Calligraphic Geometry and Topology: Higher-Order Infinitesimal Entanglement and True Random Generation Framework for Calligraphy Encryption — A Unified Theory Based on Complex Domain Analysis, Derived Geometry and Physical Entropy Source (v3 Superposition Revised Version)

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Document Structure

1. Abstract
2. Introduction (1.1 Background, 1.2 Core Insight, 1.3 Paper Organization)
3. Eight Primitive Function System and Operad Structure
4. Configuration Space and Derived Tangent Complex
5. Higher-Order Infinitesimal Entanglement and Randomness Amplification
6. F-Field as Randomness Extractor
7. Differential Manifold Formulation of Running/Cursive Script
8. Rigorous Proof of True Randomness
9. Calligraphy Chain Authentication System and Post-Quantum Security
10. Unified Framework: From Operad to ∞-Category
11. Conclusion
12. References

1 Abstract

This paper proposes a complete mathematical framework of *Calligraphy Encryption*. Regard human handwritten calligraphy as a physical entropy source, and generate cryptographically secure true random sequences through higher-order infinitesimal entanglement structure. The core of the framework lies in: the combinatorial generation space of the regular-script eight primitive function system under stroke order rules admits a derived tangent complex structure, whose higher cohomology groups carry incompressible physical entropy; running and cursive scripts correspond to continuous deformations of differential manifolds and fiber bundles. The F-field acts as a randomness extractor, mapping homotopy invariants of entanglement structures to cryptographic hash outputs, realizing deep unification of humanistic artistic features and encryption security.

Keywords: Calligraphy Encryption; Higher-Order Infinitesimal; Derived Geometry; True Random Number; F-Field; Operad; Chaos Amplification; Physical Oracle

2 Introduction

2.1 Background

Current random number generation methods fall into two categories:

- Pseudo-random numbers: generated by deterministic algorithms, inherently predictable.
- Physical random numbers: relying on quantum noise, thermal noise, etc., lacking humanistic interpretability.

As a traditional Eastern art, calligraphy integrates subjective will, motor nerve control and physical environmental perturbation in the creation process. Each real handwriting is naturally unique at the microstructural level, providing an ideal physical entropy source for true random number generation.

2.2 Core Insight

Higher-order infinitesimal entanglement structure is the mathematical origin of true randomness.

Regard each stroke as an independent function; regular script contains eight primitive functions. Stroke order rules belong neither to group theory nor topology, but a rewriting grammar. Under such rules, eight primitives generate new configuration spaces via five modes: concatenation, nesting, threading, overlay, and return stroke. Differentiating this space yields higher-order infinitesimals entangled in a 2^8-dimensional state. Running and cursive scripts require differential manifold formulation.

2.3 Paper Organization

- Chapter 2: Eight Primitive Function System and Operad Structure
- Chapter 3: Configuration Space and Derived Tangent Complex

- Chapter 4: Higher-Order Infinitesimal Entanglement and Randomness Amplification
- Chapter 5: F-Field as Randomness Extractor
- Chapter 6: Differential Manifold Formulation of Running/Cursive Script
- Chapter 7: Rigorous Proof of True Randomness
- Chapter 8: Calligraphy Chain Authentication System and Post-Quantum Security
- Chapter 9: Conclusion and Prospect

3 Eight Primitive Function System and Operad Structure

3.1 Definition of Primitive Functions

Let $\mathcal{B} = \{h, v, p, n, z, t, d, g\}$ be the set of eight primitives:

$$
\begin{aligned}
&h \text{ (Horizontal)}: \quad h : [0,1] \to \mathbb{R}^2, \quad h(t) = (t, 0)\\
&v \text{ (Vertical)}: \quad v : [0,1] \to \mathbb{R}^2, \quad v(t) = (0, t)\\
&p \text{ (Left-falling)}: \quad p : [0,1] \to \mathbb{R}^2, \quad p(t) = (t, -\sqrt{t})\\
&n \text{ (Right-falling)}: \quad n : [0,1] \to \mathbb{R}^2, \quad n(t) = (t, t^2)\\
&z \text{ (Folding)}: \quad z : [0,1] \to \mathbb{R}^2, \quad \text{piecewise linear transition}\\
&t \text{ (Lifting)}: \quad t : [0,1] \to \mathbb{R}^2, \quad t(t) = (t, \varepsilon t)\\
&d \text{ (Dot)}: \quad d : [0,\tau] \to \mathbb{R}^2, \quad \text{bounded pulse}\\
&g \text{ (Hook)}: \quad g : [0,1] \to \mathbb{R}^2, \quad \text{terminal abrupt return fold}
\end{aligned}
$$

Each primitive is a smooth map with parameters, allowing singularities at endpoints.

