ADAPTIVE MESH REFINEMENT PROCEDURES FOR THE VIRTUAL ELEMENT METHOD

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The virtual element method (VEM) is an 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 variety of approaches to adaptive mesh refinement procedures have been formulated and implemented for the VEM for the case of two-dimensional elastic problems. The approaches are motivated by seeking to improve the approximations of the displacement and/or strain fields. The performance of these approaches has been investigated in terms of accuracy vs computational cost compared to a traditional reference isotropic mesh refinement procedure.
The performance of one of the strain-based approaches is exemplified in Fig 1 for the popular L-shaped domain benchmark problem with $\mathcal{H}^1$ error plotted against the number of nodes. Here it is clear that using the adaptive refinement procedure for any choice of the refinement threshold T significantly outperforms the reference approach.

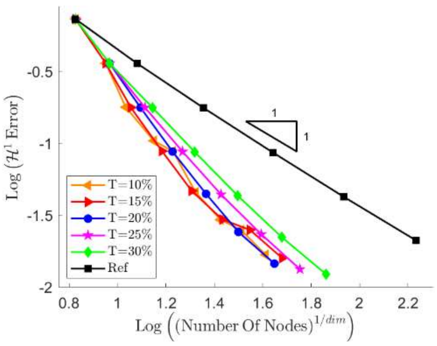

Fig 1: Error vs number of nodes

The results have shown that each of the procedures generates solutions of equivalent accuracy to the reference approach while using significantly fewer degrees of freedom, and significantly less run time, representing a dramatic improvement in computational efficiency [2].

REFERENCES

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