On a block approach for approximating selected elements of the matrix inverse

Vasileios Georgiou[1], Efstratios Gallopoulos[1]

[1]Computer Engineering and Informatics Department, University of Patras, 26504 Patras, Greece

Abstract

Approximating selected elements of the matrix inverse and more general matrix functions is a topic of importance in several applications, e.g. in data analytics [3]. The challenge is to achieve the approximation more efficiently than the obvious alternative, that is computing the matrix function in full. Recent methods to this effect, e.g. [4], attempt to exploit structural characteristics such as element decay away from the main diagonal. We present a method for achieving the approximation of blocks of the matrix inverse lying along the diagonal. Inspired by the probing techniques proposed in [4] we generalize to the case of block diagonally dominant matrices and exploit the resulting norm-decay of the blocks of the inverse [1][2]. We present numerical experiments that illustrate the features and performance of our method and its application.

References

[1] C.Echeverría, J. Liesen and R. Nabben. Block diagonal dominance of matrices revisited: bounds for the norms of inverses and eigenvalue inclusion sets. arXiv.org, December 2017.

[2] D. G. Feingold and R. S. Varga Block diagonally dominant matrices and generalizations of the Gerschgorin circle theorem, Pacific J. Math., 12:1241–1250, 1962

[3] V. Kalantzis, C Bekas, A Curioni, E Gallopoulos. Accelerating data uncertainty quantification by solving linear systems with multiple right-hand sides. Numerical Algorithms, 62(4):637-653, January 2013.

[4] J. M. Tang and Y. Saad. A probing method for computing the diagonal of a matrix inverse. Numerical Linear Algebra with Applications, 19(3):485-501, 2012