First order correction terms for trimmed quadrature in isogeometric analysis

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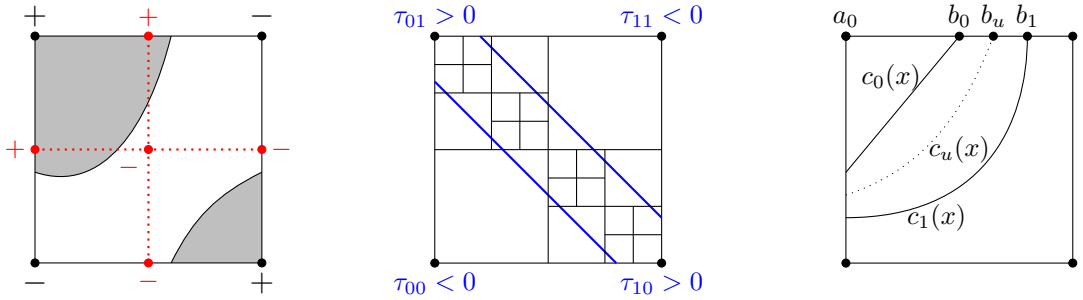

Multi-patch models created using computer aided design (CAD) typically consist of many trimmed tensor-product NURBS patches. The treatment of these trimmed patches remains an open problem in isogeometric analysis (IgA) which aims to unify the representations used in CAD and in numerical simulation. In order to compute isogeometric discretizations of partial differential equations it is necessary to perform numerical quadrature of the basis functions' derivatives and the influences stemming from the geometry and the PDE on the trimmed parametric domains of the employed models.

In this work, we develop a quadrature rule for trimmed domains, where the trimming curve is given implicitly by a real-valued function on the whole domain. Our method is based on an error correction approach. In a first step, we obtain an adaptive subdivision of the domain in such a way that each cell falls in a defined base case as shown in the first two pictures. We then extend the classical approach of linear approximation of the trimming curve by adding an error correction term based on a Taylor expansion of the interpolation between the linearized implicit trimming curve and the original one as depicted in the third picture. The derivatives appearing in the correction term are computed symbolically.

We investigate the computational complexity of the resulting method as well as the approximation power of the quadrature rule obtained by correcting the approximation of the trimming curve. Our numerical experiments show that the method performs robustly on a selection of trimmed patches and that the error correction leads to higher orders of convergence without compromising the computational complexity.

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