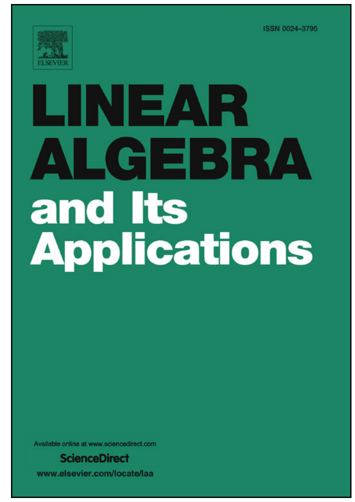
Accepted Manuscript

Approximate Cayley transform methods for inverse eigenvalue problems and convergence analysis

W.P. Shen, C. Li, J.C. Yao



PII: S0024-3795(17)30131-3
DOI: http://dx.doi.org/10.1016/j.laa.2017.02.030
Reference: LAA 14069

To appear in: *Linear Algebra and its Applications*

Received date: 2 November 2016
Accepted date: 15 February 2017

Please cite this article in press as: W.P. Shen et al., Approximate Cayley transform methods for inverse eigenvalue problems and convergence analysis, *Linear Algebra Appl.* (2017), http://dx.doi.org/10.1016/j.laa.2017.02.030

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

W. P. Shen[a,*], C. Li[b], J. C. Yao[c]

[a] *Department of Mathematics, Zhejiang Normal University Jinhua, 321004, P. R. China*
[b] *School of Mathematical Sciences, Zhejiang University Hangzhou, 310027, P. R. China*
[c] *Center for General Education, China Medical University Taichung, 40402, Taiwan*

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 $\mathrm{cl}\mathcal{S}$ 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 $\mathrm{Diag}(\mathbf{x})$ to denote the diagonal matrix with a vector $\mathbf{x}$ on its diagonal, while the symbol $\mathrm{diag}(M) := (m_{11}, \ \ldots, \ m_{nn})^T$ 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

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

☆This paper was supported in part by Zhejiang Provincial Natural Science Foundation of China (grant LY17A010006) and by the National Natural Science Foundations of China (grants 11571308, 11371325) and by the grant MOST 102-2115-M-039-003-MY3.

*Corresponding author

Email addresses: shenweiping@zjnu.cn (W. P. Shen), cli@zju.edu.cn (C. Li), yaojc@mail.cmu.edu.tw (J. C. Yao)