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Computer algebra algorithm of simplification of tensor polynomials

Tensor calculations are an important case in many natural sciences like mathematics and physics. To simplify such expressions, computer algebra is widely used. There are a number of approaches for solving this problem, namely, the component calculations, the calculations when tensor is considered as an abstract symbol with indices possessing some symmetry properties, and finally a pure abstract calculus like exterior algebra. In this paper we describe a method for reducing tensor expressions to the canonical form using group algebra method. The focus is on taking into account symmetry properties with respect to various permutations of indices inside the tensor, symmetries associated with renaming summation indices, as well as linear relationships between tensors, such as Bianchi identities. We define the canonical representation for polynomial (multiplicative) tensor expressions, which is the result of averaging the tensor expression over the orbits of certain finite group (stabilizer). We present a sketch of the algorithm which reduces tensor expression to the canonical form. The approach is illustrated by examples containing Riemann curvature tensors.

Primary author: Dr KRYUKOV, Alexander (SINP MSU)

Co-author: Dr SHPIZ, Grigory (SINP MSU)

Presenter: Dr KRYUKOV, Alexander (SINP MSU)

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