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Open-Source Parallel FE Software : FrontISTR
--- Performance Considerations about B/F (Byte per Flop) of SpMV on
K-Supercomputer and GPU-Clusters ---

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Abstract

FrontISTR is an open-source structural analysis system, supporting fruitful nonlinear analysis functions. FrontISTR also exhibits an innovative aspect that addresses large-scale application, parallelism, and programmability. A 7.5 billion DOF problem can be solved in 13.7 h using 65,536 cores of “K.” A single core performance is a most crucial factor in FEM, which uses iterative equation solvers, and SpMV (Sparse-Matrix Vector Product) is a hotspot there. Cache blocking and contiguous data structure for matrix have been investigated to challenge the memory wall problem.

Running on a note PC, PC clusters and supercomputers including the Earth Simulator 2 and the K-computer, FrontISTR has been used for solving various industrial problems, for example, (1) Dynamic friction behaviors between rail and fast running train's wheel, (2) Thermal structural deformation of electrical devices, (3) Thermal elastic-plastic residual stress of large-scale welded structures, (4) Friction of power transmission belt, (5) Large strain evaluation of fill rubber tire, (6) Fluid-structure coupled behavior of turbine blades, and so on.

Discussions at the workshop may cover the following topics :

- MPI/OpenMP hybrid performance of SpMV of FEM on a node of K and FX10
- Middleware "ppOpen-APPL/FEM" for developing FE-applications
- Necessary software techniques towards exa-scale computers

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