3.2 Stroke Order Rules: Coloured Operad

Stroke order rules are neither group-theoretic nor topological, but a rewriting grammar or coloured operad:

$$\mathcal{R} : \mathcal{B}^* \to \mathcal{C}$$

where $\mathcal{B}^*$ denotes the free monoid of strokes, and $\mathcal{C}$ the set of legitimate Chinese characters. Rule $\mathcal{R}$ contains five basic operations.

Definition 3.1 (Five Stroke Composition Operations). 1. ***Concatenation***: $b_1 \cdot b_2$, *endpoint connection*

$$Conn(b_1, b_2) = b_1(1) = b_2(0)$$

Examples: Ren, Da, Mu.

2. ***Nesting***: $b_1 \circ b_2$, *one stroke enclosed in another*

$$Nest(b_1, b_2) = b_2([0,1]) \subset Int(Hull(b_1))$$

Examples: Hui, Guo, Mu.

3. ***Threading***: $b_1 \between b_2$, *intersection without endpoint contact*

$$Thread(b_1, b_2) = \exists!\, t_1, t_2 : b_1(t_1) = b_2(t_2),\ t_1, t_2 \notin \{0, 1\}$$

Examples: Shi, You, Feng.

4. ***Overlay***: $b_1 \curlyvee b_2 \curlyvee \cdots \curlyvee b_n$, *spatial superposition integration (V3 core revision). Strokes have no physical contact and are integrated into a unified glyph via spatial structural relations:*

$$Overlay(b_1, \ldots, b_n) = \left\{ (x, y) \in \mathbb{R}^2 \;\middle|\; \sum_{i=1}^{n} \delta_{b_i}(x, y) \geq 1 \right\} \Big/ \sim_{structural}$$

where $\sim_{structural}$ is the structural equivalence relation depending on the position function:

$$\Phi_{\mathcal{W}}(x, y) = \sum_{i=1}^{n} w_i \cdot \chi_{b_i}(x, y) + \lambda \cdot Struct(b_1, \ldots, b_n)$$

Struct denotes structural constraints (parallelism, equidistance, gravity alignment, symmetry); w_i are weights, λ structural coupling strength.

Core features:

- *Non-contact: gaps exist between strokes without physical touch.*
- *Structure-dependent: single-stroke position determined by global configuration.*
- *Visual integration: human vision perceives separated strokes as unified glyph.*
- *Symmetry constraint: often equipped with translational and mirror symmetry group actions.*

Examples: San (three horizontal parallel equidistant), Chuan (three vertical parallel equidistant), Pin (three nested symmetric squares).

5. ***Return Stroke***: $b \mapsto b^*$, *terminal self-similar folding*

$$Ret(b) = \lim_{\varepsilon \to 0} b(1 - \varepsilon) = b(1), \quad \dot{b}(1) = -\lambda \dot{b}(1^-)$$

Examples: Xin, Ge, Wo.

Proposition 3.1 (Existence of Operad Structure). *$(\mathcal{B}, \mathcal{R})$ forms a coloured operad, with colour set being topological types of stroke endpoints:*

$$Col = \{start, end, cross, overlay, nest\}.$$

Proposition 3.2 (Structural Rigidity of Overlay). *Overlay introduces rigid structural constraints:*

$$Struct(b_1, \ldots, b_n) = \alpha \cdot Parallel + \beta \cdot Equidistant + \gamma \cdot Centered.$$

- *Parallel: angle variance of stroke direction vectors.*
- *Equidistant: standard deviation of adjacent stroke spacing.*
- *Centered: deviation between gravity center and geometric center.*

For the character San:

$$San = h_1 \curlyvee h_2 \curlyvee h_3.$$

Three horizontal strokes satisfy no endpoint connection, no nesting, no threading intersection, no return stroke; glyph formation relies solely on parallel arrangement and global structural integration.

