

Description

Possibly the fastest existing solution to the solution of very large (unknowns count $> 10^6$) linear systems is the PARDISO library for sparse matrices. It is available in two implementations: Intel MKL and <https://www.pardiso-project.org/>. According to manuals and practice, they have ability to use multi-core processor architectures.

However, problems do arise, if our goal is to solve **simultaneously** several different linear systems. Problem is motivated by General Relativity and model of toroids with central black hole, where equation count is 4. It is very unclear how to handle them using, say, 12 physical cores. One extreme solution is to use all cores, and solve four equations sequentially. Another proposition is to solve four equations simultaneously, using only 3 cores per equation. More cores, more possibilities.

Goal of the project is to provide evidence of all-core utilization while solving simultaneously multiple linear equations. Linear system used should be sparse, for example from discretization of the Poisson equation, or similar system from GR problem. If this will work, performance of various CPU/equation permutations must be benchmarked.

At least 8-core (physical) machine is required to pursue the project. For students who significantly advance solution of the problem, access to 56, 64, or 96-core machines will be provided.