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Rotations and Transformations

Summary

Geometric algebra provides a unified approach to rotations that extends to arbitrary dimensions, and in doing so integrates various concepts that appear disparate and unrelated in conventional approaches. In particular, it introduces the concept of rotor transformations, which unify the role of complex numbers in describing rotations in 2d with that of quaternions in 3d and Lorentz transformations in 4d. This approach enables transformation of electric and magnetic fields to be carried out in a simple way, and shows how apparently advanced quantum concepts like the Dirac wavefunction are related to classical 3d rigid body mechanics. In detail, this lecture will look at: rotations and complex numbers, rotations in 3d, angular momentum as a bivector and 3d rigid body dynamics (including the symmetric top as an example), reflections, more general rotations and the link with spinors, Lorentz transformations as rotations in spacetime, transformations of electric and magnetic fields using rotors, and the link between Dirac and Pauli wavefunctions and rotors.