MARK GIESBRECHT, University of Waterloo, School of Computing Science

Complexity and Practicality in Sparse Matrix Computation

We present new algorithms for operations related to sparse matrices which are asymptotically faster than those known previously and quite practical in some cases. Sparsity is designated by requiring a fast matrix-vector product—typically quasi-linear time—which captures many traditional families of sparse or structured matrices. We exhibit a probabilistic algorithm which finds the (dense) inverse of such a sparse matrix with $O(n^{2.27})$ field operations. This is surprising in that it is less than the cost of dense matrix multiplication and inversion, which was the previously best known approach to sparse matrix inversion. For sparse integer matrices (with constant sized entries), we show how to solve such systems with $O(n^{2.5})$ machine operations using standard matrix arithmetic. These techniques are shown to be practical at least on some classes of large sparse matrices.

This is joint work with Wayne Eberly, Pascal Giorgi, Arne Storjohann and Gilles Villard.