EUMaster4HPC

UNLEASH THE POWER OF HPC

EuroHPC Joint Undertaking

BACKGROUND

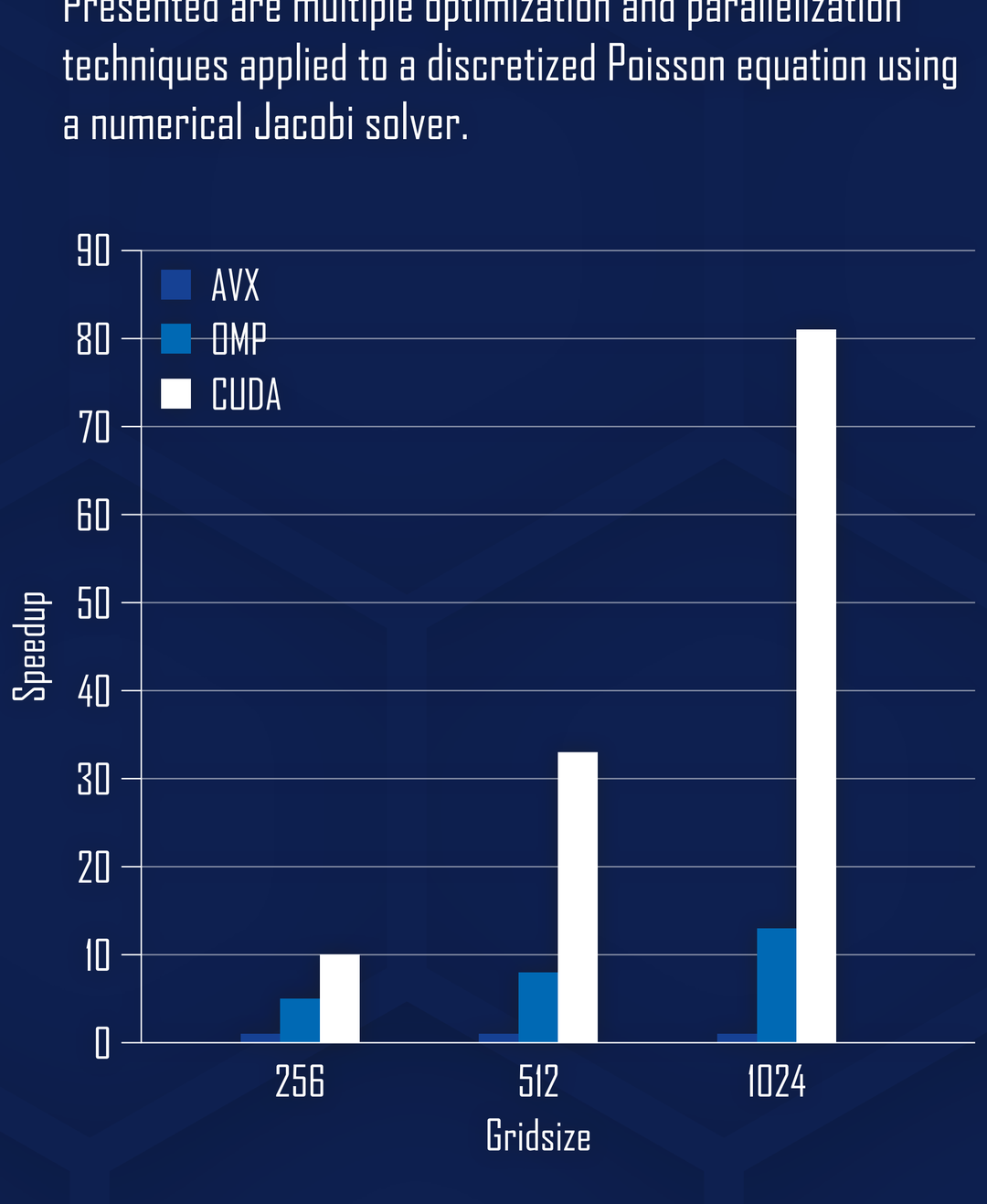
With ever-increasing core counts of CPUs, it is necessary to be able to make use of these new parallel architectures not only in high performance systems but also in home computers. This often non-trivial task requires knowledge of possible parallelization techniques.

