

OctConf 2013:

GSoC project: Incomplete factorization

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Introduction

Extend GNU/Octave with

- Incomplete LU-factorization (ilu)
 - Interfacing ITSOL
- Incomplete Cholesky-factorization (ichol)

Useful as preconditioners for solving big sparse linear systems.

The ITSOL library

- A GPLv2 mathematical library containing many factorizers by Yousef Saad, that MATLAB also offers
 - ILUK (with level of fill)
 - ILUT (with threshold)
 - ILUTP (with threshold and pivoting)
 - ILUC (Crout version of ILUT)
- <http://www-users.cs.umn.edu/~saad/software/ITSOL/>

The ITSOL library (2)

ITSOL (e.g. debian package) http://packages.debian.org/source/sid/itsol		
/usr	/include/itsol	defs.h globheads.h ios.h protos.h
	/lib	libitsol.a (static) libitsol.so (shared) <i>ILUK (ILU preconditioner with level of fill)</i> <i>ILUT (ILU preconditioner with threshold)</i> <i>ILUC (Crout version of ILUT)</i> <i>VBILUK (variable block preconditioner with level of fill - with automatic block detection)</i> <i>VBILUT (variable block preconditioner with threshold - with automatic block detection)</i> <i>ARMS (Algebraic Recursive Multilevel Solvers)</i>

What has been done...

octave	/scripts/sparse	ilu.m + not implemented
		ichol.m + not implemented
	/libinterp/dldfcn	itsol_util.h (format conversion) + works → testing + optimization
		iluk.cc (by Wei Jin) + works → testing + optimization
		ilut.cc (by Wei Jin) + works → testing + optimization
		iluc.cc + works → testing + optimization
		ilutp.cc + works, but doesn't return successful at the moment
		ichol0.cc + not implemented
	icholt.cc + not implemented	

"Short" Demo

1. Small test case from my blog:
 - ILU(0)
 - ILUT
2. Big symmetric model problem by **Andreas Stahel**

Goals for the Midterm

- Intefacing ITSOL (iluk.cc, ilut.cc, ilutp.cc, iluc.cc), callable from Octave (**almost finished**)
 - Performance issue: Format conversion CRS - CCS
 - Problem: ITSOL-library dependency
- Wrapper file for MATLAB compatibility (ilu.m)
- Test cases
- Documentation

- (optional) Complex ILU versions (ZITSOL)
- (optional) New player **Michele Martone RSB-format**

Goals for the Final Evaluation

- Implementations for IC(0) and ICT completed
- Wrapper file for MATLAB compatibility (ichol.m) finished
- Test cases
- Documentation

- (optional) Complex version for the incomplete-factorizations

Follow my work

Blog:

<http://siko1056-gsoc.blogspot.com/>

Public repository:

<http://inversethought.com/hg/octave-kai/>

References

1. [Templates for the Solution of Linear Systems: Building Blocks for Iterative Methods. Second Edition: http://netlib.org/linalg/html_templates/report.html](http://netlib.org/linalg/html_templates/report.html)
2. Saad, Yousef: Iterative Methods for Sparse Linear Systems. Second Edition. Minneapolis, Minnesota: Siam 2003. http://www-users.cs.umn.edu/~saad/IterMethBook_2ndEd.pdf
3. <http://www.mathworks.com/help/matlab/ref/ilu.html>
4. <http://www.mathworks.com/help/matlab/ref/ichol.html>