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# RefficientLib: An efficient load-rebalanced adaptive mesh refinement algorithm for high performance computational physics meshes

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## ABSTRACT

In this work we present a novel algorithm for adaptive mesh refinement in computational physics meshes in a distributed memory parallel setting. The proposed method is developed for nodally based parallel domain partitions where the nodes of the mesh belong to a single processor, whereas the elements can belong to multiple processors.

Some of the main features of the algorithm presented in this work are the capability to handle multiple type of elements in two and three dimensions (triangular, quadrilateral, tetrahedral and hexahedral), the small amount of required memory per processor and the parallel scalability up to thousands of processors. The presented algorithm is also capable of dealing with non-balanced hierarchical refinement, where multi refinement level jumps are possible between neighbor elements.

An algorithm for dealing with load-rebalancing is also presented, which allows to move the hierarchical data structure between processors so that load unbalancing is kept below an acceptable level at all times during the simulation. A particular feature of the proposed algorithm is that arbitrary renumbering algorithms can be used in the load rebalancing step, including both graph partitioning and space filling renumbering algorithms.

The presented algorithm is packed in the Fortran 2003 object oriented library RefficientLib, whose interface calls which allow it to be used from any computational physics code are summarized.

Finally, numerical experiments which illustrate the performance and scalability of the algorithm are presented.

## REFERENCES

[1] Baiges, Joan, and Camilo Bayona. "RefficientLib: An efficient load-rebalanced adaptive mesh refinement algorithm for high performance computational physics meshes." (2016).