

# On the approximate solution of triangular systems for massively parallel machines

Monica Dessolet<sup>1</sup> and Fabio Marcuzzi<sup>2</sup>

<sup>1</sup> University of Padova. [monica.dessolet@unipd.it](mailto:monica.dessolet@unipd.it)

<sup>2</sup> University of Padova. [marcuzzi@math.unipd.it](mailto:marcuzzi@math.unipd.it)

Parallel solution of sparse triangular linear systems is indeed a challenging task due to its inherently sequential nature. Many classical techniques are based on level scheduling rows that are independent [1], but depending on the sparsity pattern there may be a very large number of levels with a small amount of work to efficiently use massively-parallel architectures like GPUs. In the present talk we show other possibilities for the case of a Krylov subspace method coupled with a LU-type preconditioner. In particular, we introduce a hybrid direct/iterative two steps method and we present a numerical application to a CFD model problem [4] that shows performance gains of this approach over cuSPARSE direct solver.

## References

- [1] M. Naumov, *Parallel Solution of Sparse Triangular Linear Systems in the Preconditioned Iterative Methods on the GPU*, Technical report NVR-2011-001, NVIDIA (2011).
- [2] H. Anzt, E. Chow, J. Dongarra, *Iterative Sparse Triangular Solves for Preconditioning*, European Conference on Parallel Processing, Springer (2015) pp 650-661.
- [3] E. Gallopoulos, B. Philippe, A. Sameh, *Parallelism in Matrix Computations*, Springer (2016).
- [4] C. Calgaro, J. P. Chehab, Y. Saad, *Incremental incomplete LU factorizations with applications*, Numer. Lin. Algebra Appl. 17 (5), (2010) pp 811-837 .