



A geometric convergence theory of the preconditioned steepest descent iteration

Klaus Neymeyr

► To cite this version:

Klaus Neymeyr. A geometric convergence theory of the preconditioned steepest descent iteration. International Conference On Preconditioning Techniques For Scientific And Industrial Applications, Preconditioning 2011, May 2011, Bordeaux, France. <inria-00581298>

HAL Id: inria-00581298

<https://hal.inria.fr/inria-00581298>

Submitted on 30 Mar 2011

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

A geometric convergence theory of the preconditioned steepest descent iteration

List of authors:

Klaus Neymeyr¹

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

- [1] K. NEYMEYR, *A geometric convergence of the preconditioned steepest descent iteration*, Technical Report, Universität Rostock, 2010.
- [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.

¹Institut für Mathematik, Universität Rostock,
Ulmenstraße 69, D-18057 Rostock.