

Geometry and Symmetry in Physics

ISSN 1312-5192

PERMUTABLE SYMMETRIC HADAMARD MATRICES IN QUATERNION ALGEBRA AND ENGINEERING APPLICATIONS

MIKHAIL V. KHARINOV

Communicated by Ivaïlo M. Mladenov

Abstract. In this paper, aiming to develop the group and out-of-group formalization of the symmetry concept, the preservation of a matrix symmetry after row permutation is considered by the example of the maximally permutable *normalized* Hadamard matrices which row and column elements are either plus or minus one. These matrices are used to extend the additive decomposition of a linear operator into symmetric and skew-symmetric parts using several commuting operations of the Hermitian conjugation type, for the quaternionic generalization of a vector cross product, as well as for creating educational puzzles and other applications.

MSC: 15B34, 05A05, 11R52

Keywords: Hadamard matrices, Hermitian additive decomposition, row permutations, symmetry, symmetrixes, triple generalization, vector cross product

Contents

1	Introduction	18
2	Symmetric-Skewsymmetric Additive Decomposition	19
3	Generalization of Vector Cross Product from Symmetry Considerations	21
4	Discussion of Cross Product Generalization	22
5	Permutable Matrix Symmetry	23
6	Latin Squares	26
7	Permutable Symmetry Discussion	28
8	Hidden Matrix Symmetry	32
9	Matrices with Extremal Determinant Value	33
10	Conclusions	36
References		39
doi: 10.7546/jgsp-61-2021-17-40		17