

# External Libraries

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## 1 Description of external libraries

## 2 Parsers

### 2.1 Xerces-C

Xerces-C++ is a validating XML parser written in a portable subset of C++. Xerces-C++ makes it easy to give your application the ability to read and write XML data.

<http://xerces.apache.org/xerces-c/>

## 3 Numerical Methods

### 3.1 Solvers

#### 3.1.1 HYPRE

Introduction

Hypre is a library for solving large, sparse linear systems of equations on massively parallel computers. The main features of this library are:

- Scalable preconditioners. Hypre contains several families of preconditioned algorithms focused on the scalable solution of very large sparse linear systems. These algorithms include structured multigrid and element-based algebraic multigrid

- Implementation of a suit of common iterative methods. Hypre provides commonly used Krylov-based iterative methods to be used with its scalable preconditioners. These include Conjugate Gradient and GMRES for symmetric and unsymmetric matrices, respectively.

- Intuitive grid-centric interfaces. Hypre provides data structures to represent and manipulate sparse matrices through interfaces. Each interface provides access to several solvers without the need to write new interface codes. These interfaces include stencil-based structured/semi-structured interfaces, finite-element based unstructured interface, and a linear algebra based interface.

[http://www.llnl.gov/CASC/linear\\_solvers/](http://www.llnl.gov/CASC/linear_solvers/)

### 3.1.2 UMFPACK

UMFPACK is a set of routines for solving unsymmetric sparse linear systems,  $Ax=b$ , using the Unsymmetric MultiFrontal method. Written in ANSI/ISO C, with a MATLAB (Version 6.0 and later) interface. Appears as a built-in routine (for `lu`, `\`, and `/`) in MATLAB. Includes a MATLAB interface, a C-callable interface, and a Fortran-callable interface.

<http://www.cise.ufl.edu/research/sparse/umfpack/>

### 3.2 Fftw

<http://www.ftw.org/>

### 3.3 Sundials

SUNDIALS (SUite of Nonlinear and Differential/ALgebraic equation Solvers) consists of the following five solvers:

CVODE solves initial value problems for ordinary differential equation (ODE) systems.

CVODES solves ODE systems and includes sensitivity analysis capabilities (forward and adjoint).

IDA solves initial value problems for differential-algebraic equation (DAE) systems.

IDAS solves DAE systems and includes sensitivity analysis capabilities (forward and adjoint).

KINSOL solves nonlinear algebraic systems.

<https://computation.llnl.gov/casc/sundials/main.html>

## 4 Compression

### 4.1 Zlib

## 5 Graphics

### 5.1 Glut

### 5.2 OPENGL

## 6 Multiple Precision

### 6.1 GMP

GMP is a free library for arbitrary precision arithmetic, operating on signed integers, rational numbers, and floating point numbers. There is no practical limit to the precision except the ones implied by the available memory in the machine GMP runs on. GMP has a rich set of functions, and the functions have a regular interface.

<http://gmplib.org/>

## 6.2 MPFR

The MPFR library is a C library for multiple-precision floating-point computations with correct rounding.

<http://www.mpfr.org/>

## 7 Mesh

### 7.1 FreeFem

### 7.2 Qhull

Qhull computes the convex hull, Delaunay triangulation, Voronoi diagram, halfspace intersection about a point, furthest-site Delaunay triangulation, and furthest-site Voronoi diagram. The source code runs in 2-d, 3-d, 4-d, and higher dimensions. Qhull implements the Quickhull algorithm for computing the convex hull. It handles roundoff errors from floating point arithmetic. It computes volumes, surface areas, and approximations to the convex hull.

## 8 Minimisation

### 8.1 LEVENBERG\_MARQUADT

### 8.2 RngStream

RngStreams is a C/C++ implementation of a high quality uniform random number generator that supports multiple "independent" streams of uniform random numbers.

<http://www.iro.umontreal.ca/lecuyer/myftp/streams00/c++/>

## 9 Data Structures

### 9.1 Boost

Boost release contains over 80 individual libraries, including libraries for linear algebra, pseudorandom number generation, multithreading, image processing, regular expressions, unit testing, and many others. The majority of Boost libraries are header based, consisting of inline functions and templates, and as such do not need to be built in advance of their usage.

<http://www.boost.org/>

@node Version ,, Description, Top

## 10 Version of external libraries in H2OLAB

Library	Version	Licence
Boost	1.40.0	Boost Licence
Cgal	3.5	LGPL-QPL
Fftw	2.1.5	Free Software
FreeFem	x.y.z	??
OPENGL	x.y.z	??
Glut	x.y.z	??
Gmp	4.2.4	GNU LGPL
Mpfr	2.4.0	GNU LGPL
GL	x.y.z	??
glut	x.y.z	??
Hypre	2.4.0b	Free Software
Levenberg-Marquadt	x.y.z	??
Qhull	2003-1	??
Png	1.4.0	Libpng license – Copyright
RngStream	1.0.1?	GPL
Sundials	2.3.0	Sundials Licence File
Umfpack	5.4.0	??
Xerces-C	3.0.1	Apache License, Version 2.0
Zlib	1.2.3	Copyright J.-L. Gailly and M. Adler