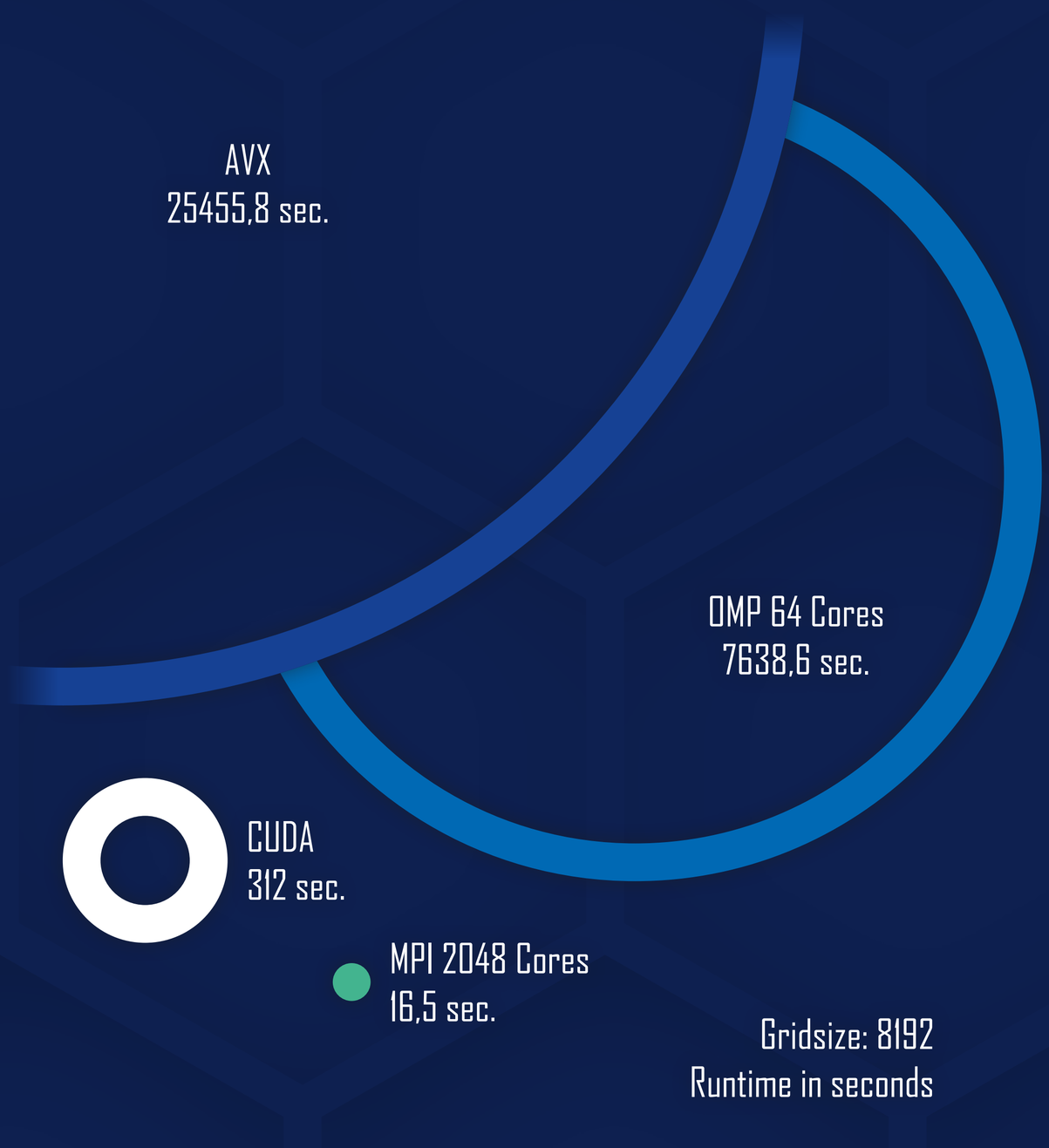
METHOD

Presented are multiple optimization and parallelization techniques applied to a discretized Poisson equation using a numerical Jacobi solver.

SINGLE CORE PERFORMANCE

By making use of the architectural structure of CPUs it is possible to significantly reduce the program runtime for serial calculations. We managed to increase the cache-hit rate by restructuring and blocking the memory accesses. Using the vectorized CPU instruction sets like AVX allows for even higher performance. Combining these optimization techniques results in single core speedup of around 150 times for a grid size of 512x512.





SINGLE NODE

Here, we showcase the performance enhancements achieved through two distinct parallelization techniques – multithreading and GPU acceleration. The former has been implemented via OpenMP, while the latter has been facilitated using CUDA. Both implementations bring significant speedup even on smaller systems.

MULTI NODE

Domain decomposition enables efficient computation of the problem across multiple nodes. The high-speed Infiniband interconnect of the Meluxina cluster further ensures seamless communication between nodes, without adversely affecting the performance of the computations.

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