A Generalized Pythagorean Theorem

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Abstract

This publication presents a novel generalization of the classical Pythagoras' Theorem. The theorem extends the relationship between orthogonal vectors to any n-dimensional Euclidean space, providing a unifying framework that connects geometry, algebra, and physics.

Formula

$||v||^2 = (\Sigma\ v■^2)$ for i = 1 to n, or equivalently $a■^2 + a■^2 + ... + a■^2 = c^2$

Introduction The Pythagorean theorem has been one of the foundational results in mathematics. Traditionally, it states that for a right-angled triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides. This work proposes a **generalized form** of the theorem in higher dimensions, applicable to vectors and multidimensional geometry. ### Generalized Theorem For an n-dimensional vector v = (a■, a■, ..., a■), the length of the vector is given by: $||v||^2 = a■^2 + a■^2 + ... + a■^2$ This reduces to the classical Pythagorean theorem when n = 2. ### Applications - Geometry in higher dimensions - Physics (relativity, vector spaces) - Data science and machine learning (distance metrics) ### Conclusion This theorem provides a natural extension of the Pythagoras' theorem into higher dimensions, reinforcing the deep connection between geometry and algebra across mathematics and applied sciences.