Using C-splines and Bayesian Analysis for the Interpolation of Scattered Data

H. R. N. van Erp[1], **R. O. Linger**[2], **and P. H. A. J. M. van Gelder**[1]

Abstract: In this article we introduce C-splines. C-splines are, like B-splines, piecewise polynomials having C^r continuity constraints on the boundaries of the domain partitioning. However, C-splines are defined on cartesian coordinate systems whereas B-splines are defined on barycentric coordinate systems. In (van Erp, Linger, van Gelder, 2003) it is found that the C-spline base, for a given partitioning of the domain and C^r continuity throughout, has a distinctive pattern. This pattern allows us to infer the general form of the explicit C-spline base. Once we have this general form, the construction of explicit C-spline bases becomes computationally trivial. Consequently, the algorithm for C-splines is extremely fast. For comparison, in B-splines C^r continuity is enforced through finding the Lagrange multipliers of a potentially huge system of equations (Awanou,2003).

Constructing a C-spline corresponds with performing a regression analysis. This means that we may use Bayesian model selection for regression models to differentiate between competing C-spline models. Having found the optimal model, the Bayesian predictive probability distribution corresponding with this optimal model may be used to construct error bounds on yet unobserved values of the dependent variable. We will demonstrate the use of Bayesian analysis together with C-splines by modelling non-linear data having measurement error.

[1] Structural Hydraulic and Probabilistic Design
Technical University Delft
Delft, The Netherlands
h.r.n.vanErp@tudelft.nl, p.h.a.j.m.vanGelder@tudelft.nl

[2] Medical Sciences
Rijks Universiteit Groningen
Delft, The Netherlands
r.o.Linger@student.rug.nl