An $\mathcal{O}(n^2)$ algorithm for the bidiagonal SVD

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Abstract

Dhillon proposed a new algorithm to compute the eigendecomposition of a symmetric tridiagonal matrix T in 1997. In this talk we discuss how this method can be applied to the bidiagonal SVD $B = U\Sigma V^T$. It turns out that using the algorithm as a black box to compute $B^T B = V\Sigma^2 V^T$ and $BB^T = U\Sigma^2 U^T$ separately may give poor results for $\|U^T BV - \Sigma\|$. The use of T_{GK} can fail as well for clusters of tiny singular values. A solution is to work on $B^T B$ and to keep factorizations of BB^T implicitly. We present transformations which allow to replace the representation $u = \frac{1}{\sigma} Bv$ by $u = \mathcal{L}v$, where $\mathcal{L}$ is a diagonal matrix. Numerical results of our implementation are compared to the LAPACK-routines `DSTEGR`, `DBDSQR` and `DBDSDC`.