Test of problems from SuiteSparse Matrix Collection

This package provides implementations of comparing BICGSTAB, GMRES, DQGMRES, FOM, DIOM, SCG and SWI for solving the linear system

$$Ax = b,$$

where the matrix A from the SuiteSparse Matrix Collection and set b so that the solution is $x_\star = (1, 1, \ldots, 1)$.

Contents

BICGSTAB

Using Matlabs function "bicgstab" directly.

DQGMRES

DQGMRES (Direct Quasi-GMRES): Algorithms 6.6 and 6.13 in Yousef Saad's "Iterative Methods for Sparse Linear System (2nd Edition)"

```
function [x, k, res, resvec] = dqgmres(A, b, m, tol, x0, maxit)
```

- [x] = dqgmres(A, b) attempts to find a solution x to the system of linear equations $Ax = b$. The n-by-n coefficient matrix A must be positive definite but need not be symmetric. The right hand side column vector b must have length n.
- [x] = dqgmres(A, b, m) specifies the number of the sliding window. If m is [ ] then dqgmres uses the default, n.
- [x] = dqgmres(A, b, m, tol) specifies the tolerance of the method. If tol is [ ] then dqgmres uses the default, 1e-6.
- [x] = dqgmres(A, b, m, tol, x0) specifies the initial guess. If x0 is [ ] then dqgmres uses the default, an all zero vector.
- [x] = dqgmres(A, b, m, tol, x0, maxit) specifies the maximum number of iterations. If maxit is [ ] then dqgmres uses the default, 10000.
- [x, k] = dqgmres(A, b, ...) returns the iteration number at which x was computed: $1 \le k \le$ maxit.
- [x, k, res] = dqgmres(A, b, ...) also returns the last relative residual norm $\|b - Ax\|/\|b\|$.

• [x, k, res, resvec] = dqgmres(A, b, ...) also returns a vector of estimates of the residual norms at each iteration, including $\|b - Ax\|$.

GMRES: set $m = n$ in the function "dqgmres".

DIOM(m)

DIOM (Direct Incomplete Orthogonalization Method): Algorithms 6.6 and 6.8 in Yousef Saad's "Iterative Methods for Sparse Linear System (2nd Edition)"

```
function [x, k, res, resvec] = diom(A, b, mk, tol, x0, maxit)
```

• [x] = diom(A, b) attempts to find a solution x to the system of linear equations $Ax = b$. The n-by-n coefficient matrix A must be positive definite but need not be symmetric. The right hand side column vector b must have length n.
• [x] = diom(A, b, m) specifies the number of the sliding window. If m is [ ] then diom uses the default, n.
• [x] = diom(A, b, m, tol) specifies the tolerance of the method. If tol is [ ] then diom uses the default, 1e-6.
• [x] = diom(A, b, m, tol, x0) specifies the initial guess. If x0 is [ ] then diom uses the default, an all zero vector.
• [x] = diom(A, b, m, tol, x0, maxit) specifies the maximum number of iterations. If maxit is [ ] then diom uses the default, 10000.
• [x, k] = diom(A, b, ...) returns the iteration number at which x was computed: $1 \leq k \leq$ maxit.
• [x, k, res] = diom(A, b, ...) also returns the last relative residual norm $\|b - Ax\|/\|b\|$.
• [x, k, res, resvec] = diom(A, b, ...) also returns a vector of estimates of the residual norms at each iteration, including $\|b - Ax\|$.

FOM: set $m = n$ in the function "diom".

SWI(m)

SWI: Sliding window implementation with pre-allocated memory
SWIWP: Sliding window implementation without pre-allocated memory

```
[x, k, res, resvec] = swi(A, b, m, tol, x0, maxit)
[x, k, res, resvec] = swiwp(A, b, m, tol, x0, maxit)
```

• [x] = swi/swiwp(A, b) attempts to find a solution x to the system of linear equations $Ax = b$. The n-by-n coefficient matrix A must be positive definite but need not be symmetric. The right hand side column vector b must have length n.
• [x] = swi/swiwp(A, b, m) specifies the number of the sliding window. If m is [ ] then swi uses the default, n.

• [x] = swi/swiwp(A, b, m, tol) specifies the tolerance of the method. If tol is [ ] then swi uses the default, 1e-6.
• [x] = swi/swiwp(A, b, m, tol, x0) specifies the initial guess. If x0 is [ ] then swi uses the default, an all zero vector.
• [x] = swi/swiwp(A, b, m, tol, x0, maxit) specifies the maximum number of iterations. If maxit is [ ] then swi uses the default, 10000.
• [x, k] = swi/swiwp(A, b, ...) returns the iteration number at which x was computed: $1 \leq k \leq$ maxit
• [x, k, res] = swi/swiwp(A, b, ...) also returns the last relative residual norm $\|b - Ax\|/\|b\|$.
• [x, k, res, resvec] = swi/swiwp(A, b, ...) also returns a vector of estimates of the residual norms at each iteration, including $\|b - Ax\|$.

SCG: set $m = n$ in the function "swiwp".

Example

1. Download the files: diom.m, dqgmres.m, swi.m, swiwp.m, cage12.mat, test_suitesparse.m, and testproblem.txt;

2. Run the function "test_suitesparse" directly, i.e.,

   ```
   >> test_suitesparse
   ```

3. The test results are saved in "TestResult" file.