

Super Matrix Solver
High-speed and Robust Matrix Solver
Super Matrix Solver

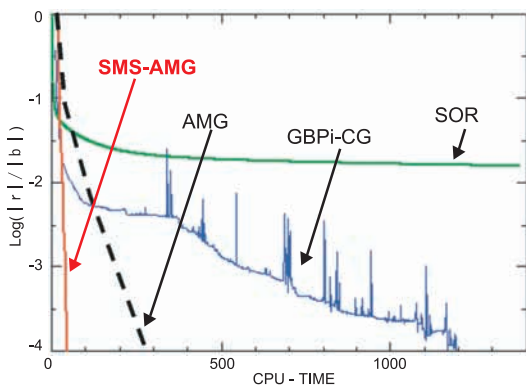
Patent granted

**Accelerates and Stabilizes Numerical Solution of CFD, Structural, Electromagnetic and Optical Analyses !
Realizes high-speed calculation with software (algorithm) while keeping the investment cost for hardware.**

Super Matrix Solver is a series of matrix calculation software libraries that were developed by the National Aerospace Laboratory of Japan (currently the Japan Aerospace Exploration Agency) and VINAS for acceleration and stabilization of calculations to solve simultaneous linear equation systems in numerical analyses.

Super Matrix Solver series comprise of modules of different matrix solution methods that solve large scale and hard-to-converge matrix problems accurately with avoidance of round-off errors, in short time and stably.

Example of Super Matrix Solver's
Calculation Performance Comparison with other solvers



Relative residual (logarithmic scale) vs. calculation time
*Case of 1.1 Million unknowns
*GPB-CG is one of the fastest and most stable CG methods.

Features of Super Matrix Solver

- Different types of solution methods (e.g. iterative and direct methods) to choose from depending on the types of problems.
- Solves even large scale problems with high accuracy.
- Highly stable convergence
- High-speed calculation
- Modules are provided in executable format (e.g. DLL), which can easily be integrated into current solution method.

Intended Problems

- Simultaneous linear equation systems that are derived from discretization of differential, finite element, finite volume or boundary element methods.
- Problems that are generated from various types of analyses such as CFD, structural, electromagnetic, plastic mold flow and electronic circuit analyses.
- Other types of analyses in engineering fields.

Super Matrix Solver Series

Iterative Method

- **SMS-AMG** — AMG (Algebraic Multigrid Method), which is a high-speed iterative method, has been accelerated and stabilized with proprietary technology.
- **P-ICCG** — Parallel version of ICCG method with many actual performance results in various analysis fields.

Direct Method

- **SMS-MF** — Packaged product of MultiFrontal method, which is the fastest method in direct methods. Accelerated with unique ordering method that reduces fill-ins. Easy to use without complex setup.

Boundary Element Method

- **SMS-BEM** — Proprietary hybrid solver based on direct and iterative methods. Dedicated for dense matrices that are generated with boundary element method (BEM).



SMS-AMG
**Software Product of the Year 2003
Engineering Section Award**
Awarded by the Software Information Center (SOFTIC)

<http://www.vinas.com/jp/en/seihin/sms/>

Please visit our web site for detailed product information, application examples of *Super Matrix Solver*.

See reverse side for application examples.



Super Matrix Solver Application Examples

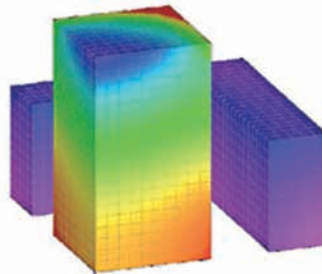
SMS-AMG Electromagnetic analysis

MU TECH Co., Ltd.

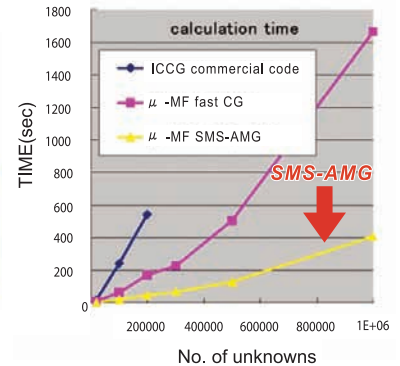
10 times faster calculation than ICCG method

"Speed of calculation, in particular, is extremely higher than our expectation from conventional solution methods. With appropriate computer hardware, SMS-AMG is expected to be able to handle calculations with degrees of freedom exceeding 2 million. It was also confirmed that iterations needed to reach convergence by SMS-AMG are independent of aspect ratio of finite elements. This performance is more remarkable than its calculation speed."

Yoichi Nojima, CEO, MU TECH Co., Ltd.



Standard IEEJ verification model for static electromagnetic analyses



URL <http://www.mutec.org/>

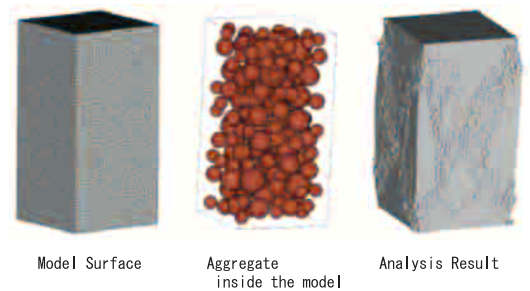
SMS-AMG Breakage Analysis of Concrete Structure

Hokkaido University

10 times faster calculation on a PC than on a supercomputer

Hokkaido Univ., Structural and Geotechnical Engineering Div.

- Applied Field** Breakage Analysis of Concrete Structure Simulation of crack propagation process by a meso-scale model
- Solution Method** Rigid Body Spring Model (RBSM)
- Size of Calculation** Several thousand calculations of 250 to 400 thousand unknowns
- Calculation Speed** SMS-AMG on a Windows PC calculated 10 times faster than ICCG library run on a super-computer.



3D RBSM Analysis
75 x 75 x 150mm Concrete Compression Analysis Result
(48,258 elements) loading plate is fixed horizontally

Reference URL's

- Laboratory: <http://www.kozo.eng.hokudai.ac.jp/~hybrid/index.html>
- Researches: <http://www.kozo.eng.hokudai.ac.jp/~hybrid/page/act/hakai.htm>

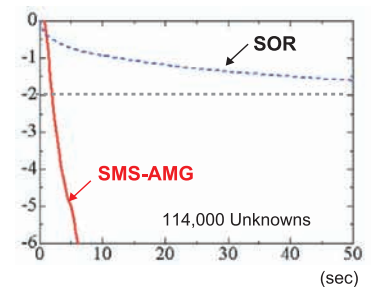
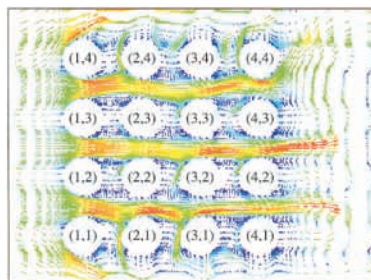
SMS-AMG Analysis of Flow-Induced Vibration of Nuclear Reactor Fuel Rods

SIT

x50 - x100 faster calculation for the same accuracy

Saitama Institute of Technology Hisashi Hishida Ph.D.

- Applied Field** Flow-Induced Vibration of Nuclear Reactor Core Fuel Rods
- Background** Analysis models are getting bigger for normal iterative methods to take few months to solve depending on modeled cases.



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