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Anisotropic mesh adaption based on a posteriori estimates

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ABSTRACT

Efficient numerical approximation of solution features like boundary or interior layers by means of the finite element method requires the use of layer adapted meshes. Anisotropic meshes, like for example Shishkin meshes, allow the most efficient approximation of these highly anisotropic solution features. However, application of this approach relies on *a priori* analysis on the thickness, position and stretching direction of the layers. If it is impossible to obtain this information *a priori*, as it is often the case for problems with interior layers of unknown position for example, automatic mesh adaption based on *a posteriori* error estimates or error indicators is essential in order to obtain efficient numerical approximations.

Historically the majority of work on automatic mesh adaption used locally uniform refinement, splitting each element into smaller elements of similar shape. This procedure is clearly not suitable to produce anisotropically refined meshes. The resulting meshes are over-refined in at least one spatial direction, rendering the approach far less efficient than that of the anisotropic meshes based on *a priori* analysis.

Here we consider automatic anisotropic mesh adaption approaches, which are able to generate suitable anisotropic elements based only on a shape regular initial mesh and *a posteriori* information on the error.

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