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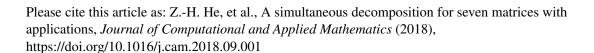
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A simultaneous decomposition for seven matrix s with applications

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Abstract

Let $\mathbb{H}^{m \times n}$ be the set of all $m \times n$ matrices over the quaternion algebra. In this paper, we construct a simultaneous decomposition for seven matrices with compatible sizes: $A \in \mathbb{H}^{m \times n}, B \in \mathbb{H}^{m \times p_1}, C \in \mathbb{H}^n$, $A \in \mathbb{H}^{m \times p_3}, E \in \mathbb{H}^{q_1 \times n}, F \in \mathbb{H}^{q_2 \times n}$ and $A \in \mathbb{H}^{q_3 \times n}$. As applications of the simultaneous matrix decomposition, we give some obviously conditions, general solutions, as well as the range of ranks of the general solutions to the following two generals of Sylvester matrix equations BXE + CYF + DZG = A and BX + WE + CYF + DZG = A, where A, B, C, D, E, F, and $A \in \mathbb{R}^n$ under the results of this paper.

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1. Introduction

In mathematics, engineering, sign?, circ it a d others, many problems can be transformed into the decompositions of multiple matrices (e.g. [15]-[18] [21], [59]). Paige and Saunders [41] introduced the generalized singular value decomposition of two matrices with the time row number. De Moor and Golub [19] and Zha [59] gave restricted singular value decompositions of the following general matrix triplet

$$\begin{array}{ccc}
n & m \\
p & A & B \\
C & \end{array}$$
(1)

Gustafson [26] preser ed the vanonical form for the general matrix triplet (1). Chu, De Lathauwer and De Moor [9] proved that the resulted singular value decomposition of the general matrix triplet (1) can be computed using a CSD-based QR-type method. Moreover, Chu and Mehrmann [12] provided a condensed form for the following five

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