of the other BBSC; (3) calculating the intersection curves between a parametric surface and an implicit surface numerically by using the Newton's method; and (4) tracing the intersection curves for the construction of intersection solid regions. In particular, we present simple methods for pa-

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