In study of black holes, the two-spinor formalism [1] has been useful particularly in the analysis of Dirac equations in Kerr geometry, see, *e.g.*, Chapter 10 in [2]. Symmetry operators of the Dirac equations, or any other physically intriguing differential equations, provide deep geometric insights on solutions of the equations; for previous works on the symmetry operators along these lines of developments, see, *e.g.*, [3, 4].

In this paper the authors carry out systematic treatments of finding second-order symmetry operators for the massive Dirac equation. The existence of the second-order symmetry operators is described by a set of Killing spinors satisfying certain differential equations. This enables the authors to write down a general expression of the second-order symmetry operators for the massive Dirac equation; see Eqns (49, 50) in the paper.

As a by-product, it is also reported that there are no nontrivial zeroth-order symmetry operators for the massive Dirac equation. Furthermore, constraints for the existence of first-order symmetry operators are given in terms of conditional equations for a set of Killing spinors. A general form of the first-order symmetry operators for the massive Dirac equation is derived as well; see Eqn (44). Computational data used in this study are available from a URL link provided in the last part of the paper.

References

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