

On the QR decomposition of backslashfancyscript H - matrices

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Abstract

The hierarchical (backslashfancyscriptH -) matrix format allows storing a variety of dense matrices from certain applications in a special data-sparse way with linear-polylogarithmic complexity. Many operations from linear algebra like matrix--matrix and matrix--vector products, matrix inversion and LU decomposition can be implemented efficiently using the backslashfancyscriptH -matrix format. Due to its importance in solving many problems in numerical linear algebra like least-squares problems, it is also desirable to have an efficient QR decomposition of backslashfancyscriptH - matrices. In the past, two different approaches for this task have been suggested in Bebendorf (Hierarchical matrices: a means to efficiently solve elliptic boundary value problems. Lecture notes in computational science and engineering (LNCSE), vol 63. Springer, Berlin, 2008) and Lintner (Dissertation, Fakultät für Mathematik, TU München. <http://tumb1.biblio.tu-muenchen.de/publ/diss/ma/2002/lintner.pdf> , 2002). We will review the resulting methods and suggest a new algorithm to compute the QR decomposition of an backslashfancyscriptH -matrix. Like other backslashfancyscriptH -arithmetic operations, the backslashfancyscriptH QR decomposition is of linear-polylogarithmic complexity. We will compare our new algorithm with the older ones by using two series of test examples and discuss benefits and drawbacks of the new approach.

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