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Energy Efficiency of Nonlinear Domain Decomposition Methods

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A nonlinear domain decomposition (DD) solver is considered with respect to improved energy efficiency. In this method, nonlinear problems are solved using Newton's method on the subdomains in parallel and in asynchronous iterations. The method is compared to the more standard Newton-Krylov approach, where a linear domain decomposition solver is applied to the overall nonlinear problem after linearization using Newton's method. It is found that in the nonlinear domain decomposition method, making use of the asynchronicity, some processor cores can be set to sleep to save energy and to allow better use of the power and thermal budget. Energy savings on average for each socket up to 77% (due to the RAPL hardware counters) are observed compared to the more traditional Newton-Krylov approach, which is synchronous by design, using up to 5120 Intel Broadwell (Xeon E5-2630v4) cores. The total time to solution is not affected. On the contrary, remaining cores of the same processor may be able to go to turbo mode, thus reducing the total time to solution slightly. Last, we consider the same strategy for the ASPIN (Additive Schwarz Preconditioned Inexact Newton) nonlinear domain decomposition method and observe a similar potential to save energy

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