Collaboration with the SME TAILSIT during the SHAPE project PARTS: Electromagnetic simulations with the finite/boundary element method for large systems using HPC

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TAILSIT is a company based in Styria, Austria, that produces custom-fit simulation software tools for electromagnetic problems and structural analysis. During this SHAPE project TAILSIT's electromagnetic simulation software has been ported to HPC machines with the support from an expert from the VSC Research Center at TU Wien and using the computing resources of the Vienna Scientific Cluster (VSC, https://vsc.ac.at). A careful performance analysis revealed several bottlenecks and limitations that were addressed by implementing optimised communication strategies with the Message Passing Interface (MPI). While the previous version of TAILSIT's software simulation tools relying on shared-memory parallelism was restricted to typically less than one million surface degrees of freedom, the new and optimised version employing distributed-memory parallelisation with MPI allows to treat problems up to $50{\cdot}10^9$ surface degrees of freedom. In addition, access to the HPC resources allowed to test and further optimise the shared-memory version of the fast multipole method FMM library. A detailed description of the project is given in [1].

This SHAPE project allowed for a giant leap from running simulations on desktop workstations to an HPC version of the software being able to not only treating much larger problem sizes than previously possible but also providing much faster time to solution. Since larger models become more and more relevant to TAILSIT's customers and being aware of their customer's interest in 'faster code', the new HPC version helps TAILSIT to increase the competitiveness of their software library and puts TAILSIT in a much better market position.

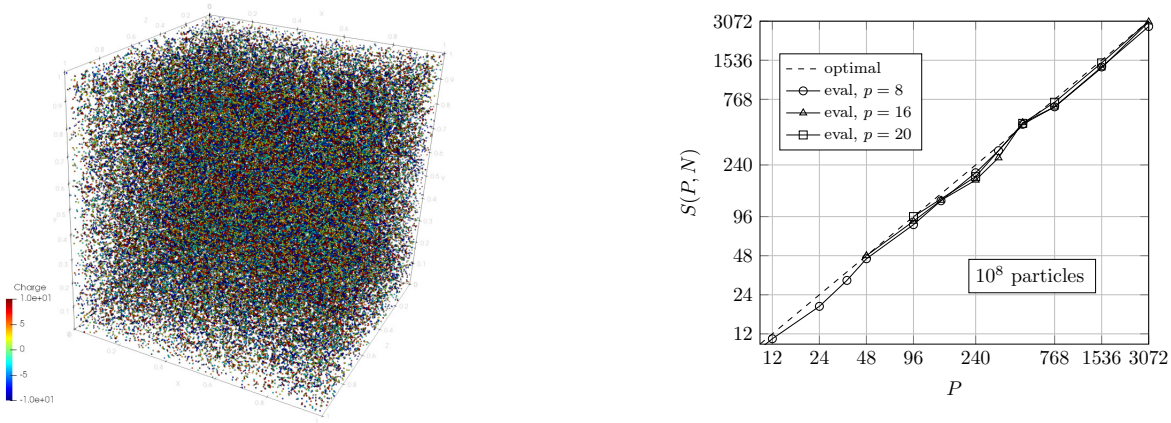

Fig. 1: Randomly charged point cloud in an unit cube (left). Parallel speedup of the evaluation of the potential with $N = 10^8$ particles for different FMM expansion degrees p (right).

The results shown in Fig. 1 are accumulated in a white paper [1] and will be online in the near future.

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References

[1] Zechner J., Kielhorn L., Rüberg T. and Steiner S., to be published at
`https://prace-ri.eu/training-support/technical-documentation/white-papers/shape-white-papers/`