A Comprehensive Approach to the Classical Matrix Equation AXB=C over the Dual Split Quaternion Algebra

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Introduction

The classical matrix equation AXB=C represents a fundamental problem in linear algebra, where A, B, and C are matrices of appropriate dimensions, and the goal is to find a matrix X that satisfies the equation. However, when dealing with complex structures like the Dual Split Quaternion Algebra, the solution to this equation becomes more intricate yet fascinating.

Description

The Dual Split Quaternion Algebra is an extension of the well-known quaternion algebra, introducing additional elements and properties that make it a valuable tool in mathematical modeling and applied mathematics. In this algebra, numbers are represented as dual split quaternions, which are linear combinations of basic elements {1, i, j, k, ε, η} with specific multiplication rules. To approach the general solution of the matrix equation AXB=C over the Dual Split Quaternion Algebra, we first need to define the operations and properties within this algebra. Multiplication of dual split quaternions involves the usual rules for quaternion multiplication, with the added multiplication rules for the dual elements ε and η. Addition and subtraction are performed component-wise, similar to standard vector operations. Given matrices A, B, and C represented in terms of dual split quaternions, the matrix equation AXB=C translates into a system of linear equations involving the elements of X. This system can be solved using various techniques from linear algebra, such as Gaussian elimination, matrix inversion, or specialized algorithms for solving matrix equations. One approach to finding the general solution involves transforming the matrix equation into a form suitable for computational methods. This may involve rewriting the equation in terms of individual components of the matrices and dual split quaternions, then applying appropriate algorithms to solve the resulting system of equations iteratively or numerically. Another approach is to utilize the properties of the Dual Split Quaternion Algebra to simplify the equation and identify special cases where solutions can be found analytically. For instance, if the matrices A, B, and C have certain symmetry properties or if their elements follow specific patterns, the general solution may be obtained through algebraic manipulations and deduction. The general solution to the matrix equation AXB=C over the Dual Split Quaternion Algebra may also involve considering constraints or additional conditions imposed on the matrices and dual split quaternions. For example, if the matrices A and B are invertible, then the solution for X may be expressed explicitly in terms of matrix multiplication and inverses. Moreover, the properties of the Dual Split Quaternion Algebra, such as its non-commutative nature and the presence of dual elements, can lead to interesting phenomena and solutions that differ from those in standard linear algebra. This adds a layer of complexity and richness to the analysis, requiring a deep understanding of the algebraic structures and their implications for solving matrix equations. The study of the general solution to the matrix equation AXB=C over the Dual Split Quaternion Algebra extends beyond theoretical mathematics to applications in computer graphics, robotics, and signal processing. In computer graphics, for instance, dual split quaternions are used to represent rotations and transformations in three-dimensional space, making the solution to matrix equations crucial for animation and rendering algorithms. In robotics and control theory, the Dual Split Quaternion Algebra provides a framework for modeling complex mechanical systems and analyzing their dynamics. Solving matrix equations over this algebra enables researchers to design control algorithms, optimize robot trajectories, and simulate robotic manipulations with high accuracy and efficiency [1-4].

Conclusion

The general solution to the matrix equation AXB=C over the Dual Split Quaternion Algebra presents a fascinating and challenging problem in algebraic structures and linear algebra. By leveraging the properties of dual split quaternions and applying specialized computational techniques, researchers can uncover solutions that have applications in diverse fields, from mathematical modeling to practical engineering problems.

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Conflict of Interest

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