Geometric Hyperplane Intersection Solver: A Matrix-Inversion-Free Framework Enhanced by Quantum and Evolutionary Algorithms

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Linear systems of equations are fundamental for scientific and engineering projects. Yet, traditional methods of solving linear systems struggle with scalability(speed) , instability, and are energy deficient. The Geometric Hyperplane Intersection Solver (GHIS) provides a novel geometric algebra approach to solving linear systems through exterior algebra and generalized cross product. replacing error-prone matrix inversion by interpreting equations as intersecting hyperplanes in n-dimensional space. Using Hodge duality and wedge products, two important tools in exterior algebra to generalize the cross product, GHIS compute the solution of the system by taking the line which n-1 hyperplane intersect then intersect it by the last hyperplane and that's through deriving the orthogonal vector to hyperplanes normal vectors by generalized cross product which is the direction vector of the line that n-1 hyperplane intersect then find the solution of the reduced system and this is for creating the line equation which we want to intersect it with the last hyperplane equation to find the solution of the system , In addition the algorithm side of Ghis has ,A novel integration of graph neural networks (GNNs) dynamically optimizes variable selection to eliminate unstable subsystems, And GHIS contain a combination of modern techniques that will improve it to deal with an ill condition systems and very big system like quantum acceleration for speed up Ghis and regularization for ill-conditioned . Ultimately, GHIS bridges abstract mathematics and practical computation, enabling breakthroughs in climate modeling, robotics, and AI through a sustainable, novel approach to solving high-dimensional systems which is important for solving real world challenges and develop technology .

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