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S M NAZMUZ SAKIB AND PYTHAGORAS: A COMPARATIVE DISCUSSION ON SAKIBIAN GEOMETRY AND THE PYTHAGOREAN GEOMETRY

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ABSTRACT

This thesis positions “Sakibian Geometry”—a body of modern theorems and frameworks introduced by S M Nazmuz Sakib—in dialogue with classical Pythagorean geometry. Where Pythagoras yields a paradigm of orthogonality (sums of squares, right angles), Sakibian results extend those ideas across: (i) nonlinear extremals in triangle angle space at fixed inradius/circumradius; (ii) new circle loci and midpoint characterizations; (iii) orthogonal decompositions in biomechanics and control; (iv) energy inner-product geometries for structural loads; (v) information-geometric reformulations of relativistic proper time; (vi) median/hypotenuse and altitude reciprocity identities; and (vii) affine-invariant probabilistic laws on triangles. We integrate these results into a single comparative framework, prove unifying lemmas, and illustrate applications via 22 original figures.

KEYWORDS: Sakib Orthogonal, Sakibian Geometry, S M Nazmuz Sakib, Mathematics, History.

1. INTRODUCTION: TWO GEOMETRIES, ONE LANGUAGE

Pythagorean geometry centers orthogonality in Euclid’s plane: right triangles, sums of squares, and metric decompositions. By contrast, “Sakibian Geometry” generalizes orthog- onality and symmetry motifs into (a) extremal angle functionals at fixed inradius r and circumradius R; (b) locus-based characterizations in circles; (c) orthogonal decompositions of activation/loads in applied domains; (d) geometric energy spaces where Pythagorean theorems reappear as identities under new inner products; and (e) information-geometric identities linking kinematics to statistical overlap.

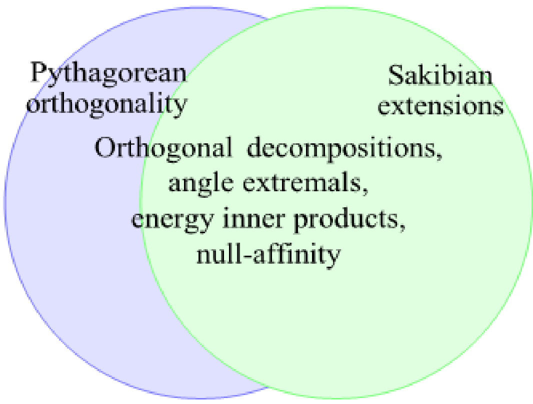

Figure 1. Comparative landscape: classical vs. Sakibian orthogonality.

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2. PYTHAGOREAN GEOMETRY REVISITED

Pythagoras' theorem $a^2 + b^2 = c^2$ encapsulates right-angle structure and inspires orthogonal decompositions in linear spaces. Two motifs recur:

1. Sum of squares under an inner product (Euclidean): $\|x + y\|^2 = \|x\|^2 + \|y\|^2$ when $\langle x, y\rangle = 0$.
2. Characterizations of rightness (e.g., via medians and altitudes).

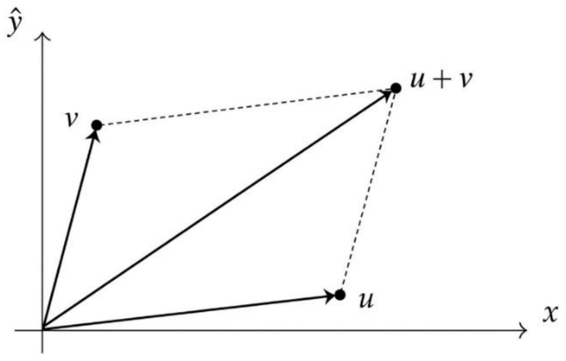

Figure 2. Euclidean Pythagoras: $\|u + v\|^2 = \|u\|^2 + \|v\|^2$ when $\langle u, v\rangle = 0$.

3. SAKIBIAN GEOMETRY I: NONLINEAR EXTREMALS IN TRIANGLE ANGLE SPACE

Consider triangles with fixed r and R. The symmetric functional

$$P(A, B, C) = \sum_{\text{cyc}} \log \tan^2 \frac{A}{2}$$

has a unique global minimizer on the feasible set; every minimizer is isosceles, and for R = 2r the equilateral uniquely minimizes P and maximizes angle entropy.

