

SparSol™ — Sparse Linear Solver

SparSol™ is a library of highly-efficient algorithms intended for the preconditioned, iterative solution of large systems of sparse linear algebraic equations.

Sparse linear systems are commonly encountered in the many industries and fields of research that utilize virtual prototyping and large-scale data modeling. The need to solve these systems quickly and efficiently is critical for product design (aerospace, automotive, semiconductor) and business process simulation (power grid modeling, oil & gas extraction, complex financial modeling), and directly impacts productivity and profitability.

SparSol – developed initially for ExxonMobil Upstream Research Company and its reservoir modeling application – is now commercially available from Sparsix worldwide to accelerate the most demanding analytical applications. SparSol's algorithms can quickly be integrated into existing applications through a rich set of application programming interfaces (APIs), delivering dramatic improvements in performance of up to 50x and, depending on the problem, even more.

Advanced Solver Capabilities

- ◆ Solution of very ill-conditioned systems
- ◆ Solution of very large systems – easily handles millions of unknowns
- ◆ Solution of symmetrical and unsymmetrical systems including systems with block structures
- ◆ Adaptive convergence schemes guarantee fast convergence
- ◆ Incorporates a large collection of custom, problem-specific algorithms with numerous widely-used, public domain algorithms
- ◆ Supports many widely-used data formats and specific binary formats

Object-oriented Framework

- ◆ Framework allows easy inclusion of new, custom algorithms

- ◆ Fully-parametric environment can be tuned for a wide variety of applications
- ◆ Well-documented APIs allow easy integration with external C++, C or FORTRAN applications
- ◆ Supported on Windows, Linux and Unix operating systems

High-performance Computational Core

- ◆ Custom library of basic linear algebra operations and grouped functions
- ◆ Robust set of highly-tuned preprocessing and preconditioning algorithms
- ◆ High-performance implementations of multiple iterative sparse linear solvers
- ◆ Thread-safe serial and parallel versions
- ◆ Highly-efficient and scalable parallel solution algorithms with support for both SMP and MPI-based architectures
- ◆ Optimized for multi-step applications

SparSol Components

- ◆ Preprocessing Algorithms
 - * Scaling, reordering, filtration
- ◆ Serial Preconditioners
 - * Incomplete LU: RILU0, FILU, ILU2, ILUDP; multi-level ILU
 - * Incomplete Cholesky: RIC0, FIC, RIC2
 - * Nested factorization: NF, GNF, UNF
- ◆ Parallel Preconditioners
 - * Parallel recursive FILU without overlap: RParFILU
 - * Parallel FILU with overlap: ParOFILU
- ◆ Iterative Methods
 - * Conjugate gradient-type
 - * Minimal residual-type with different convergence criteria
 - * Special convergence control scheme
- ◆ Partitioners
 - * Multi-level partitioning
 - * Partitioning with overlap
- ◆ GUI interface for finding and tuning optimal parameters and for data visualization
- ◆ Command-line interface for use as stand-alone utility
- ◆ HTML documentation includes description of program interfaces, command-line options and usage examples

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Supported Matrix Formats

- ◆ Text Formats
 - * Compress Row Storage (CRS)
 - * Compress Column Storage (CCS)
 - * Coordinate (Matlab-like)
 - * Matrix-Block CRS
 - * Matrix-Market
 - * Harwell-Boeing
 - * Rutherford-Boeing
 - * Block Modified Sparse Row format
 - * Block CRS format
- ◆ SparSol Binary
 - * Internal matrix representation is in CRS format
- ◆ OP4 format
- ◆ XML format (with possible data compression)
- ◆ Custom formats

Complex Linear Systems

SparSol is tuned to provide breakthrough performance for solving large, sparse linear systems with real coefficients. For systems based on complex coefficients, particularly those defined by Helmholtz or Maxwell equations, we offer LinCoS™, a high-performance, parallel iterative solver intended for the solution of large, sparse linear systems with complex coefficients.

Its unique data model is optimized for handling complex numbers and provides a significant increase in performance over other solvers.

Like SparSol, LinCoS includes a rich library of partitioners, preconditioners and iterative methods for both serial and parallel computing environments and can quickly be integrated into existing analysis applications to deliver significant increases in performance.

Our Company

Sparsix Corporation is a computational mathematics firm that develops high-performance solutions for the largest, most computationally challenging problems faced by businesses.

We provide consulting, custom development, service, and support to customers across numerous industries with special emphasis on the needs of customers involved in energy related markets including power transmission and distribution, integration of renewable energy sources, and oil and gas exploration and production.

Sparsix has an extensive team of professional mathematicians, physicists, machine learning experts and computer scientists with exceptional expertise in:

- ◆ Computational modeling and simulation
- ◆ Mathematical programming and optimization
- ◆ Linear systems solutions and linear programming
- ◆ Learning algorithms and machine learning technologies
- ◆ Parallel programming techniques and architectures

We empower our customers' businesses by delivering robust solutions based on superior mathematics.