# Adaptive Refinement for Unstructured T-Splines with Linear Complexity

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We present an adaptive refinement algorithm for T-splines on unstructured 2D meshes. We consider unstructured spline spaces on manifolds as in [3], which yield $\mathcal{C}^{p-1}$-continuous splines except in the vicinity of extraordinary nodes, where the continuity is reduced to $\mathcal{C}^0$-continuity. Inspired by theory on higher-dimensional structured T-splines [2], we introduce the concept of direction indices, i.e., integers associated to each edge. These are a crucial ingredient refinement algorithm, in addition to the refinement levels of edges. We combine these ideas with an edge subdivision routine that allows for I-junctions, yielding a very flexible refinement scheme that nicely distributes the T-junctions, preserving sparsity of the system matrix and shape regularity of the mesh elements, and having linear complexity in the sense of a guaranteed upper bounds on a) the ratio of generated and marked mesh elements, and on b) the distance between marked and additionally refined elements. If used with conservative parameters, we also preserve analysis-suitability (local linear independence) except in the vicinity of extraordinary nodes. However, we also suggest the use of smaller edge neighborhoods in the refinement scheme for more localized refinement, sacrificing local linear independence for the sake of more localized refinement. In this case, we can still guarantee for the other properties mentioned above, such as sparsity of the system matrix, shape regularity, and linear complexity.

## References

[1] R. Maier, P. Morgenstern, and T. Takacs, Adaptive Refinement for Unstructured T-Splines with Linear Complexity, in preparation.

[2] Philipp Morgenstern, Mesh refinement strategies for the adaptive isogeometric method, Ph.D. thesis, Institut für Numerische Simulation, Rheinische Friedrich-Wilhelms-Universität Bonn, 2017.

[3] G. Sangalli, T. Takacs, and R. Vázquez, Unstructured spline spaces for isogeometric analysis based on spline manifolds, Computer Aided Geometric Design 47 (2016), 61–82.