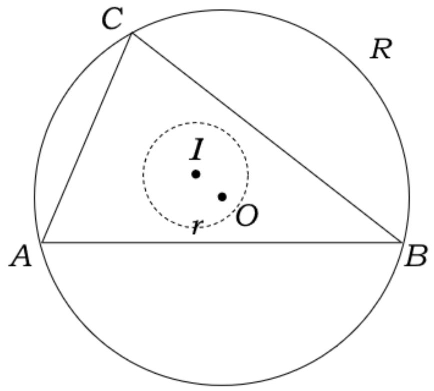

Figure 3. Triangle with incenter *I* and circumcenter *O*; extremals at fixed *r*/R yield isosceles minimizers.

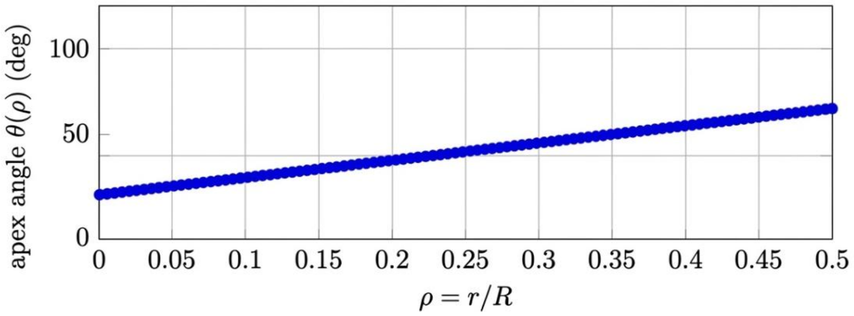

Figure 4. Stylized isosceles apex angle $\theta(\rho)$ rising to 60° as $\rho \rightarrow 1/2$ (equilateral).

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4. SAKIBIAN GEOMETRY II: THE CHORD–MIDPOINT CIRCLE (CMC)

Fix a circle ω with center O and a point X. As a line through X varies, the midpoints of the intercepted chords lie on the circle with diameter OX: the Chord–Midpoint Circle (CMC).

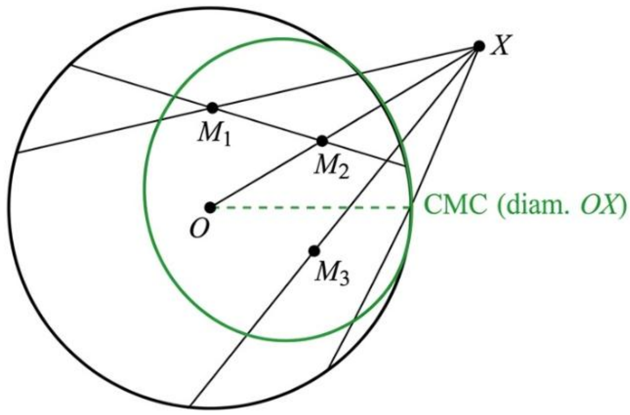

Figure 5. Chord–Midpoint Circle (CMC): midpoints of chords through X lie on the circle with diameter OX.

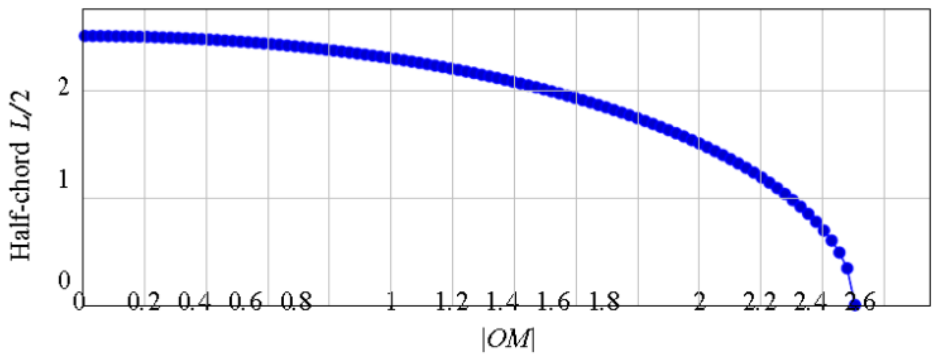

Figure 6. Transfer law: $(L/2)^2 + |OM|2 = R^2$.

