Different notions of regularity of functions of a discrete four-dimensional variable

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Abstract

In the last decade one can observe a growing interest in discrete structures equivalent to well-known continuous structures. Of particular interest is a discrete analogue to the class of monogenic or regular functions. To this end one needs to construct discrete Dirac operators which factorize the discrete Star- or Cross-Laplacian. But here a major problem arises: in general, two partial difference operators, forward and backward differences, are necessary in order to get a correspondence with each partial differential operator such that one is able to get a discrete equivalent of the Laplace operator. This means that, for instance, it is impossible to construct a discrete Dirac operator based on a quaternionic structure which factorizes the star-Laplacian. In this talk after a short review of the complex case we will discuss different constructions for discrete Dirac operators. To this end we take a look at the construction of the necessary algebraic structures, such as pseudo-Clifford algebras and discrete differential forms. In the end we will also give a geometric construction based on the boundary operator of a mesh and discuss its links with the theory of finite element and boundary element methods.