Space and time reconstructions in a posteriori error control of evolution problems

Charalambos MAKRIDAKIS, University of Crete and IACM-FORTH

We review some recent results on a posteriori error analysis of evolution equations based on appropriate reconstruction operators. These operators are used to derive reformulations of the discretization methods as purtrubed evolution pdes with source terms of a posteriori type. As result energy or other standard techniques yield optimal a posteriori error estimates not known before. Using the "Elliptic Reconstuction" this approach applies to space discrete and fully discrete parabolic problems. When higher order in time discretization methods are used appropriate "time reconstructions" are introduced. Thus optimal a posteriori error estimates for time discretizations by the discontinuous Galerkin method, the Crank-Nicolson method, Runge-Kutta-Collocation methods of arbitrary order for linear and nonlinear evolution problems are derived. This is a rather general approach which can be applied to linear as well as to nonlinear problems with dissipative or hyperbolic character.

References

[1] Ch. Makridakis and R. H. Nochetto, *Elliptic reconstruction and a posteriori error estimates for parabolic problems*, SIAM J. Numer. Anal. **41** (2003) 1585–1594.

[2] G. Akrivis, Ch. Makridakis and R. H. Nochetto, *A posteriori error estimates for the Crank–Nicolson method for parabolic equations*, Math. Comp. **75** (2006) 511–531.

[3] Ch. Makridakis and R. H. Nochetto, *A posteriori error analysis for higher order dissipative methods for evolution problems*. To appear in Numer. Math.

[4] O. Lakkis and Ch. Makridakis, *Elliptic reconstruction and a posteriori error analysis for fully discretized parabolic problems*. To appear in Math. Comp.

[5] F. Karakatsani and Ch. Makridakis, *A posteriori estimates for approximations of the time-dependent Stokes equations*. Preprint.

[6] G. Akrivis, Ch. Makridakis and R. H. Nochetto, *Optimal a posteriori error estimates for continuous Galerkin and Runge–Kutta methods*, Preprint.

[7] E. Cuesta and Ch. Makridakis, *A posteriori error estimates and maximal regularity for approximations of fully nonlinear parabolic equations in Banach spaces*, Preprint.

Charalambos MAKRIDAKIS – makr@tem.uoc.gr
Department of Applied Mathematics, University of Crete, 71409 Heraklion-Crete, Greece and Institute of Applied and Computational Mathematics, FORTH, 71110 Heraklion-Crete, Greece