B-Spline Tangential Angle Parameterization Curves for Aesthetic Design

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For highly aesthetic curve design, it is important to control curvature profile. However, curvature profile is difficult to control by a designer. In most design CAD systems, curve representations are based on NURBS. They are superior in controlling the curve position, but are difficult about controlling curvature profile. As an alternative, curves can be represented based on curvature. Log-aesthetic curves are a good example [1]. Although these curves guaranty good curvature profiles, they have insufficient flexibility of curve position because of strong curvature restriction.

In late years, a new type of planar curve representation has been proposed. A curve is expressed as a function $\rho(\theta)$, where ρ is radius of curvature and θ is tangential angle [2, 3]. It is called Tangential Angle Parameterization curve (TAP curve), and $\rho(\theta)$ is called TAP radius function. If a TAP radius function is a polynomial, the position of each point on the TAP curve become closed-form expression. In this case, the TAP radius function can be represented with Bernstain basis, which gives a Bézier-TAP curve [3]. Its curvature profile can be modified with several control curvature radii.

In this presentation, we propose B-spline TAP curves as an extension of Bézier-TAP curves. In a B-spline TAP curve, TAP radius function is expressed with an explicit B-spline [4] to improve curvature profile control (Fig 1, 2). To calculate the position of each point on the curve, the explicit B-spline is divided into explicit Bézier sections, and then it is treated as a series of Bézier-TAP curves. We have realized G^1 and G^2 Hermite interpolation with a B-spline TAP curve.

Also, we have developed an interactive control scheme for designing smoothly connected multiple TAP curves that satisfy G^2 continuity (Fig. 3).

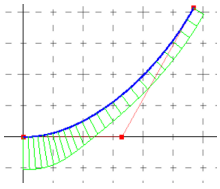

Figure 1: B-spline TAP curve

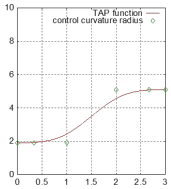

Figure 2: TAP curvature function

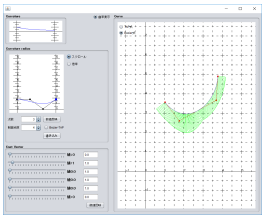

Figure 3: Interactive control

Joint work with: Takafumi SAITO, Norimasa YOSHIDA.

References

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