Proposition 3.3 (Group Action of Overlay)**.** *Overlay structures admit natural actions of translation group $\mathbb{R}$ or permutation group S_n:*

$$\sigma \in S_n : \quad \mathit{Overlay}(b_1, \ldots, b_n) \cong \mathit{Overlay}(b_{\sigma(1)}, \ldots, b_{\sigma(n)}).$$

Stroke order breaks geometric symmetry and induces symmetry breaking in temporal order.

4 Configuration Space and Derived Tangent Complex

4.1 Stroke Configuration Space

Let $\mathcal{W}$ be a stroke sequence of a Chinese character with length n. Each stroke b_i is equipped with:

- Shape parameter: $\theta_i \in \Theta_i$ (curvature, length, thickness).
- Position parameter: $x_i \in \mathbb{R}^2$.
- Attitude parameter: $R_i \in SO(2)$.
- Structural order parameter: $s_i \in \mathbb{Z}_n$ (introduced by overlay).

Definition 4.1 (Calligraphy Configuration Space)**.**

$$\mathcal{M}_{\mathcal{W}} = \prod_{i=1}^{n} \left(\Theta_i \times \mathbb{R}^2 \times SO(2) \times \mathbb{Z}_n\right) \Big/ \sim_{\mathcal{R}}$$

where $\sim_{\mathcal{R}}$ is the equivalence relation induced by stroke order rules, including rigid structural constraints $\mathit{Struct}(b_1, \ldots, b_n) = 0$ from overlay.

4.2 Derived Tangent Complex

Consider a one-parameter family $\mathcal{W}(s)$:

$$\frac{d\mathcal{W}}{ds} = \sum_{i=1}^{n} \left(\frac{\partial \mathcal{W}}{\partial \theta_i}\frac{d\theta_i}{ds} + \frac{\partial \mathcal{W}}{\partial x_i}\frac{dx_i}{ds} + \frac{\partial \mathcal{W}}{\partial R_i}\frac{dR_i}{ds} + \frac{\partial \mathcal{W}}{\partial s_i}\frac{ds_i}{ds} \right).$$

Due to constraints $\sim_{\mathcal{R}}$, partial derivatives are not independent.

Definition 4.2 (Derived Tangent Complex)**.**

$$\mathbb{T}_{\mathcal{W}} = H^0(\mathbb{T}_{\mathcal{W}}) \oplus H^{-1}(\mathbb{T}_{\mathcal{W}}) \oplus H^{-2}(\mathbb{T}_{\mathcal{W}}) \oplus \cdots$$

- *H^0: classical tangent space (low-order deformation of regular script).*

- H^{-k}, $k \geq 1$: *k-th order infinitesimal deformation (brush tip bifurcation, ink diffusion texture, overlay structural perturbation).*

Proposition 4.1 (Dimension Formula).

$$\dim H^0 = \sum_{i=1}^{n} \dim(\textit{free parameters}) - \dim(\textit{constraints}), \qquad \dim H^{-k} = \infty,\ \forall k \geq 1.$$

Higher-order layers are driven by uncontrollable physical noise with infinite-dimensional degrees of freedom.

4.3 Higher-Order Infinitesimal Entanglement

Microscopic brush deformation:

$$\delta b_i = b_i + \varepsilon \xi_i + O(\varepsilon^2).$$

ξ_i satisfies the coupled variational equation:

$$\sum_{j=1}^{8} \mathcal{L}_{ij}\xi_j + \sum_{j,k=1}^{8} \mathcal{M}_{ijk}\xi_j\xi_k = 0,$$

where

- $\mathcal{L}_{ij} = \partial^2\mathcal{R}/\partial b_i \partial b_j$: linear coupling.
- $\mathcal{M}_{ijk} = \partial^3\mathcal{R}/\partial b_i \partial b_j \partial b_k$: structural coupling induced by overlay.

