Electronic Transactions on Numerical Analysis.
Volume 21, pp. 1-19, 2005.

ISSN 1068-9613.

ETNA
Kent State University
etna@mcs.kent.edu

A TREE-BASED DATAFLOW MODEL FOR THE UNSYMMETRIC MULTIFRONTAL METHOD*

STANLEY C. EISENSTAT† AND JOSEPH W.H. LIU‡

Dedicated to Alan George on the occasion of his 60th birthday

Abstract. This paper introduces a new model to describe the flow of data from update to frontal matrix in the unsymmetric multifrontal method for solving sparse linear systems. The model is based on the elimination tree of an unsymmetric matrix and consists of the edges in this tree together with some cross edges.

By symmetrically renumbering the rows and columns of the coefficient matrix using a tree-based postordering, we can permute the matrix into a bordered block triangular form while preserving the elimination tree. The model simplifies when the matrix has this form, which suggests that a multifrontal implementation based on it should be simpler as well.

We also extend the model to handle pivoting for stability; compare it with others used in the unsymmetric multifrontal method; and point out the implications for parallelism.

Key words. sparse matrix factorization, sparse LU decomposition, elimination tree

AMS subject classifications. 65F05, 65F50

*Received April 8, 2004. Accepted for publication June 7, 2005. Recommended by S. Oliveira.

†Department of Computer Science, Yale University, P. O. Box 208285, New Haven, CT 06520-8285 (Stanley.Eisenstat@yale.edu).

‡Department of Computer Science, York University, North York, Ontario, Canada M3J 1P3 (Joseph@cs.yorku.ca). This research was supported in part by the Natural Sciences and Engineering Research Council of Canada under grant A5509.