A5. Estimation of the quality of the approximated numerical solution

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The difference between the exact solution of the problem and the approximate one obtained through the finite element method allows us to assess the quality of the solution: this is called “discretization error”. Since in the general case the exact solution is not known, the idea is to estimate this difference by computing an “error estimator”. The error estimators can be categorized as:

- global error estimators: to evaluate the quality of the solution on the whole domain (stress smoothing method, equilibrium residuals, constitutive law errors...),
- local error estimators: to evaluate the quality of a particular quantity, such as displacement on a certain point or stresses in a particular zone (weighted residuals method...).

The “error estimator” tools (available in some software, with different computational costs in each one) can be used for two different purposes:

- to improve the quality of the results of a finite element calculation by refining automatically the mesh and or the time discretization,
- to obtain an interval of confidence (inferior and superior boundaries) associated with a global error or a particular quantity of interest.

It is important to highlight that certain error estimators, such as the stress smoothing method, only estimate the error, while others, such as the weighted residual method, guaranty the numerical results by computing the range of error.

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