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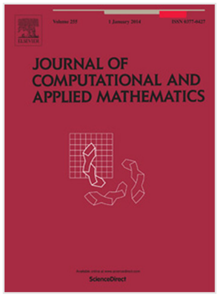

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Computing humps of the matrix exponential

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Abstract

This work is devoted to finding maxima of the function $\Gamma(t) = \|\exp(tA)\|_2$ where $t \geq 0$ and A is a large sparse matrix whose eigenvalues have negative real parts but whose numerical range includes points with positive real parts. Four methods for computing $\Gamma(t)$ are considered which all use a special Lanczos method applied to the matrix $\exp(tA^*)\exp(tA)$ and exploit the sparseness of A through matrix-vector products. In any of these methods the function $\Gamma(t)$ is computed at points of a given coarse grid to localize its maxima, and then maximized by a standard maximization procedure or via an alternating maximization procedure. Results of such computations with some test matrices are reported and analyzed.

Key words: matrix exponential norm, time integration method, Krylov subspace method, truncated Taylor series method, Lanczos method, alternating maximization

1. Introduction

This paper is concerned with the computation of maxima of the function

$$\Gamma(t) = \|\exp(tA)\|_2 \tag{1}$$

in a given nonnegative interval of time t, where A is an $n \times n$ matrix with negative spectral abscissa, i.e., the largest real part of eigenvalues of A, denoted by $\alpha(A)$, is

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