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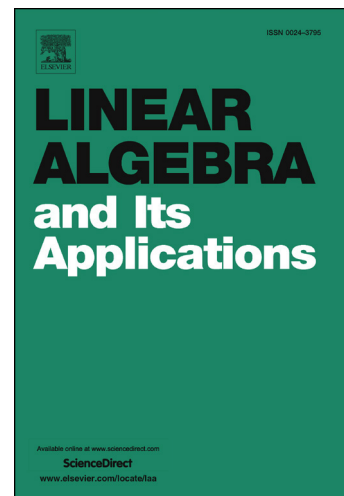
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# Trace inequalities for positive semidefinite block matrices

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## Abstract

If a  $2 \times 2$  block matrix  $\begin{bmatrix} A & B \\ B^* & C \end{bmatrix}$  is positive semidefinite, where each block is square, then the following trace inequality holds

$$|\operatorname{tr}AC - \operatorname{tr}B^*B| \leq \operatorname{tr}A\operatorname{tr}C - |\operatorname{tr}B|^2.$$

This improves a result of Besenyei [2]. Moreover, we show that

$$|\operatorname{tr}B^m| \leq \operatorname{tr}A^{m/2}C^{m/2}, \quad m = 2, 3, \dots$$

*Keywords:* trace inequality, majorization, eigenvalue.

*2010 MSC:* 15A45, 15A42

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## 1. Introduction

In the IMAGE problem 50-3, Besenyei [2] drew us attention to the following novel trace inequality: If  $\begin{bmatrix} A & B \\ B^* & C \end{bmatrix}$  is positive semidefinite with each block square, then

$$\operatorname{tr}AC - \operatorname{tr}B^*B \leq \operatorname{tr}A\operatorname{tr}C - |\operatorname{tr}B|^2. \quad (1)$$

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