A ROBUST AND EFFICIENT PARALLEL SVD SOLVER BASED ON RESTARTED LANCZOS BIDIAGONALIZATION

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Abstract

The computation of singular subspaces associated with the k largest or smallest singular values of a large, sparse (or structured) matrix A is commonplace. Example applications are the solution of discrete ill-posed problems or the construction of low-rank matrix approximations in areas such as signal processing or information retrieval.

Lanczos bidiagonalization can exploit matrix sparsity, thus being competitive with other methods in many situations. However, the straightforward algorithm may encounter convergence problems and some effective restarting technique is required. In this work, we present a Lanczos bidiagonalization procedure implemented in SLEPc (Scalable Library for Eigenvalue Problem Computations), a software library for the solution of large, sparse eigenvalue problems on parallel computers. Our solver is based on a thick restart variant [1] and it also incorporates the following features:

- A one-sided variant [2] that can reduce computational and storage requirements, while allowing for better parallel performance.
- Robust Gram-Schmidt orthogonalization balancing numerical reliability and computational efficiency and scalability.

We use the solver to investigate different restarting strategies, including locking, non-locking and hybrid, in practical applications.

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References

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