Error estimates based on equilibrated residuals for domain decomposition methods

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During numerical solution of partial differential equations by some iterative method preconditioned by domain decomposition, a good error indicator could help us to decide whether the error of a current approximation to the solution is sufficiently low or not on a particular subdomain. If we use domain decomposition methods balanced by constraints [2], we can then decrease or increase the number of coarse degrees of freedom on these subdomains. We derive our error estimates from the equilibrated residual strategy which is described in [1] and further developed e.g. in [3]. In our contribution we discuss how this can be applied to domain decomposition methods without much additional effort.

In classical applications, fluxes over all element edges of a finite element solution are calculated and smoothed in some sense on every patch of elements which share a single vertex. Then the energy norm of the error is computed from solutions of Neumann problems on elements. In our approach we exploit this basic idea, but there are two main differences. First, instead of patches of elements we use subdomains and moreover, only interface unknowns are calculated with. Second, we can compute the estimates in every iteration, it means that we do not need the exact solution of an underlying linear system.

Instead of a posteriori error estimates, this method rather yields suggestions of residual partitioning for iterative methods preconditioned by a domain decomposition method.

References

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