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Adjusting the energy of ball curves by modifying movable control balls. (English)

Summary: Ball curve plays a crucial role in modeling tubular shapes with variable thickness. In this paper, energy functionals for curve design are generalized to Ball curves and the variational design of Ball curves is investigated. Given a Ball curve with some of its control balls movable and having variable radiuses, we propose a method to determine the positions and radiuses of the movable control balls which minimize the energy functional. Based on this, we provide two efficient design tools: (i) to achieve $C^k$ continuity across linked Ball curves at their joint, while decreasing their energy as low as possible, (ii) for blending disjoint Ball curves subject to $C^k$ continuity constraints and energy minimization. The feasibility of the method is verified by several examples. By adjusting the weighted coefficients, different energy functionals are defined and thus Ball curves with different shapes and thickness can be obtained.

MSC:
65D07 Numerical computation using splines
65D10 Numerical smoothing, curve fitting
65D17 Computer-aided design (modeling of curves and surfaces)
65D18 Numerical aspects of computer graphics, image analysis, and computational geometry
68U05 Computer graphics; computational geometry (digital and algorithmic aspects)
68U07 Computer science aspects of computer-aided design

Keywords:
ball curves; variational design; energy minimization; skeleton; $C^k$ continuity

Full Text: DOI

References:
[1] Farin, G., Curves and surfaces for computer aided geometric design (1990), Salt Lake City: Academic Press, Salt Lake City - Zbl 0702.68004