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Dual weighted residual error estimation for the Finite Cell Method

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In the Finite Cell Method (FCM), the finite-element discretization is performed on a domain of simple shape that encloses the original domain of interest. This proceeding greatly simplifies mesh generation [1]. The main idea is to recover the structure of the original domain by applying a quadrature scheme which, for instance, relies on a separate quadrature mesh. This quadrature mesh approximates the original domain and, thus, incurs a quadrature error. Therefore, there are two main computational error sources in the FCM that need to be accounted for: the discretization error and the quadrature error.

In this talk, we apply a goal-oriented error control based on the dual weighted residual method (DWR) to the FCM [2]. The DWR method can be used to estimate errors in the context of both linear and nonlinear problems with respect to user-defined, more local (nonlinear) quantities of interest. The error identity resulting from the DWR approach allows for a combined treatment of the discretization and quadrature error. Furthermore, we use a localization technique based on a partition of unity proposed by Richter and Wick [3]. An adaptive strategy is presented which balances the two error contributions. The performance of the error control is demonstrated for linear and nonlinear problems in 2D.

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