VI International Conference on Adaptive Modeling and Simulation
ADMOS 2013
J. P. Moitinho de Almeida, P. Díez, C. Tiago and N. Parés (Eds)

GOAL-ORIENTED ERROR ESTIMATOR FOR THE FRACTIONAL STEP θ TIME-STEPPING SCHEME

Thomas Richter*, **Dominik Meidner**†

*University of Heidelberg
Institute of Applied Mathematics
INF 294, 69120 Heidelberg
e-mail: thomas.richter@iwr.uni-heidelberg.de

†Dominik Meidner
TU Munich
e-mail: meidner@ma.tum.de

Key words: error estimation, fractional step time-stepping, DWR

Abstract. In this contribution we present an adjoint based a posteriori error estimator for (nonlinear) parabolic problems discretized with the fractional step θ time-stepping scheme. This scheme combines several highly desired attributes: it is second order accurate, strongly A-stable and shows very little numerical dissipation. The drawback of this time-stepping scheme is its time-stepping character based on a finite difference approximation which makes it ill-suited for variational and in particular adjoint error estimation techniques.

We will propose a Petrov-Galerkin scheme, that is shown to be algebraically equivalent to the fractional step θ time-stepping scheme for linear problems and that can be regarded as an approximation of this scheme for general nonlinear problems.

The error estimator is split into two parts: the first is a traditional residual based estimator of the Galerkin scheme, the second measures the defect in Galerkin orthogonality given by the numerical quadrature error. Both estimator parts require the solution of an adjoint in time solution.