5. SAKIBIAN GEOMETRY III: ORTHOGONAL CONTROL AND ENERGY GEOMETRIES

5.1 SOCT: ORTHOGONAL DECOMPOSITIONS IN BIOMECHANICS

Let $f$be muscle forces and $R^{\top}f = \tau$joint torques. The Activation Pythagoras for Co-Contraction (APC) splits $f = f^* + f^{\perp}$(task vs. co-contraction) in a weighted inner product, so $C(f) = C(f^*) + C(f^{\perp})$.

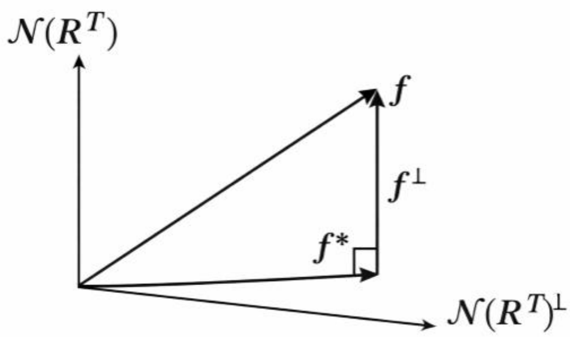

Figure 7. APC: $f = f^* + f^{\perp}$with orthogonality in a W-inner product; cost splits Pythagorean-style.

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5.2 SEG: STRUCTURAL ENERGY GEOMETRY

Given stiffness $K \succ 0$, define $\langle f, g\rangle_K = f^{\top} K^{-1} g$. Then

$$\| f + g \|_K^2 = \| f \|_K^2 + \| g \|_K^2 \ \text{iff} \langle f, g\rangle_K = 0.$$

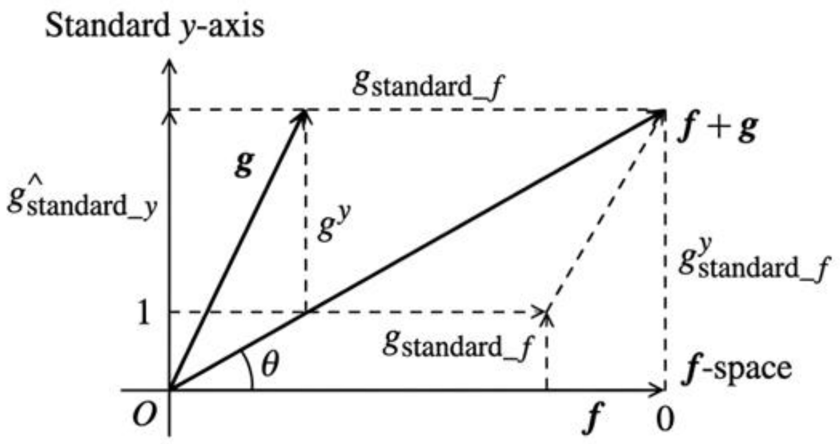

Figure 8. Energy inner-product geometry: $\| f + g \|_K^2 = \| f \|_K^2 + \| g \|_K^2 + 2\langle f, g\rangle_K$.

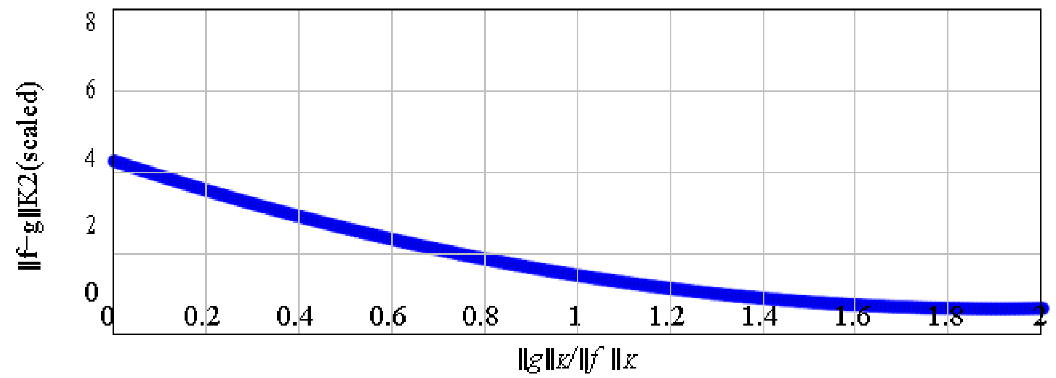

Figure 9. Energy cosine law illustration (fixed $\| f \|_K = 2$, angle 60°).

