On ParaDiag for BDFs

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Many parallel-in-time (PinT) paradigms have been developed in the last decades to efficiently solve time-dependent partial differential equations (PDEs). In this talk we focus on the ParaDiag scheme whose most peculiar feature consists in the explicit diagonalization of the matrix stemming from the adopted time-stepping method [1]. However, certain classes of time integrators lead to a discrete operator which is not diagonalizable. This is the case of Backward Differentiation Formulas (BDFs) like the backward Euler scheme. With the aim of overcoming such a drawback, different approaches have been developed in the literature [2]. In this talk, we illustrate a novel technique. In particular, we show how to exploit the circulant-plus-low-rank structure of the discrete BDF operators to design a new, successful implementation of the ParaDiag paradigm. The efficiency of our original scheme is displayed by several numerical examples.

Joint work with M. J. Gander

References

[1] Y. Maday and E. M. Rønquist, *Parallelization in time through tensor-product space-time solvers*, Comptes Rendus Mathematique Vol. 346 (2008), pp. 113-118.

[2] M. J. Gander, J. Liu, S.-L. Wu, X. Yue and T. Zhou, *ParaDiag: Paralel-in-Time Algorithms Based on the Diagonalization Technique*, Preprint (2020), ArXiv: 2005.09158.