

Test of Iterative Solvers on ITBL

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Test of Iterative Solvers

- TiS is an internet calculator for solving Linear System of Equations $Ax = b$ with preconditioned Krylov subspace methods.

Test of Iterative Solvers

- TiS is a tool for finding appropriate preconditioner and iterative solver for a given Linear System of Equations $Ax = b$ with no programming effort.

Test of Iterative Solvers

- TiS is a joining project of users, researchers, and ITBL administrator for making a new research community.

Q1: Is it possible that a certain preconditioner and iterative solver is the best for any problem?

Answer:

It is impossible.

Q2: Are there any public computation services via the internet?

Answer:

Maybe No. At least I do not know.

Test of Iterative Solvers provides:

- Testing some iterative solvers and preconditioners for users' problem
- Public computation service via ITBL Grid portal
- Utilizing given problems for future analysis
- Making a new research community

What is the ITBL?

- Information-Technology-Based Laboratory
- One of Japanese national Grid projects
- Virtual Research Environment
 - Searching new research style based on IT
- The purpose of ITBL
 - Anywhere
 - Anybody
 - Anytime
 - Chance to meet people

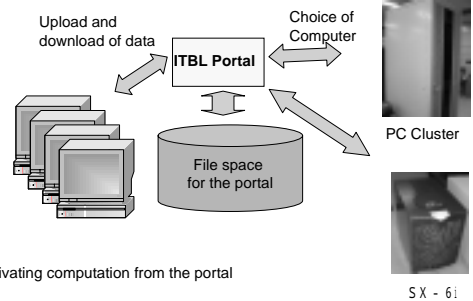
➤ Joining institutes: NIMS, NIED, JAXA, JAERI, RIKEN, and JST

ITBL Portal

- Any people can use resources of ITBL
- Resources:
 - 1) Computing power
 - 2) Softwares
 - 3) Data
 - 4) Knowledge of members

ITBL Portal

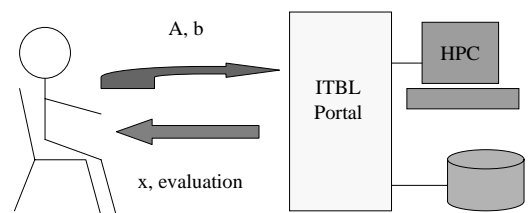
Web facilities



Public Services on Internet

- Repository
 - Software www.netlib.org
 - Data math.nist.gov/MatrixMarket/
 - Knowledge?
- Search Engine
 - www.google.co.jp
- Computation service
 - TiS: Test of Iterative Solvers

TiS: Test of Iterative Solvers



Evaluation of iterative solvers and preconditioners for $Ax=b$

Users:

(Give)

Provide their problem A and b

(Take)

Get solution x and a comparison chart

Researchers:

(Give)

Provide their algorithms (Iterative solvers and preconditioners) as a code

(Take)

Get a right to use stored data for future research

ITBL manager:

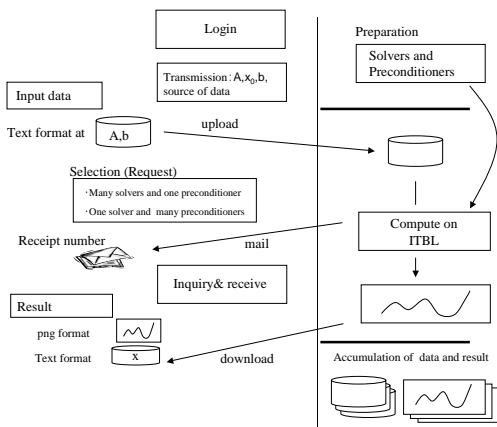
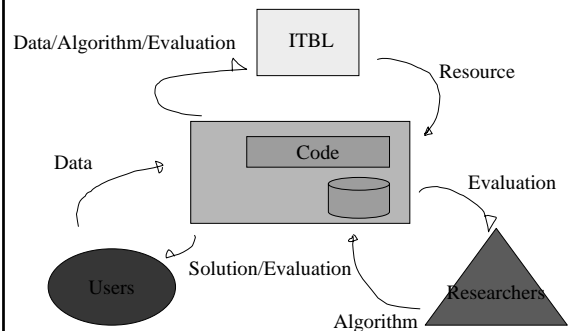
(Give)

