

Accepted Manuscript

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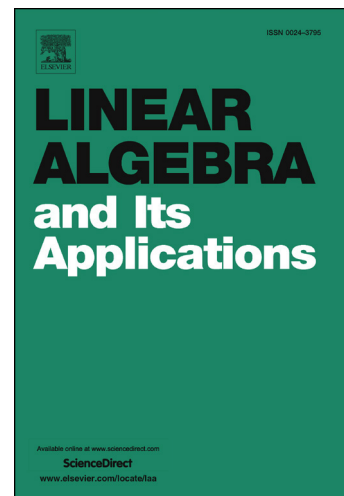
PII: S0024-3795(17)30419-6
DOI: <http://dx.doi.org/10.1016/j.laa.2017.07.009>
Reference: LAA 14255

To appear in: *Linear Algebra and its Applications*

Received date: 5 May 2015
Accepted date: 6 July 2017

Please cite this article in press as: F. Chatelin, M. Monserrat Rincon-Camacho, Hermitian matrices: Spectral coupling, plane geometry/trigonometry and optimisation, *Linear Algebra Appl.* (2017), <http://dx.doi.org/10.1016/j.laa.2017.07.009>

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Hermitian matrices : Spectral coupling, plane geometry/trigonometry and optimisation

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Abstract

The paper presents the information processing that can be performed by a general hermitian matrix when two of its distinct eigenvalues are coupled, such as $\lambda < \lambda'$, instead of considering only one eigenvalue as traditional spectral theory does. Setting $a = \frac{\lambda + \lambda'}{2} \neq 0$ and $e = \frac{\lambda' - \lambda}{2} > 0$, the information is delivered in geometric form, both metric and trigonometric, associated with various right-angled triangles exhibiting optimality properties quantified as ratios or product of $|a|$ and e . The potential optimisation has a triple nature which offers two possibilities: in the case $\lambda\lambda' > 0$ they are characterised by $\frac{e}{|a|}$ and $|a|e$ and in the case $\lambda\lambda' < 0$ by $\frac{|a|}{e}$ and $|a|e$. This nature is revealed by a key generalisation to indefinite matrices over \mathbb{R} or \mathbb{C} of Gustafson's operator trigonometry.

Keywords:

Spectral coupling, indefinite symmetric or hermitian matrix, spectral plane, invariant plane, catchvector, antieigenvector, midvector, local optimisation, Euler equation, balance equation, torus in 3D, angle between complex lines

2010 MSC: 15A18,

2010 MSC: 15A42,

2010 MSC: 15B57,

2010 MSC: 35Q31,

2010 MSC: 51M99

1. Spectral coupling

1.1. Introduction

In the work we present below, we focus our attention on the coupling of any two distinct real eigenvalues $\lambda < \lambda'$ of a general hermitian or sym-

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