

Improved parallel in time integration via low-rank updates and interpolation

Daniel Kressner* Stefano Massei[†] Junli Zhu[‡]

Abstract

Two novel algorithms for the parallel time integration of linear differential problems are proposed. As other techniques for time parallelization, the two procedures make the time stepping matrices circulant to efficiently block diagonalize the linear system corresponding to the all-at-once formulation. Additionally, our methods avoid any iterative refinement phase by relying on tensorized Krylov subspace approximation or interpolation; this results in an enhanced communication efficiency. The effectiveness of these approaches is demonstrated on several numerical examples.

*MATH-ANCP, cole Polytechnique Fdrale de Lausanne, Station 8, 1015 Lausanne, Switzerland. E-mail: daniel.kressner@epfl.ch

[†]Centre for Analysis, Scientific Computing and Applications (CASA), TU Eindhoven, Eindhoven, Netherlands. E-mail: s.massei@tue.nl

[‡]School of Mathematics and Statistics, Lanzhou University, Lanzhou 730000, Gansu, PR China. The work of the third author has been supported by National Natural Science Foundation of China (Grant Nos. 11471150, 12161030) and China Scholarship Council (Contract No. 202006180060). E-mail: zhujl18@lzu.edu.cn