Provide computing resources for public use

(Take)

Collect and store performance result for comparing computing environments

Economics?? (ideal/future)



Current status

- Service of TiS started from Nov. 1
- Real General Sparse matrix
- Data format is i, j, a_{ij} in text-format
- Not more than one CD-R (700 MB)
- Krylov iterative Solvers
- Some preconditioners
- No user manual

Data Format

MatrixMarket's format and right-hand side

(1)	(2)	(3)
% comment	% comment	% comment
N, NNZ	N, NNZ	N, NNZ
i, j, a _{ij}	b	b
b	{x ₀ }	i, j, a _{ij}
{x ₀ }	i, j, a _{ij}	{x ₀ }

* N is dimension, NNZ is number of Non-Zero elements

Iterative Solvers

- BiCG
- CGS
- BiCGSTAB
- BiCGSTAB(l)
- GPBiCG
- GMRES(k)
- QMR
- Jacobi
- Gauss-Seidel
- SOR

– LiS by Dr. Kotakemori is used for computation kernel

Preconditioners

- No
- Scaling
- Jacobi
- Incomplete LU
- SSOR
- Hybrid
- I+S type
- SAIMV

– LiS by Dr. Kotakemori is used for computation kernel

How large problem can be solved

- 3D problem with $N_x = N_y = N_z = 100$
N: number of unknown is 10^6
- i, j, a_{ij} ~ Each entry is almost 50 byte
- Case of FDM : $7*50*10^6 \sim 350$ Mbyte

The maximum problem size is one million!

How much time is necessary for uploading the problem

Assume 500 Mbyte ($N \sim 10^6$)

- 1.5 Mbit/sec (ADSL at home)
2,700 sec ~ 45 min ~ 1 hour
- 100 Mbit/sec (very good IT office)
40 sec ~ 1min

How much time is necessary for solving the problem

- It depends on computing environment
- It depends on Grid scheduling
- Only waiting to finish
- Total Time = “Time of basic operation” * “number of iterations”

How much time is necessary for downloading solution and comparison

Solution ($N \sim 10^6$) \sim 30 Mbyte

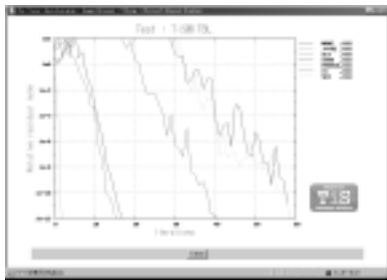
Comparison is one PNG file \sim 1Mbyte

- 1.5 Mbit/sec (ADSL at home)
170 sec \sim 3 min
- 100 Mbit/sec (very good IT office)
3 sec

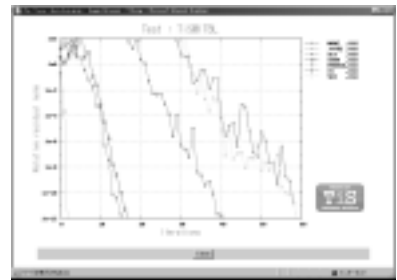


Selection
Menu of
TiS

Comparison result



Comparison result with marker



Please use TiS

- Before choosing an appropriate algorithm
- For checking the correctness of your code
- For analyzing the property of your data
- For requesting a new algorithm
- To complete your homework quickly!

Summary

- TiS is a new computation service on ITBL
- Public service (any people, no charge)
- Choose the best solver and preconditioner with no programming effort
- We appreciate your use of TiS as a user or as a researcher, and your comments
- Please visit
– www.itbl.jp