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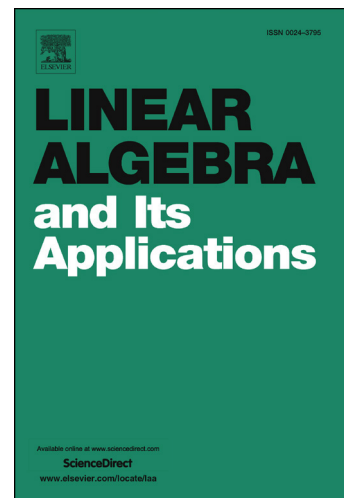
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Approximate Cayley Transform Methods for Inverse Eigenvalue Problems and Convergence Analysis [☆]

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Abstract

Based on an approximation to Cayley transform, we propose an approximate Cayley transform method and its inexact version for solving inverse eigenvalue problems, which has the advantage over other known methods in the sense that it avoids solving systems in obtaining the approximate eigenvectors. Under the nonsingular condition used in D. Sun and J. Sun [SIAM J. Numer. Anal., 40(2003), pp. 2352–2367], we show that the proposed methods converge at least superlinearly. Moreover, numerical experiments are given which illustrate that, comparing with the Cayley transform methods, our methods need much less inner iterations and CPU time.

Keywords: nonlinear equation, inverse eigenvalue problem, Cayley transform method
2010 MSC: 65F18, 65F10, 65F15

1. Introduction

Let \mathbb{R}^n be the n -dimensional Euclidean space and $\mathbf{B}(x, \delta)$ denote the open ball in \mathbb{R}^n with center $x \in \mathbb{R}^n$ and radius $\delta > 0$. Let \mathcal{S} be a subset of \mathbb{R}^n and $\text{cl}\mathcal{S}$ be the closure of \mathcal{S} . Let $\mathbb{R}^{l \times n}$ denote the set of all real $l \times n$ matrices. Let $\mathcal{O}(n) \subset \mathbb{R}^{n \times n}$ be the set of all orthogonal matrices and I_n the identity matrix in $\mathbb{R}^{n \times n}$. Moreover, we use $\mathbf{0}$ to denote a zero matrix or vector. Following [35], we use the symbol $\text{Diag}(\mathbf{x})$ to denote the diagonal matrix with a vector \mathbf{x} on its diagonal, while the symbol $\text{diag}(M) := (m_{11}, \dots, m_{nn})^T$ stands for the vector containing the diagonal elements of an $n \times n$ matrix $M := [m_{ij}]$. Let $\|\cdot\|$ be the Euclidean vector norm or its induced matrix norm, and let $\|\cdot\|_F$ denote the Frobenius norm on matrixes. Then

$$\|A\| \leq \|A\|_F \leq \sqrt{n}\|A\|, \quad \text{for each } A \in \mathbb{R}^{l \times n}. \quad (1.1)$$

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