



Nekbone Performance Assessment Summary

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Weak scaling on the JUQUEEN Blue Gene/Q was examined with up to 1,835,008 threads (28,672 MPI ranks, one per compute node) showing only minor efficiency degradation. Serialization efficiency was a poor 0.70 at all scales due to explicit OpenMP barrier synchronizations and an expensive critical section.

Load balance efficiency is very good, with only a small amount of additional work evident on Master threads where MPI communication is done. Transfer efficiency is excellent due to mostly non-blocking point-to-point communication with neighbours. However, 45% of total CPU time was associated with wait states for MPI and OpenMP communication and synchronization, 93% of which is attributed roughly equally to five explicit OpenMP barrier synchronizations and lock contention for an OpenMP critical section. Computation efficiency deteriorates only slightly for the largest configuration which has a non-power-of-2 z-processor distribution ($32 \times 32 \times 28$).

Nekbone is a proxy mini-app which captures the basic structure of the extensive Nek5000 incompressible flow simulation open-source software, exposing the spectral element method with an iterative conjugate gradient solver. The CORAL benchmark version is implemented in Fortran (with communication wrappers in C) using MPI and OpenMP (MPI_THREAD_FUNNELED).

A full technical report can be found at

https://pop-coe.eu/sites/default/files/pop_files/pop-ar-nekbone.pdf

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Notices: The research leading to these results has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.676553.



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