The Argyris isogeometric space on unstructured multi-patch planar domains

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Multi-patch spline parametrizations are used in geometric design and isogeometric analysis to represent complex domains. We deal with a particular class of C^0 planar multi-patch spline parametrizations called analysis-suitable G^1 (AS-G^1) multi-patch parametrizations (cf. [3]). This class of parametrizations has to satisfy specific geometric continuity constraints, and is of importance since it allows to construct, on the multi-patch domain, C^1 isogeometric spaces with optimal approximation properties. It was demonstrated in [6] that AS-G^1 multi-patch parametrizations are suitable for modeling complex planar multi-patch domains.

In this work, we present a basis, and an associated dual basis, for a specific C^1 isogeometric spline space $\mathcal{A}$ over a given AS-G^1 multi-patch parametrization. We call the space $\mathcal{A}$ the Argyris isogeometric space, since it is C^1 across interfaces and C^2 at all vertices and generalizes the idea of Argyris finite elements (see [1]) to tensor-product splines. The considered space $\mathcal{A}$ is a subspace of the entire C^1 isogeometric space $\mathcal{V}^1$, which maintains the reproduction properties of traces and normal derivatives along the interfaces. Moreover, it reproduces all derivatives up to second order at the vertices. In contrast to $\mathcal{V}^1$, the dimension of $\mathcal{A}$ does not depend on the domain parametrization, and $\mathcal{A}$ admits a basis and dual basis which possess a simple explicit representation and local support.

We conclude with some numerical experiments, which exhibit the optimal approximation order of the Argyris isogeometric space $\mathcal{A}$ and demonstrate the applicability of our approach for isogeometric analysis.

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References

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