The effect on spline spaces structures and B-spline scaling factors on different approaches to locally refined splines

Tor Dokken, SINTEF Digital, Oslo, Norway

Even though the extended T-mesh of the different T-spline variants (TS) and the knot line mesh of Locally Refined B-splines (LRB) in many situations can seem very similar, the structure of the resulting spline spaces can have significant differences. This can be observed both for diagonal refinements and L-shaped corners of refinement regions. In general, LR B-splines will provide a larger spline space with finer granularity than TS. If the mesh of knotlines for LRB and THB are the same, then in most cases the spline spaces spanned are identical. However, even when the spline spaces are the same, the collection of (truncated) tensor product B-splines spanning the spline space in the case of LRB, and THB have significant differences.

Both THB, TS and LRB use scaled tensor product B-splines as part of the construction to ensure partition of unity. Certain configurations of refinements have a surprisingly big effect on the scaling factor. The scaling factors have a direct effect on magnitude of the elements in the mass and stiffness matrices. Consequently, scaling directly impacts the condition numbers of these matrices. These effects can be observed already for bidegree (3,3). The effect grows with the polynomial degree.

The talk will illustrate the above observations with examples and discuss how combining the best of the different approaches can potentially unify different approaches for locally refined splines.