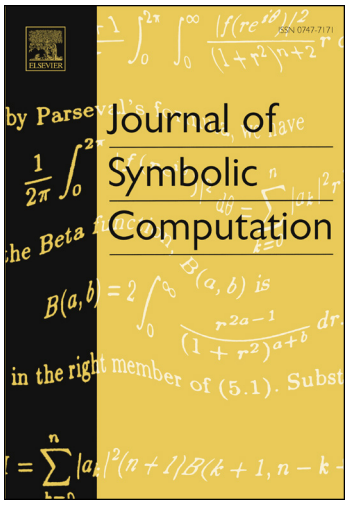
Accepted Manuscript



Time and space efficient generators for quasiseparable matrices

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PII: S0747-7171(17)30076-7
DOI: http://dx.doi.org/10.1016/j.jsc.2017.07.010
Reference: YJSCO 1807

To appear in: *Journal of Symbolic Computation*

Received date: 30 November 2016
Accepted date: 1 May 2017

Please cite this article in press as: Pernet, C., Storjohann, A. Time and space efficient generators for quasiseparable matrices. *J. Symb. Comput.* (2017), http://dx.doi.org/10.1016/j.jsc.2017.07.010

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Time and space efficient generators for quasiseparable matrices

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Abstract

The class of quasiseparable matrices is defined by the property that any submatrix entirely below or above the main diagonal has small rank, namely below a bound called the order of quasiseparability. These matrices arise naturally in solving PDE's for particle interaction with the Fast Multi-pole Method (FMM), or computing generalized eigenvalues. From these application fields, structured representations and algorithms have been designed in numerical linear algebra to compute with these matrices in time linear in the matrix dimension and either quadratic or cubic in the quasiseparability order. Motivated by the design of the general purpose exact linear algebra library LinBox, and by algorithmic applications in algebraic computing, we adapt existing techniques introduce novel ones to use quasiseparable matrices in exact linear algebra, where sub-cubic matrix arithmetic is available. In particular, we will show, the connection between the notion of quasiseparability and the rank profile matrix invariant, that we have introduced in 2015. It results in two new structured representations, one being a simpler variation on the hierarchically semiseparable storage, and the second one exploiting the generalized Bruhat decomposition. As a consequence, most basic operations, such as computing the quasiseparability orders, applying a vector, a block vector, multiplying two quasiseparable matrices together, inverting a quasiseparable matrix, can be at least as fast and often faster than previous existing algorithms.

Keywords: Quasiseparable; Hierarchically Semiseparable; Rank profile matrix; Generalized Bruhat decomposition; Fast matrix arithmetic.

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