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Title:

A preconditioned condition number based mesh relaxer for
2D dendritic/AMR meshes with with very bad aspect ratios.

Abstract:

In many applications, it is convenient to use a mesh that has hanging nodes. These are vertices whose coordinates are determined as an average of two neighbor vertices. Such constrained vertices can occur in two different situations: in a regularly adaptively refined mesh at the interface between refined and unrefined cells, as well as in meshes where quads are refined only by halving them (dendritic meshes). Such refined meshes present a challenge to mesh smoothing algorithms. We present an algorithm that is based on a condition number minimization approach and that can handle these different types of mesh refinement. Additionally, very bad aspect ratio cells severely limit the efficiency of such a minimization based approach. We address this issue by preconditioning our condition number based mesh smoother with a smart Laplacian smoother that takes into account the principal directions of the set of edges that are connected to each vertex. By using this approach we greatly accelerate the convergence of our condition number smoother.