Tracking the dominant subspace of indefinite matrices

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Indefinite symmetric matrices occur in many applications, such as optimization, partial differential equations and variational problems where they are linked to a so-called saddle point problem. In these applications one is often interested in computing an estimate of the dominant eigenspace of such matrices, in order to solve regularized least squares problems or compute preconditioners. In this talk we propose an incremental method to compute the UTU^T factorization of a symmetric indefinite matrix, where U is an orthogonal matrix and T is a symmetric anti–triangular one, i.e., a matrix having zero entries below the anti–diagonal.

We show that the latter factorization is a symmetric rank–revealing one [2]. Moreover, we describe an algorithm for computing an estimate of the dominant eigenbasis of such matrices based on low rank updates and downdates of indefinite matrices.

We show that the proposed algorithms are well–suited for large scale problems since they are efficient in terms of complexity as well as data management.

Some numerical experiments showing the behavior of the proposed algorithms are presented.

References

[1] J. R. Bunch and L. Kaufman, *Some stable methods for calculating inertia and solving symmetric linear systems*, Math. Comput., 31 (1977), pp. 163–179.

[2] R. D. Fierro and P. C. Hansen, *Truncated VSV solutions to symmetric rank–deficient problems*, BIT, 42 (2002), pp. 531–540.