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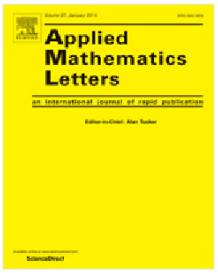

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Projection-Based Commuting Solutions of the Yang-Baxter Matrix Equation for Non-semisimple Eigenvalues

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Abstract

Let A be a square matrix. We construct projection-based commuting solutions of the quadratic matrix equation $AXA = XAX$, which are associated with non-semisimple eigenvalues of A with at least one 1×1 Jordan block, based on special projections onto some subspaces of the corresponding generalized eigenspaces. The result extends the main one (*Applied Math. Letters* 35 (2014), 86-89.) from the semisimple eigenvalue case to the non-semisimple one.

Abbreviated title: Solving Quadratic Matrix Equation
Keywords: Matrix equation, Jordan matrix, Jordan blocks, Projection
AMS Subject Classifications: 15A24, 15A18

1 Introduction

Let A be an $n \times n$ complex matrix. The spectral solutions of the following quadratic matrix equation

$$AXA = XAX \tag{1}$$

were obtained in [4] corresponding to all eigenvalues of A. The above equation is similar in format to the classic Yang-Baxter equation from the pioneering works [1, 9], so it is called the Yang-Baxter matrix equation or Yang-Baxter-like matrix equation in some recent papers on this topic. The Yang-Baxter equation is closely related to some areas of mathematical and physical sciences, such as knot theory, braid groups, and quantum groups; see, e.g., [6, 10] for more details.

The number of the spectral solutions from [4] is at most n, and each of them is the product of A and the spectral projection from $\mathbb{C}^n$ onto the generalized eigenspace of A; so