Smith Form of Sparse Integer Matrices via Valence: Algorithm and Example

Jean-Guillaume Dumas
LMC/IMAG, BP 53X, Bat. Maths pures
100, rue des Mathématiques
38041 Grenoble Cedex 9, France
Email: Jean-Guillaume.Dumas@imag.fr
and
B. David Saunders
Department of Computer and Information Science
University of Delaware
Newark, DE 19716
Email: saunders@udel.edu

April, 24, 1999

Abstract

We give a new algorithm for integer Smith form, using a black box approach suitable for sparse matrices. The method first determines a set of primes that may occur in the Smith form and then proceeds locally at each prime The first step, to compute the valence, can be quite fast in some cases. The algorithm exploits Wiedemann's method for computing minimal polynomials and thus is probabilistic.

We give some examples involved in the computation of the homology groups of simplicial complexes. For example, we are able to compute the invariant factors of some matrices with about a million nonzero entries in reasonable time (measured in days).