

Homework I

Iterative methods for sparse matrices

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1 Theoretical background

1.1 GMRES

The GMRES abbreviates generalized minimal residuals. It's idea is to solve $Ax = b$ by using a vector $x_n \in \mathcal{K}_n$ that minimizes the residual $r_n = b - Ax_n$ ¹. In general the process is implemented using Arnoldi-iterations to compute the Krylov subspace and the Hessenberg representation of the original problem. The least square problem is then solved by coupling a QR decomposition into the Arnoldi iterations.

1.2 BICGSTAB

The Bi-CGSTAB, method is a modified version of the biconjugate gradient method. The biconjugate gradient method uses recurrences which only require data from the last iteration, which keeps memory requirements under control. The original BCG algorithm does not converge nicely. The main added benefit of the Bi-CGSTAB algorithm is better convergence behavior.

1.3 IDR

IDRS are improved krylov subspace methods developed in Delft.

1.4 Spectrum

1.5 Preconditioning

The convergence of iterative methods depends on the properties of the matrix a ...

2 Results

2.1 rajat12

The first experiment consisted of solving the four given problems using the GMRES and BiCGStab implementations from the binaries given on Toledo.

¹Numerical Linear Algebra, Trefethen, Bau page 266

2.2 lhr01

2.3 ship003

2.4 Fault639

3 Conclusion

A lot of assumptions have been made throughout the creation of the model. Most of these are oversimplifications of the real world and we barely scratched the surface of the real optimization problem behind the airplane.