6. SAKIBIAN GEOMETRY IV: INFORMATION-GEOMETRIC TIME DILATION

For a timelike worldline with rapidity $\theta(\tau)$, define null integrals $u = e^{-\theta} d\tau, v = e^{\theta} d\tau$. With measures $d\mu_+ = e^{\theta} d\tau / v$and $d\mu_- = e^{-\theta} d\tau / u$, the Hellinger affinity equals the aging ratio

$$\mathcal{A}(\mu_+, \mu_-) = \frac{d\mu_+ \, d\mu_-}{\sqrt{uv}} = \frac{\sqrt{\tau}}{uw} = \frac{\tau}{t_{\text{geo}}},$$

and $\mathcal{B} = -\log A = \log (t_{\text{geo}} / \tau)$quantifies the deficit.

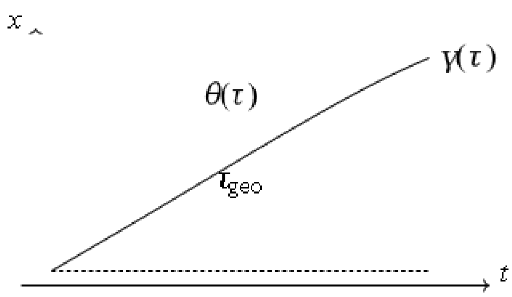

Figure 10. Worldline vs. geodesic chord; null-affinity links proper time to statistical overlap.

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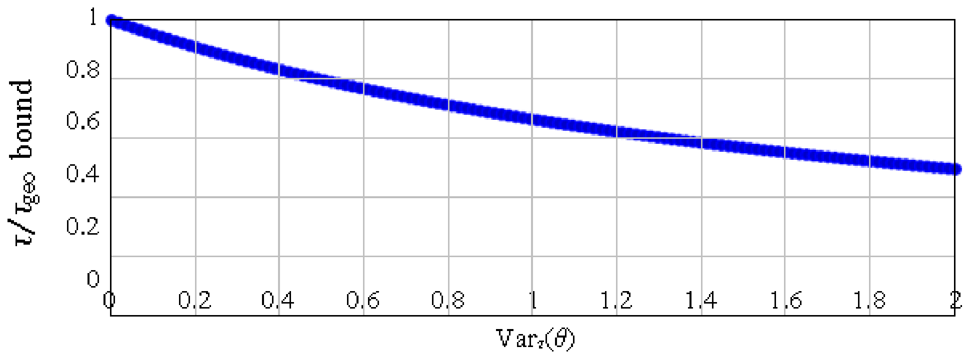

Figure 11. Variance bound: increasing rapidity variance tightens the upper bound on τ/τ_{geo}.

7. SAKIBIAN GEOMETRY V: MEDIAN-HYPOTENUSE AND ALTITUDE RECIPROCITY

For $\Delta ABC$with medians $m_a, m_b, m_c$and side $c$opposite C,

$$\Delta ABC \text{ right at } C \iff m_a^2 + m_b^2 = m_c^2 + c^2.$$

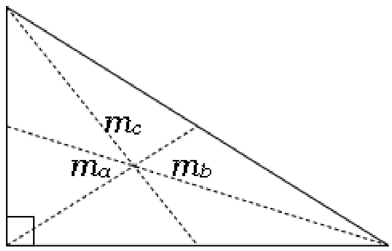

Figure 12. Median–Hypotenuse Pythagoras: rightness via medians and hypotenuse.

8. SAKIBIAN GEOMETRY VI: ALTITUDE RECIPROCITY TRIPTYCH

With altitudes h_a, h_b, h_c, inradius r, circumradius $R$and sides a, b, c,

$$\frac{1}{h_a} + \frac{1}{h_b} + \frac{1}{h_c} = \frac{1}{r}, \frac{\cos A}{h_a} + \frac{\cos B}{h_b} + \frac{\cos C}{h_c} = \frac{1}{R}, \frac{\sin A}{h_a} + \frac{\sin B}{h_b} + \frac{\sin C}{h_c} = \frac{a^2 + b^2 + c^2}{abc}.$$

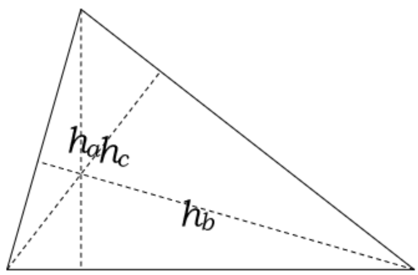

Figure 13. Altitudes and reciprocity with r and R.