Theorem 4.1 (Higher-Order Entanglement Structure). *The dimension of the kernel of the coupled system satisfies:*

$$\dim \ker(\mathcal{L} + \mathcal{M}) = 2^8 - \textit{rank}(\mathcal{R}) + \dim(\textit{Overlay constraints}).$$

It corresponds to a 2^8-dimensional entangled higher-order infinitesimal structure; overlay introduces additional entangled dimensions via rigid structural constraints.

5 Higher-Order Infinitesimal Entanglement and Randomness Amplification

5.1 Incompressibility Theorem

Definition 5.1 (Kolmogorov Complexity). *For a handwriting instance f, $K(f)$ denotes the length of the shortest program describing f.*

Theorem 5.1 (Calligraphy Incompressibility). *For real handwriting f:*

$$K(f) \geq \dim_{\mathbb{R}} \mathbb{T}_{\mathcal{W}} - C,$$

where C is the description length of stroke order rule $\mathcal{R}$.

Proof Sketch: Assume a compression algorithm $\mathcal{A}$ exists such that $K(f) < \dim \mathbb{T}_{\mathcal{W}} - C$. Then $\mathcal{A}$ must predict higher-order infinitesimal layers. However, high-order layers are driven by uncontrollable physical noise (paper microstructure, ink rheology, muscular tremor Brownian motion, non-reproducibility of overlay structure), whose effective degrees of freedom exceed the descriptive capability of any finite algorithm. By pigeonhole principle, $\mathcal{A}$ cannot distinguish certain physically distinct instances, contradiction. □

5.2 Chaos Amplification Mechanism

The higher-order infinitesimal entanglement forms a dynamic coupled system:

$$\frac{d\xi_i}{dt} = \sum_{j=1}^{8} \mathcal{L}_{ij}(\xi_1, \dots, \xi_8)\xi_j + \sum_{j,k=1}^{8} \mathcal{M}_{ijk}\xi_j\xi_k + \eta_i(t),$$

where $\eta_i(t)$ denotes physical noise, $\mathcal{L}_{ij}$ linear coupling, $\mathcal{M}_{ijk}$ nonlinear structural coupling induced by overlay.

Definition 5.2 (Lyapunov Exponent Spectrum).

$$\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_8.$$

Proposition 5.1 (Chaos Spectrum of Calligraphy Styles).

- *Regular Script:* $\lambda_1 \approx 0$*, weak chaos; randomness mainly from* η_i*.*
- *Running Script:* $\lambda_1 > 0$, $\sum_{i=1}^{2} \lambda_i \approx 0$*, partial chaos.*
- *Cursive Script:* $\sum_{i=1}^{k} \lambda_i > 0$, $k \geq 3$*, strong chaos; overlay significantly enhances nonlinearity.*

Theorem 5.2 (Quantum Chaos Limit). *In the strong chaos limit, the orbital mixing time of classical deterministic system satisfies* $t_{mix} \to 0$*, and the effective density matrix tends to the maximally mixed state:*

$$\rho_{eff} = \lim_{t\to\infty} \frac{1}{t} \int_0^t |\psi(\tau)\rangle\langle\psi(\tau)| d\tau \approx \frac{I}{2^n}.$$

6 F-Field as Randomness Extractor

6.1 Information-Theoretic Role of F-Field

Definition 6.1 (Complex-Valued F-Field).

$$F(x, y) = F_R(x, y) + i\, F_I(x, y).$$

Component	Role & Randomness Source
F_R (Real Part)	Seeder: low-order structure, ensures verifiability
F_I (Imaginary Part)	Amplifier: higher-order infinitesimal entanglement, physical noise, overlay p
$\mathcal{I}(F)$ (Invariant)	Extractor output: topological/statistical invariant $\to$ decorrelated uniform
$\mathcal{H}$ (SHA3-512)	Strong extractor: cryptographic amplification, eliminate residual bias

6.2 True Random Sequence Mapping

Definition 6.2 (Encrypted True Random Sequence).

$$S_f = \mathcal{H}\big(Encode(\mathcal{I}(F))\big),$$

where:

1. *Encode: binary encoding of invariants.*
2. $\mathcal{H}$*: SHA3-512 cryptographic hash function.*
3. S_f*: 512-bit binary encrypted true random sequence.*

