Sparse matrix preordering algorithm based on symbolic factorization.

Jagoda Plata, Michał Dobrzyński

{plata, d_michal} @lmn.pub.ro
Numerical Methods Laboratory, "Politehnica" University of Bucharest,
Splaiul Independentei 313, Bucharest, ROMANIA

Abstract

Solution of linear systems in large-scale scientific and engineering calculations often occurs to be a bottleneck of the computations. Finite Element Method (FEM) or Finite Integral Technique (FIT) modeling leads to very large and very sparse coefficient matrices [1] [2]. For this reason, efficient and matrix-structure dependent solvers are widely needed. Given a system of linear equations, direct solutions can be obtained using Gaussian elimination, where the sparse system fill-ins number reduction problem has to be solved [3].

The paper describes the application of Markowitz Cost Function (MCF) [4] as a pivot criterion function in the process of symbolic factorization for preordering purpose. In the case, when MCF does not give a unique solution, the algorithm extention minimizing the number offill-ins will be proposed.

A prototype algorithm (MARKOMOD), that tends to produce for some matrices even 25% less nonzero elements in LU decomposition then UMFPACK [3], will be presented. The algorithm body, robust example and comparison with other methods will show the strong and the weak sides of the MARKMOD and pointing at main direction in the further work.

References

[1] G. Ciuprina, D. Ioan, D. Niculae, J. F. Villena, L. M. Silveira, "Parametric model based on sensitivity analysis for passive components", Studies in Computational Intelligence, vol. 119, pp. 17-22, Springer, 2008.

[2] J. Plata, M. Dobrzynski, Solving methods for sparse matrices in modeling of EM effects in nano IC, presented at IP:M&S 2008 - IV International Conference on Inverse Problems: Modeling & Simulation, Fethiye, Turkey, 2008.

[3] T. A. Davis, "Direct Methods for Sparse Linear Systems", SIAM, Philadelphia, USA, 2006.

[4] H. M. Markowitz, The elimination form of the inverse and its application to linear programming, Management Science 3, 1957