Review of: "On n-Dimensional Maxwell and Dirac Equations in Curved Space-Time and Its Applications in SO(P,Q) Group Theoretic Image Processing"

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Potential competing interests: No potential competing interests to declare.

Review Report: On n-Dimensional Maxwell and Dirac Equations in Curved Space-Time and Its Applications in SO(P,Q) Group Theoretic Image Processing

Paper Information

- **Title:** On n-Dimensional Maxwell and Dirac Equations in Curved Space-Time and Its Applications in SO(P,Q) Group Theoretic Image Processing
- **Target Journal:** Qeios

Summary of the Paper

This paper explores the formulation of Maxwell's and Dirac's equations in n-dimensional space-time with p time coordinates and q spatial coordinates. The study examines the properties of the Green's function for the (p,q)-wave operator, the SO(p,q) invariance properties, and their applications in group theoretic image processing. The Einstein-Maxwell equations and the interactions between gravitational and electromagnetic fields in curved space-time are also analyzed. The paper aims to generalize these equations to higher dimensions and apply them to various physical phenomena, including psychic fields.

Major Scientific Questions

Derivation and Properties of Green's Function:

- **Question:** How are the properties of the Green's function for the (p,q)-wave operator derived, and what are their implications for solving the (p,q)-dimensional Maxwell equations?
- **Recommendation:** Provide a step-by-step derivation of the Green's function properties and discuss their physical significance and potential applications.

Analogies with Four-Dimensional Physics:

- **Question:** How are the electric and magnetic fields in (p,q)-dimensions defined by analogy with four-dimensional physics, and what are the key differences?
- **Recommendation:** Elaborate on the analogies and distinctions between (p,q)-dimensional and four-dimensional electric and magnetic fields, including a comparison of their mathematical formulations and physical interpretations.

SO(p,q) Invariance and Image Processing:

- **Question:** How does the SO(p,q) invariance of the Maxwell equations contribute to formulating SO(p,q)-group theoretic image processing problems?
- **Recommendation:** Detail the process of utilizing SO(p,q) invariance in image processing and provide examples or applications demonstrating its effectiveness.

References for Enhancement

To support and enhance the study, the following references are recommended:

1. https://doi.org/10.1109/TPS.2021.3084904
2. https://doi.org/10.1038/s41598-023-36536-z
3. https://doi.org/10.1140/epjs/s11734-023-00934-1
4. https://doi.org/10.2298/tsci221111008y
5. https://doi.org/10.1038/s41598-023-45707-x
6. https://doi.org/10.1038/s41598-024-52308-9
7. https://doi.org/10.1038/s41598-024-60401-2

Dirac Equation and Spinor Representation:

- **Question:** How is Dirac's equation in (p,q)-dimensional space-time derived using the Clifford algebra of the Dirac gamma matrices, and what are the implications for quantum mechanics in higher dimensions?
- **Recommendation:** Explain the derivation process in more detail, including the role of the Clifford algebra, and discuss the implications for understanding quantum mechanics in higher-dimensional space-times.

Perturbation Theory in Curved Space-Time:

- **Question:** How is perturbation theory applied to analyze Maxwell's equations in (p,q)-dimensional curved space-time, and what are the key findings?
- **Recommendation:** Describe the perturbation theory approach and its application to Maxwell's equations, highlighting any significant results or conclusions drawn from the analysis.

Einstein-Maxwell Equations and Interactions:

- **Question:** What are the main results obtained from studying the Einstein-Maxwell equations for (p,q)-dimensional gravity and electromagnetism, particularly regarding the motion of point charges?

- **Recommendation:** Summarize the key findings from the Einstein-Maxwell equations study, emphasizing the interactions between gravitational and electromagnetic fields and their effects on the motion of point charges.

U(1)-Gauge and SO(p,q) Invariance:

- **Question:** How are the U(1)-Gauge, local SO(p,q) Lorentz, and diffeomorphism invariances of the Dirac equation in (p,q)-dimensional curved space-time demonstrated?
- **Recommendation:** Provide a thorough explanation of the methods used to establish these invariances, including mathematical proofs and their implications for the consistency and symmetry of the Dirac equation in higher-dimensional curved space-time.

Conclusion

The paper provides a comprehensive exploration of Maxwell's and Dirac's equations in n-dimensional curved space-time, along with their SO(p,q) group theoretic applications. Addressing the scientific questions and recommendations outlined above will significantly enhance the clarity, rigor, and impact of the study, ensuring a robust contribution to the field of higher-dimensional physics and group theoretic image processing.