第 24 回先進スーパーコンピューティング環境（ASE）研究会実施報告

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東京大学情報基盤センターASE 研究会（Advanced Supercomputing Environment）は内外からの講演者を招いて不定期に開催している。2016 年 12 月 1 日（木）に実施された第 24 回 ASE 研究会[1]では，並列直接法ライブラリ PARADISO の開発者である Olaf Schenk 教授（Universita della Svizzera italiana, Switzerland）をお招きして，疎行列直接並列解法の最近の動向についてご講演いただいた。学内外から合計 12 名の出席者があり，活発な議論が行われた。

表 1　プログラム

時間帯	講演者	題　目
10:00-10:05	Kengo Nakajima (Information Technology Center (ITC), The University of Tokyo)	Opening
10:05-11:05	Olaf Schenk (Universita della Svizzera italiana, Switzerland)	Performance Engineering and Sparse Matrices: Introduction, applications and supercomputing
We will review the state-of-the art techniques in the parallel direct solution of linear systems of equations and present several recent new research directions. This includes (i) fast methods for evaluating certain selected elements of a matrix function that can be used for solving the Kohn-Sham-equation without explicit diagonalization and (ii) stochastic optimization problems under uncertainty from power grid problems from electrical power grid systems. Several algorithmic and performance engineering advances are discussed to sove the underlying sparse linear algebra problems. The new developments include novel incomplete augmented multicore sparse factorizations, multicore- and GPU-based dense matrix implementations, and communication-avoiding Krylov solvers. We also improve the interprocess communication on Cray systems to solve e.g. 24-hour horizon power grid problems from electrical power grid systems of realistic size with up to 1.95 billion decision variables and 1.94 billion constraints. Full-scalr results are reported on Cray XC30 and BG/Q, where we observe very good parallel efficiencies and solution times within an operationally defined time interval. To our knowledge, "real-time"-compatible performance on a broad range of architectures for this class of problems has not been possible prior to present work.		
11:15-11:55	Akhiro Ida (ITC, The University of Tokyo)	Development of H-matrices with ACA for Large-scaled BIEM Analyses
The boundary integral equation method (BIEM) is applied to a wide spectrum of numerical simulations. The method of hierarchical matrices (H-matrices) combined with the adaptive cross approximation (ACA) is an efficient approximation technique that can be applied to the dense matrices arising in the integral equation method. We have been developing the HACApK library for the H-matrices with ACA. To conduct large-sized simulations, we adopt new techniques including improvement and parallelization of H-matrices with ACA. These techniques are examined through practical numerical experiments for electric field analyses and earthquake cycle simulations.		
11:55-12:00	Kengo Nakajima (ITC, The University of Tokyo)	Closing

[1] http://www.cc.u-tokyo.ac.jp/event/ase/24.html