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A Knot Insertion Algorithm for Weighted Cubic Splines

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Abstract. One of the main reasons why polynomial splines play an important role in computer–aided design as well as in diverse areas of approximation theory and numerical analysis is the fact that they can be represented as linear combination of B-splines. There are nice and stable algorithms for evaluation of such splines and their derivatives and integrals. The well known tools of knot insertion and degree raising can be enhanced by introducing still more additional parameters, and relaxing the continuity conditions at the knots by prescribing jumps in their derivatives. The purpose of this paper is to derive recurrence formulae for some related B-splines, and to exploit the underlying connection with the theory of Chebyshev splines. The cubic version of the jump spline is then recognized as Foley's $\nu-$spline, often used in minimizing functionals like $V(f) := \sum_{i=1}^{n}(w_i \int_{t_i}^{t_{i+1}} [D^2 f(t)]^2\,dt + \nu_i \int_{t_i}^{t_{i+1}} [Df(t)]^2\,dt)$, $\nu_i \geq 0$, $w_i > 0$. The parametric version is often used as a polynomial alternative to the exponential spline in tension in computer–aided geometric design. It is shown how the associated B-splines can be calculated by a knot–insertion algorithm, and this in turn motivates a definition of certain generalized discrete splines.

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Proceedings of Chamonix 1996
A. Le Méhauté, C. Rabut, and L. L. Schumaker (eds.), pp. 1–8.
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