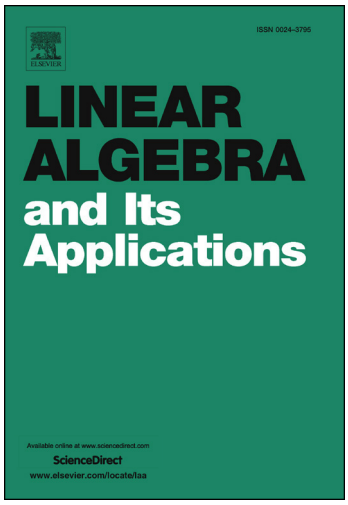

On the distance from a matrix polynomial to matrix polynomials with some prescribed eigenvalues

E. Kokabifar, P.J. Psarrakos, G.B. Loghmani

PII: S0024-3795(18)30016-8
DOI: https://doi.org/10.1016/j.laa.2018.01.010
Reference: LAA 14433

To appear in: *Linear Algebra and its Applications*

Received date: 27 October 2017
Accepted date: 8 January 2018

Please cite this article in press as: E. Kokabifar et al., On the distance from a matrix polynomial to matrix polynomials with some prescribed eigenvalues, *Linear Algebra Appl.* (2018), https://doi.org/10.1016/j.laa.2018.01.010

On the distance from a matrix polynomial to matrix polynomials with some prescribed eigenvalues

E. Kokabifar*, P.J. Psarrakos† and G.B. Loghmani*

Abstract

Consider an $n \times n$ matrix polynomial $P(\lambda)$ and a set Σ consisting of $k \leq n$ complex numbers. Recently, Kokabifar, Loghmani, Psarrakos and Karbassi studied a (weighted) spectral norm distance from $P(\lambda)$ to the $n \times n$ matrix polynomials whose spectra contain the specified set Σ, under the assumption that all the entries of Σ are distinct. In this paper, the case in which some or all of the desired eigenvalues can be multiple is discussed. Lower and upper bounds for the distance are computed, and a perturbation of $P(\lambda)$ associated to the upper bound is constructed. A detailed numerical example illustrates the efficiency and validity of the proposed computational method.

Keywords: Matrix polynomial, Eigenvalue, Perturbation, Singular value, Jordan chain.
AMS Classification: 15A18, 65F35.

1 Introduction

Assume that all the eigenvalues of a matrix $A \in \mathbb{C}^{n\times n}$ are simple. Computing the distance from A to the set of $n \times n$ (complex) matrices having multiple eigenvalues is known as Wilkinson's problem. Wilkinson introduced this problem in [22] and computed bounds for this distance, known as Wilkinson's distance, in [23–26]. Demmel [2] and Ruhe [19] also calculated alternative bounds for Wilkinson's distance. In 1999, Malyshev [14] obtained a singular value optimization characterization for the spectral norm distance from A to the set of all $n \times n$ complex matrices that have a fixed multiple eigenvalue; his work can be construed as a solution to Wilkinson's problem.

Expanding and improving the methodology used in [14], Gracia [4] and Lippert [13] studied a spectral norm distance from A to $n \times n$ complex matrices with two prescribed

*Department of Mathematics, Faculty of Science, Yazd University, Yazd, Iran (e.kokabifar@yahoo.com, loghmani@yazd.ac.ir). These authors were supported by grant no. 95002829 of Iran National Science Foundation (INSF).

†Department of Mathematics, National Technical University of Athens, Zografou Campus, 15780 Athens, Greece (ppsarr@math.ntua.gr).