A cubic B-spline curve for quasi arc-length approximation

Javier Sánchez-Reyes
Universidad de Castilla-La Mancha
Javier.SanchezReyes@uclm.com

We present a simple, yet general tool for curve approximation with quasi arc-length parameterization, a desirable property in applications such as robotics or CNC. This feature is incorporated in Hermite fashion, by imposing unit speed and vanishing tangential acceleration at the endpoints. Using a Bézier quintic [1], these conditions translate into a simple geometric constraint on the control polygon, in terms of equal projections of the control legs on the tangent lines at the endpoints. We consider a lower degree alternative, namely a cubic B-spline curve with two internal knots that can be freely located. The quasi arc-length condition also results in a straightforward geometric constraint on the lengths of the projections of the control legs. By additionally prescribing the position, tangent direction and curvature at the endpoints, this tool can be employed for osculatory Hermite interpolation. We give examples of application for generating polynomial quasi-arc length approximations of conics, or transcendental curves such as the clothoid. Finally, we explore the potential of this scheme for free-form design, by moving the control points in a constrained manner and adjusting automatically the internal knots to meet the quasi-arc length condition.

Joint work with: J.M. Chacón, R. Dorado.

References

[1] J. Sánchez-Reyes, J.M. Chacón. A polynomial Hermite interpolant for C^2 quasi arc-length approximation. *Computer-Aided Design* 62:218-226, 2015