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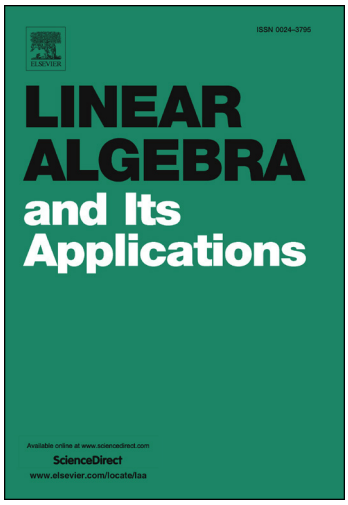

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Some norm inequalities for commutators of contracted tensor products ☆

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Abstract

The paper concerns generalizations of the Böttcher-Wenzel inequality to contracted products of tensors. We show that the best constant in the inequality is as expected in some cases and present an example where the best constant is larger than expected.

Keywords: Contracted product, matricization, tensor, norm inequality, commutator
2000 MSC: 15A52, 15A45, 60H25, 65F35

1. Introduction

In general, the matrix multiplication is not commutative, i.e., there are matrices $A, B \in \mathbb{R}^{n\times n}$ such that

$$AB \neq BA.$$

The difference $AB - BA$ is called the commutator of A and B. How big is the difference between AB and BA? For the Frobenius norm $\|AB - BA\|_{\mathrm{F}}$ one easily obtains

$$\|AB - BA\|_{\mathrm{F}} \leq \|AB\|_{\mathrm{F}} + \|BA\|_{\mathrm{F}} \leq \|A\|_{\mathrm{F}}\|B\|_{\mathrm{F}} + \|B\|_{\mathrm{F}}\|A\|_{\mathrm{F}} = 2\|A\|_{\mathrm{F}}\|B\|_{\mathrm{F}}.$$

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