Randomization in Localized Model Order Reduction

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Localized (in space) model order reduction is a promising approach for many simulation tasks in engineering because of its good parallelization behavior and and the potential reuse of local models. Especially for highly complex structures with large geometric detail, large simulation speedups can be achieved. We focus on signal integrity simulations in printed circuit boards, which can be performed by approximating the solution of the time harmonic Maxwell's equation. Such simulations often take several hours or days with classical methods, because even a coarse mesh easily leads to $\mathcal{O}(10^8)$ or more unknowns.

To generate local approximation spaces for localized model order reduction, we recently proposed to employ methods from randomized numerical linear algebra (RandNLA) [A. Buhr and K. Smetana, *SIAM J. Sci. Comput.*, 40(4), A2120-A2151]. We define local transfer operators which have quickly decaying singular values and approximate their left singular vectors to obtain good local approximation spaces. RandNLA provides fast algorithms having good parallelization behavior and provable convergence rates for this task.

We will showcase the application of randomized local model order reduction on the signal integrity simulation for an Olimex OLinuXino A64 mini PC (Raspberry Pi like).