**Electronic Transactions on Numerical Analysis.**
**Volume 35, pp.129-147, 2009.**

**ISSN 1068-9613.**

**ETNA**
**Kent State University**
**http://etna.math.kent.edu**

# ON THE FAST REDUCTION OF SYMMETRIC RATIONALLY GENERATED TOEPLITZ MATRICES TO TRIDIAGONAL FORM*

K. FREDERIX†, L. GEMIGNANI‡, AND M. VAN BAREL†

**Abstract.** In this paper two fast algorithms that use orthogonal similarity transformations to convert a symmetric rationally generated Toeplitz matrix to tridiagonal form are developed, as a means of finding the eigenvalues of the matrix efficiently. The reduction algorithms achieve cost efficiency by exploiting the rank structure of the input Toeplitz matrix. The proposed algorithms differ in the choice of the generator set for the rank structure of the input Toeplitz matrix.

**Key words.** Toeplitz matrices, eigenvalue computation, rank structures

**AMS subject classifications.** 65F15

*Received April 15, 2008. Accepted for publication March 16, 2009. Published online June 24, 2009. Recommended by G. Ammar.

†Department of Computer Science, Katholieke Universiteit Leuven, Celestijnenlaan 200A, B-3001 Leuven (Heverlee), Belgium ({Katrijn.Frederix,Marc.VanBarel}@cs.kuleuven.be). The research was partially supported by the Research Council K.U.Leuven, project OT/05/40 (Large rank structured matrix computations), CoE EF/05/006 Optimization in Engineering (OPTEC), by the Fund for Scientific Research–Flanders (Belgium), G.0455.0 (RHPH: Riemann-Hilbert problems, random matrices and Padé-Hermite approximation), G.0423.05 (RAM: Rational modelling: optimal conditioning and stable algorithms), and by the Interuniversity Attraction Poles Programme, initiated by the Belgian State, Science Policy Office, Belgian Network DYSCO (Dynamical Systems, Control, and Optimization). The scientific responsibility rests with its authors.

‡Dipartimento di Matematica, Università di Pisa, Largo Bruno Pontecorvo 5, 56127 Pisa, Italy (gemignan@dm.unipi.it). This work has been supported by MIUR under project 2006017542.