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Solutions to matrix equations $X - AXB = CY + R$ and $X - A\widehat{X}B = CY + R$ *

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Abstract

The present work proposed an alternative approach to find the closed-form solutions of the nonhomogeneous Yakubovich matrix equation $X - AXB = CY + R$. Based on the derived closed-form solution to the nonhomogeneous Yakubovich matrix equation, the solutions to the nonhomogeneous Yakubovich quaternion j-conjugate matrix equation $X - A\widehat{X}B = CY + R$ are obtained by the use of the real representation of a quaternion matrix. The existing complex representation method requires the coefficient matrix A to be a block diagonal matrix over complex field. In contrast in this publication we allow a quaternion matrix of any dimension. As an application, eigenstructure assignment problem for descriptor linear systems is considered.

Keywords: Closed-form solution; quaternion matrix equation; real representation

1. Introduction

The generalized Sylvester matrix equation

$$AX - EXF = CY, \tag{1.1}$$

is closely related with many problems in control theory, such as pole/eigenstructure assignment

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