

Exploring Physics With Geometric Algebra

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Summary : Free exploring physics with geometric algebra pdf download - this is an exploratory collection of notes containing worked examples of a number of applications of geometric algebra ga also known as clifford algebra this writing is focused on undergraduate level physics concepts with a target audience of somebody with an undergraduate engineering background i e me at the time of writing these notes are more journal than book you ll find lots of duplication since i reworked some topics from scratch a number of times in many places i was attempting to learn both the basic physics concepts as well as playing with how to express many of those concepts using ga formalisms the page count proves that i did a very poor job of weeding out all the duplication these notes are dis organized into the following chapters basics and geometry this chapter covers a hodge-podge collection of topics including ga forms for traditional vector identities quaterions cauchy equations legendre polynomials wedge product representation of a plane bivector and trivector geometry torque and more a couple attempts at producing an introduction to ga concepts are included none of which i was ever happy with projection here the concept of reciprocal frame vectors using ga and traditional matrix formalisms is developed projection rejection and moore-penrose generalized inverse operations are discussed rotation ga rotors euler angles spherical coordinates blade exponentials rotation generators and infinitesimal rotations are all examined from a ga point of view calculus here ga equivalents for a number of vector calculus relations are developed spherical and hyperspherical volume parameterizations are derived some questions about the structure of divergence and curl are examined and tangent planes and normals in 3 and 4 dimensions are examined wrapping up this chapter is a complete ga formulation of the general stokes theorem for curvilinear coordinates in euclidean or non-euclidean spaces is developed general physics this chapter introduces a bivector form of angular momentum instead of a cross product examines the components of radial velocity and acceleration kinetic energy symplectic structure newton s method and a center of mass problem for a toroidal segment relativity this is a fairly incoherent chapter including an attempt to develop the lorentz transformation by requiring wave equation invariance lorentz

transformation of the four-vector sta gradient and a look at the relativistic doppler equation electrodynamics the ga formulation of maxwell s equation singular in ga is developed here various basic topics of electrodynamics are examined using the ga toolbox including the biot-savart law the covariant form for maxwell s equation space time algebra or sta four vectors and potentials gauge invariance tem waves and some lienard-wiechert problems lorentz force here the ga form of the lorentz force equation and its relation to the usual vectorial representation is explored this includes some application of boosts to the force equation to examine how it transforms under observe dependent conditions electrodynamic stress energy this chapter explores concepts of electrodynamic energy and momentum density and the ga representation of the poynting vector and the stress-energy tensors quantum mechanics this chapter includes a look at the dirac lagrangian and how this can be cast into ga form properties of the pauli and dirac bases are explored and how various matrix operations map onto their ga equivalents a bivector form for the angular momentum operator is examined a multivector form for the first few spherical harmonic eigenfunctions is developed a multivector factorization of the three and four dimensional laplacian and the angular momentum operators are derived fourier treatments solutions to various pde equations are attempted using fourier series and transforms much of this chapter was exploring fourier solutions to the ga form of maxwell s equation but a few other non-geometric algebra fourier problems were also tackled

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