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GOAL-ORIENTED ERROR ESTIMATION AND MESH ADAPTIVITY IN THREE-DIMENSIONAL ELASTICITY PROBLEMS

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In finite element simulation of engineering applications, accuracy is of great importance considering that generally no analytical solution is available. Conventional error estimation methods aim to estimate the error in energy norms or the global L_2-norm. These values can be used to estimate the accuracy of the model or to guide how to adapt the model to achieve more accuracy. However, in engineering applications specific quantities are required to be accurate.

The novel error estimation approach which is called Dual-Weighted Residual error estimation, approximates the error with respect to the quantity of interest which can be mean stress or displacement in a subspace or the solution ('s gradient) on a specific point, etc. Dual-Weighted Residual error estimation is a dual-based scheme which requires an adjoint problem. The adjoint or dual problem is described by defining the quantity of interest in a functional form. Then by solving the primal and dual problems, errors in terms of the specified quantities are calculated.

In this paper the Dual-Weighted Residual error estimation besides the conventional residual-based error estimation and a recovery-based error estimation are applied in a three-dimensional elasticity problem. Local estimated errors are exploited in order to accomplish the mesh adaptivity procedure. The goal-oriented mesh adaptivity control the local errors in terms of the prescribed quantities. Both refinement and coarsening processes are applied to raise the efficiency. The convergence rates are plotted to illustrate the superiorities of the goal-oriented adaptivity over the traditional ones.