

Comparison of Locally Refined B-Spline and Truncated Hierarchical B-Spline over Hierarchical Meshes

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ABSTRACT

The mesh of knot lines of Truncated Hierarchical B-splines (THB) looks like the LR-mesh used for Locally Refined B-Spline (LRB). In most cases the spline space spanned by THB can be exactly reproduced by LRB. In this presentation we will start from such mesh configurations.

The use of open knot vectors (boundary knots with full multiplicity) is superior to the use of boundary knots of single multiplicity. Examples run show that the use of open knot vectors gives condition numbers for the stiffness matrix three order of magnitude smaller than single multiplicity boundary knots independent of refinement level. For the mass matrix the difference is as well three orders of magnitude before refinements starts, but from five (LRB) to seven (THB) refinement levels the condition numbers are similar for both boundary knot alternatives.

Both THB and LRB results in overloaded elements when run on the same meshes, e.g., elements covered by more B-splines than what is necessary for spanning the polynomial space over the element. For THB overloading occurs along boundaries between refinement levels, for LRB only at convex corners of such boundaries. We show that the flexible refinement of LRB can be used for removing overloading and at the same time improving condition numbers and reduce the bandwidth of both mass and stiffness matrices.

The difference of condition numbers of mass and stiffness matrices, when using open knot vectors of THB and different variants of LRB with no overloading is small, with a positive bias towards non-overloaded LRB.

REFERENCES

- [1] Ivar Stangeby and Tor Dokken, Properties of Spline Spaces Over Structured Hierarchical Box Partitions, submitted to the proceedings of IGAA 2018.