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ADAPTIVE MODELLING AND MESHING FOR TIME DEPENDENT PROBLEMS BASED ON TIME AVERAGES

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Abstract. We present a duality based a posteriori error estimator for the computation of functionals averaged in time for nonlinear time dependent problems. Such functionals are typically relevant for periodic or quasi-periodic solutions in time. Applications arise, e.g., in systems of convection-diffusion-reaction equations including a large amount of chemical reactions. In order to reduce the numerical complexity, we use simultaneously locally refined meshes and adaptive (chemical) models. Such strategies come along the question of how to control the discretization error and the model error.

These error parts are expressed in terms of output functionals. Hence, considerations of adjoint problems measuring the sensitivity of the functional output are needed. In contrast to the classical dual-weighted residual (DWR) method, we favor a fixed mesh and model strategy in time. Taking advantage of the (quasi-)periodic behaviour, only a stationary dual problem has to be solved. This implies that the computation of an evolutionary adjoint problem is circumvented. Storing the primal solution at every timestep is also not necessary. Only averaging in time is needed.

This a posteriori estimation technique is applied, e.g., to a system of convection-diffusion-reaction equations. The perfomance is checked by evaluating and comparing the estimated and exact erros for the mesh and the used model.