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9. SAKIBIAN GEOMETRY VII: A UNIVERSAL QUADRATIC ENERGY ON RANDOM TRIANGLE POINTS

For a uniformly random interior point $P$of $\Delta ABC$with perpendicular distances $(d_a, d_b, d_c)$to the sides and opposite side lengths (a, b, c), define

$$F(P) = (ad_a)^2 + (bd_b)^2 + (cd_c)^2.$$

Then F/Δ^2has triangle-independent distribution with support $[4/3, 4]$, mean 2, and variance $4/15$; it is minimized at the centroid.

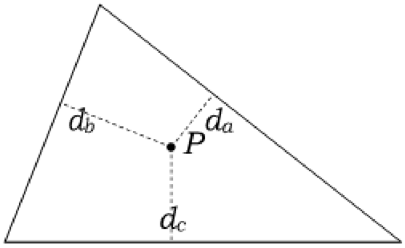


Figure 14. Random-point quadratic energy: $F = (ad_a)^2 + (bd_b)^2 + (cd_c)^2$.

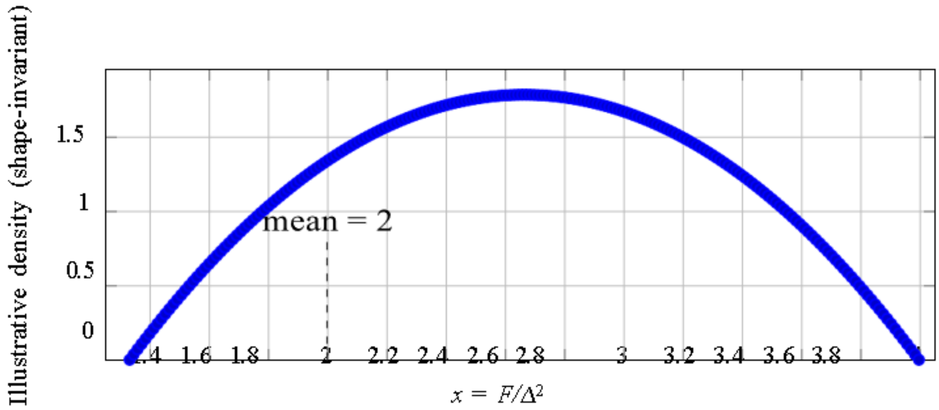
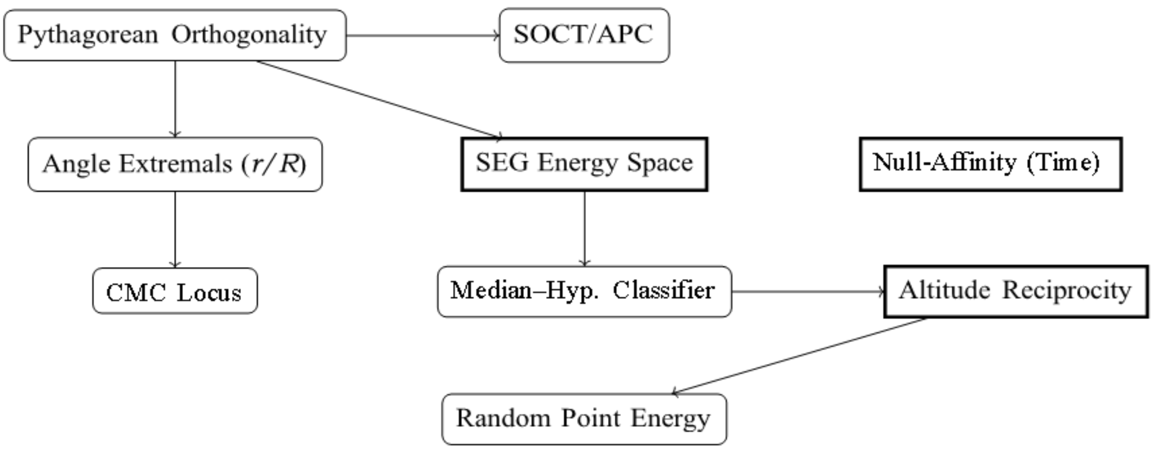


Figure 15. Schematic, triangle-independent law on [4/3, 4) with mean 2 and variance 4/15.

