Adaptive mesh refinement procedures for the virtual element method

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ABSTRACT

The virtual element method (VEM) is a recent extension of the finite element method that permits arbitrary polygonal element geometry in two dimensions [1]. This mesh flexibility means that the VEM is well-suited to problems involving adaptive mesh refinement. However, the virtual element function spaces are defined such that quantities are only explicitly known on element edges. Thus, the well-known approaches to mesh adaptivity developed for finite elements cannot be directly applied to problems involving the VEM.

A simple mesh refinement procedure has been formulated and implemented for the VEM for the case of two-dimensional elastic problems. The procedure is motivated by seeking to improve the approximation of the element-level strain field and does not require explicit knowledge of the element basis functions. The performance of the procedure has been investigated in terms of accuracy in the $\mathcal{H}^1$ error norm vs computational cost compared to a traditional reference mesh refinement procedure.

Numerical results over a wide range of benchmark problems have demonstrated that the proposed refinement procedure generates solutions of equivalent accuracy to the reference procedure while using significantly fewer degrees of freedom, and significantly less run time. Thus, representing a dramatic improvement in computational efficiency [2].

REFERENCES

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