A geometric convergence theory of the preconditioned steepest descent iteration

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The topic of this talk is a new convergence analysis for the *preconditioned steepest descent* (PSD) iteration to solve (elliptic operator) eigenvalue problems. The PSD iteration combines the Rayleigh-Ritz procedure and the preconditioned gradient iteration for optimal convergence acceleration. Sharp non-asymptotic convergence estimates are derived by means of a geometric theory.

Up to now sharp convergence estimates are only known for the basic fixed-step size preconditioned gradient iteration (also called preconditioned inverse iteration). The new result substantiates that preconditioned eigensolvers are robust and stable solvers which allow to compute (e.g. for partial differential operator eigenproblems and with multigrid preconditioning) a fixed number of the smallest eigenvalues and the corresponding eigenfunctions with costs that increase only linearly in the number of unknowns.

References

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[2] K. Neymeyr, E. Ovtchinnikov, and M. Zhou, *Convergence analysis of gradient iterations for the symmetric eigenvalue problem.* Technical Report, Universität Rostock, submitted to SIMAX, 2010.

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