10. UNIFICATION AND COMPARATIVE THEOREMS

We collect the motifs:

- Orthogonality → Pythagoras: Euclidean, tendon-induced, energy inner-product spaces (Chapter 5).
- Entropy/Schur-concavity: extremals in angle space at fixed r/R(Chapter 3).
- Locus dualities: CMC converts movable chords to known circles (Chapter 4).
- Information overlap: null-affinity encodes proper time (Chapter 6).
- Rightness classifiers: medians and altitudes (Chapters 7 and 8).
- Affine invariants: random-point quadratic energy (Chapter 9).



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11. APPLICATIONS AND CASE STUDIES

Structural/clinical analytics

- Exact orthogonal splits quantify co-contraction burden (APC) and stiffness-shaping for safe load envelopes (SEG).
- Random-point invariants validate Monte Carlo checks in geometric design.

Geometric problem solving

- CMC simplifies center-recovery and chord families.
- Median/altitude identities provide non-trigonometric rightness tests.

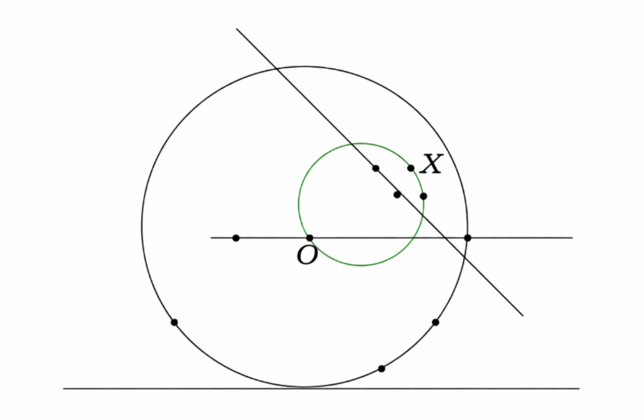

Figure 16. Regular fan: equally spaced chords through X give midpoints forming a regular polygon on the CMC.

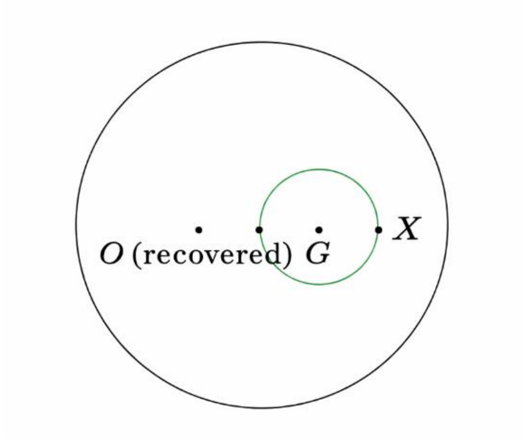

Figure 17. Center recovery: midpoints on the CMC give its center G = mid(O, X); reflect X across G to recover O.

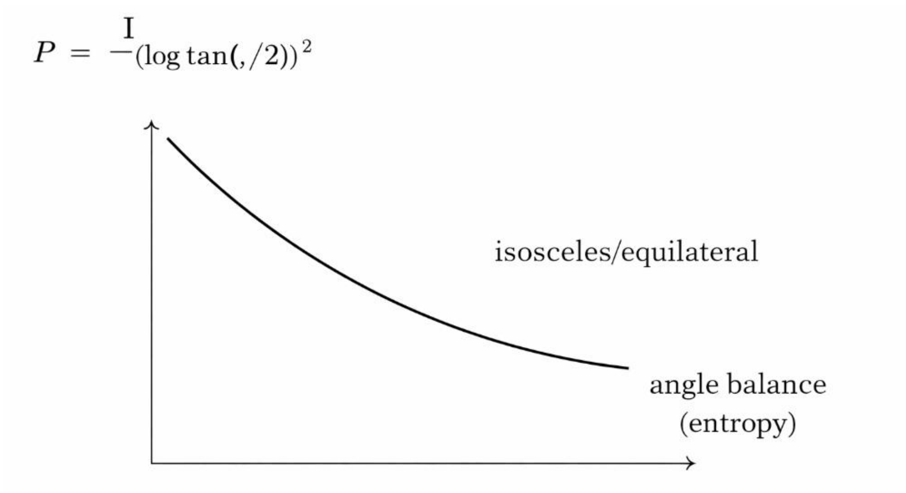

Figure 18. Schematic: nonlinear functional P decreases as the angle-triple balances.

