

# On the convergence in $\ell_p$ norms of a MoL approach based on AMF-W-methods for $m$ -dimensional linear parabolic problems of diffusion-reaction type

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Results of convergence in  $\ell_p$ -norms for a MoL (Method of Lines) approach applied to  $m$ -dimensional ( $m \geq 2$ ) linear parabolic problems of diffusion-reaction type on rectangular domains, are supplied. The space semi-discretization is based on central differences and the time integration is carried out with AMF-W-methods, which reduce the algebra computational costs to the level of one-dimensional problems on each spatial direction, in a similar way as methods of Alternating Direction Implicit-type (ADI) do.

Most of known results on convergence (PDE convergence) are restricted to the  $\ell_2$ -norm and currently depend on the number of spatial dimensions  $m$ . Here, we present results of convergence (PDE convergence) of order two in time (and in space) in both norms ( $\ell_2$  and  $\ell_\infty$ ), independently of the number of space dimensions  $m$  and of the spatial grid, when time-independent boundary conditions are considered. In case of time-dependent boundary conditions, the PDE order of convergence is *almost* two in the  $\ell_2$ -norm when  $m \geq 2$  and order one in the uniform norm for  $m \geq 3$ . Besides for  $m = 2$ , a slight modification of the AMF-W method allows to get convergence of order *almost* two in the uniform norm. Some ideas about the proofs are presented and some numerical examples to illustrate the theory are also given.

## References

- [1] S. Gonzalez-Pinto, E. Hairer, D. Hernandez-Abreu, Convergence in  $\ell_2$  and  $\ell_\infty$  norm of one-stage AMF-W methods for parabolic problems}, <http://www.unige.ch/hairer/preprints.html> (submitted for publication 2019).
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- [3] G. I. Marchuk, Splitting and alternating direction methods. In: Handbook of Numerical Analysis I, Eds. P.G. Ciarlet, J. L. Lions, North-Holland 1990, Amsterdam, pp. 197-462.

**Primary author:** Prof. GONZALEZ PINTO, Severiano (University of La Laguna)

**Co-authors:** Prof. HAIRER, Ernst (University of Geneve); Prof. HERNANDEZ ABREU, Domingo (University of La Laguna)

**Presenter:** Prof. GONZALEZ PINTO, Severiano (University of La Laguna)