Accelerating Spike algorithms for the solution of sparse linear systems with multiple right-hand sides

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The Spike algorithm ([1, Chapter 1] and [2] and references therein) is a state-of-the-art parallel, narrow-banded linear solver whose effectiveness has been demonstrated in a series of real world applications. Given the matrix equation $AX = B$ for block tridiagonal $A \in \mathbb{R}^{n\times n}$, with $B \in \mathbb{R}^{n\times s}$ and $s \geq 1$, is partitioned among the processors, each being assigned a block of rows, the first step of Spike is the independent factorization of the diagonal blocks followed by the extraction of a smaller reduced matrix equation, while the second step consists of the solution of the latter and then substitution to compute the remaining components

Following many developments from its initial conception, it would be fair to characterize Spike as a fast and robust parallel polyalgorithm that can be used as a preconditioner for general sparse linear systems [3].

In this presentation we consider ways to further improve the performance of Spike focussing on the use of projection methods for multiple right-hand sides to solve the above matrix equation. We show that with careful design that targets not only the right-hand sides but also the spike construction, it is possible to improve Spike even in case $s = 1$, that is when a single linear system is to be solved. Our findings are illustrated with numerical experiments on HPC platforms.

References

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