Goal oriented adaptive isogeometric methods with applications to porous media

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ABSTRACT

In this work, we propose a method of goal adaptive isogeometric analysis using goal oriented error estimation and adaptivity with LR B-splines for local h-refinement [1]. In goal-oriented error estimation based on a Serendipity pairing of approximation spaces [2], the numerical error of finite element approximations is estimated in terms of quantities of interest that is characterized by a linear functional that controls the behavior of a solution in certain subdomains, along some curves, or at interesting points.

The idea of a Serendipity pairing of discrete approximation spaces S_h,p,k – S_h,p+1,k+1 where the space S_h,p+1,k+1 is considered as an enrichment of the original basis of S_h,p,k by means of the k-refinement, utilizes a typical unique feature available in isogeometric analysis. The space S_h,p+1,k+1 is used to obtain a higher order accurate isogeometric finite element approximation and using this approximation we propose a simple a posteriori error estimator that may be used to estimate the error in recovered quanitity of interest.

We will demonstrate the use of the proposed goal oriented error estimator related to flow in porous media. The reliability of the estimator are tested on problems with analytical solution. The numerical tests illustrate the optimal convergence rates obtained for the unknown, as well as the effectiveness of the proposed error estimators.

References

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