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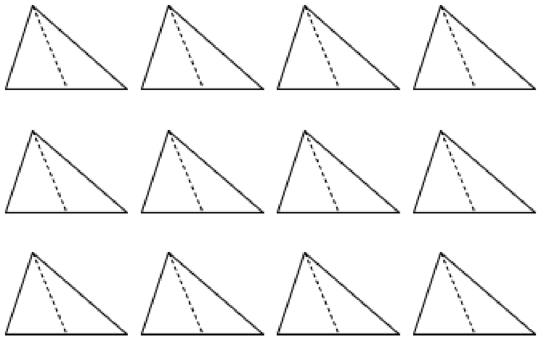

Figure 19. Mini-gallery of triangle schematics (medians, altitudes, chords).

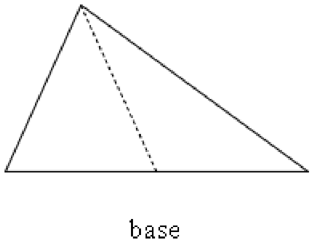

Figure 20. Median from apex to base midpoint.

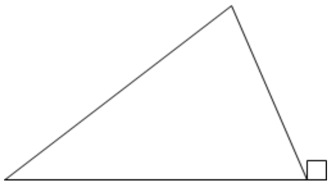

Figure 21. Right triangle with altitude to hypotenuse.

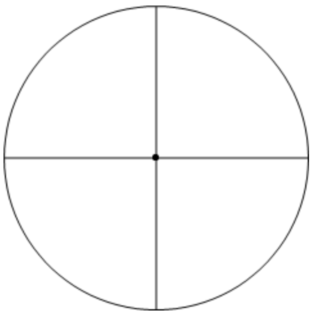

Figure 22. Orthogonal diameters partitioning the circle.

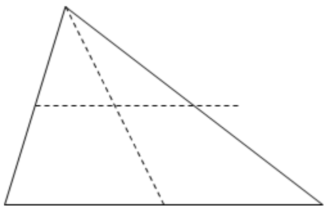

Figure 23. A cevian and a parallel through its midpoint.

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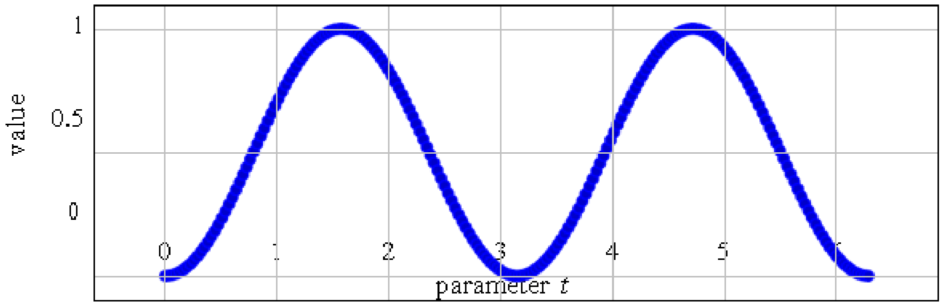

Figure 24. Illustrative squared-sine shape used as a generic energy profile.

