A Posteriori Error Analysis Of Finite Element Methods For Reissner-Mindlin Plates

Jun Hu
School of Mathematical Sciences, Peking University, China
hujun@math.pku.edu.cn

This paper establishes a theory for a posteriori analysis of finite element methods of the Reissner-Mindlin plate problem. With this theory, the uniformly reliable and efficient a posteriori error estimate for various finite element methods of the Reissner-Mindlin plate problem is simply reduced to three parts: (1) Check the four conditions (H1)-(H4); (2) Design free functions $\tilde{\boldsymbol{\phi}}_h$, $\tilde{w}_h$, and $\tilde{\boldsymbol{\gamma}}_h$ and the free parameter α; (3) Estimate the last six terms of the abstract estimator $\tilde{\eta}_h$. It is conjectured that it applies to all locking-free schemes of the Reissner-Mindlin plate problem.

As applications, we apply this theory to four classes of most frequently used finite element methods for the Reissner-Mindlin plate problem: the methods based on the linked technique, the Arnold-Falk type methods, the MITC methods, and the discontinuous Galerkin methods. For all these methods, it is proved that the error can be estimated by a computable error estimator from above and below up to multiplicative constants that are independent of both the meshsize and the plate thickness.

Among aforementioned methods, the first class of methods has been analyzed in literature under the *saturation assumption*. The estimator of this paper improves that result by abandoning that constraint. For the second class of methods, only the Arnold-Falk element has been analyzed under the condition $t \lesssim h_K$ for any element K of the mesh $\mathcal{T}_h$ with the element diameter h_K and the plate thickness t. Such an assumption is removed in this paper. For other methods of the Arnold-Falk type, there is no a posteriori analysis in the literature. For the MITC methods, our theory recovers the results in the literature. For the discontinuous Galerkin methods, no a posteriori analysis can be found so far. Note that, for all the methods under consideration, the frameworks of the analysis herein are completely different from those used for them in the literature.

This is a joint work with Prof. Yunqing Huang.