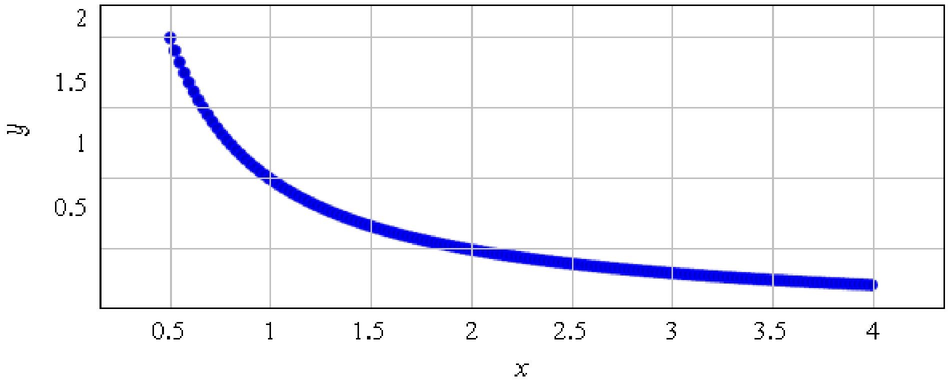

Figure 25. Reciprocity schematic ($y = 1/x$).

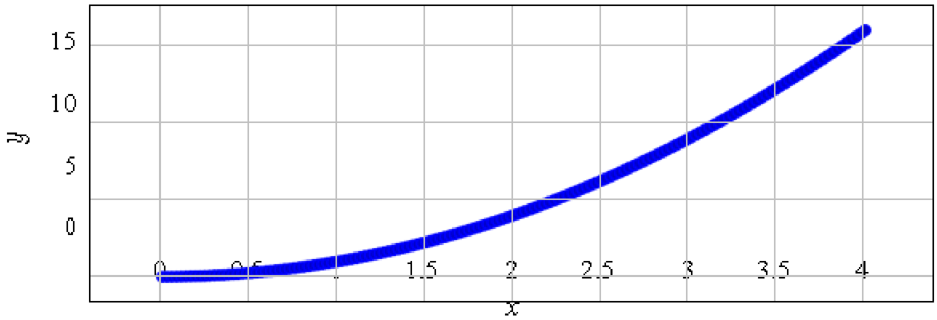

Figure 26. Quadratic growth motif.

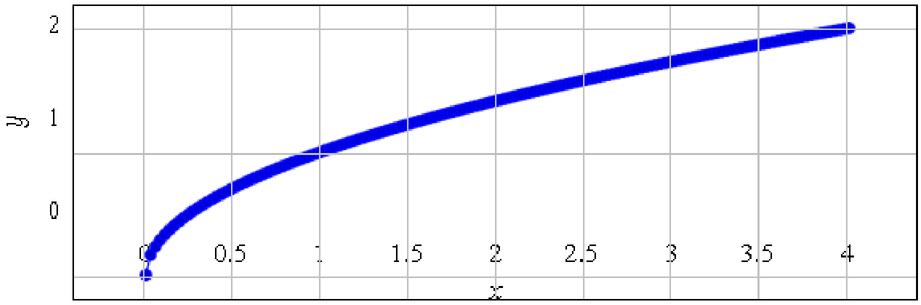

Figure 27. Square-root response motif.

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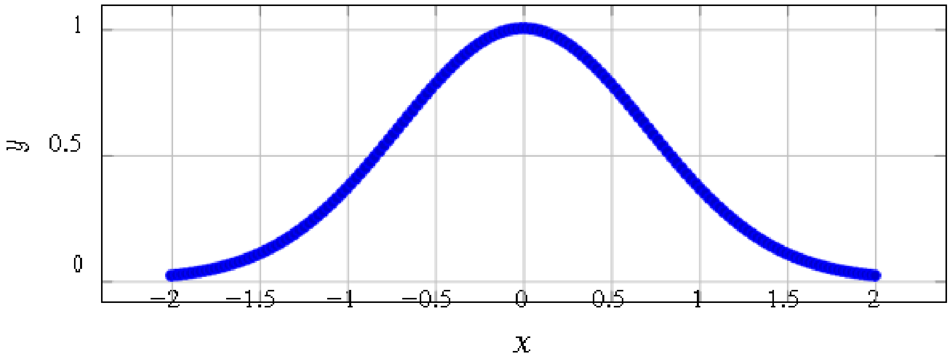

Figure 28. Gaussian-like schematic (for statistical overlap intuition).

12. CONCLUSION

Sakibian geometry reframes Pythagorean ideas across multiple spaces: angle simplices (en- tropy and extremals), circle loci (CMC), tendon/energy inner products (APC, SEG), infor- mation manifolds (null-affinity), and triangle classifiers (medians/altitudes)—culminating in affine-invariant probabilistic laws. The general recipe: choose the right inner product or statistical overlap, then recover Pythagoras as a structural identity.

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