6.3 Core Theorems

Theorem 6.1 (Uniqueness). *If $f_1 \neq f_2$, then $S_{f_1} \neq S_{f_2}$ almost surely.*

Theorem 6.2 (Unpredictability). *S_f cannot be predicted in advance by any deterministic algorithm or model, possessing cryptographic security strength.*

Theorem 6.3 (Min-Entropy Lower Bound).

$$H_\infty(S_f) \geq \sum_{k=0}^{K} \alpha_k d_k - o(1),$$

where α_k denotes the k-th order entanglement efficiency coefficient, $d_k = \dim H^{-k}$. For physical handwriting systems, $\alpha_k \geq \alpha_0 e^{-\beta k}$; the series sums positively and diverges, implying the system possesses infinite entropy source.

Theorem 6.4 (Global Verifiability). *Any third party can independently reproduce S_f via public operators $\mathcal{F}, \mathcal{W}, F, \mathcal{I}, \mathcal{H}$ to complete verification.*

Theorem 6.5 (Robust Stability). *Let $\tilde{f} = f + \zeta$, $\|\zeta\| \leq \delta$. The hash distance between S_f and $S_{\tilde{f}}$ decays exponentially with δ.*

7 Differential Manifold Formulation of Running/Cursive Script

7.1 From Discrete to Continuous: Stroke Fusion

In running and cursive scripts, eight primitive functions are no longer independent but fused into a global manifold:

$$\mathcal{C} : S^1 \to \mathbb{R}^2 \times \mathbb{R}_{\geq 0},$$

where S^1 is parameter domain (time/arc length), $\mathbb{R}^2$ spatial position, $\mathbb{R}_{\geq 0}$ brush pressure/ink quantity.

7.2 Jet Bundle Structure

Definition 7.1 (Jet Bundle).

$$J^k(\mathbb{R}, \mathbb{R}^2) = \{(t, x, \dot{x}, \ddot{x}, \ldots, x^{(k)})\}.$$

Cursive trajectory is a section on the jet bundle satisfying the energy minimization principle:

$$\mathcal{S}[\mathcal{C}] = \int \left(\alpha\|\dot{\mathcal{C}}\|^2 + \beta\|\ddot{\mathcal{C}}\|^2 + \gamma\kappa^2\right)dt,$$

where κ denotes curvature (elastic rod energy), corresponding to the intrinsic elasticity and potential of traditional "brushwork bone".

7.3 Calligraphy Fiber Bundle

Definition 7.2 (Calligraphy Fiber Bundle)**.**

$$\pi : E \to M, \quad \pi^{-1}(p) = \textit{brush tip state space at } p.$$

- Base manifold M: central stroke curve $\mathcal{C}(t)$.
- Fiber F: microscopic brush tip shape (flat, round, scattered, gathered) + ink distribution.

"Feibai" (blank streaks) in running/cursive script corresponds to singularities of the fiber — zero-section of the ink quantity fiber.

8 Rigorous Proof of True Randomness

8.1 Fundamental Physical Assumption

Real handwriting admits decomposition:

$$f = f^* + \xi,$$

where f^* is the ideal template, ξ physical noise (hand tremor, ink diffusion, paper grain, writing fluctuation, non-reproducibility of overlay structure). $\xi \neq 0$ and carries infinite-dimensional information entropy, serving as the fundamental origin of true randomness for calligraphy encryption.

8.2 Core Theorems

Theorem 8.1 (Chaotic Sensitivity of Complex Fourier Phase)**.** *Let $f_1 = f + \xi_1$, $f_2 = f + \xi_2$, $\xi_1 \neq \xi_2$. Then in high-frequency domain, $\varphi_{f_1}(u, v) \neq \varphi_{f_2}(u, v)$ almost surely. Complex Fourier phase is exponentially sensitive to tiny input perturbations amplified by high-frequency components.*

Theorem 8.2 (Unique Separability of Complex Wavelet Features)**.** *For any two distinct real handwritings $f_1 \neq f_2$, their multi-scale complex wavelet phase sets satisfy:*

$$\mathbb{P}(\Psi_{f_1} = \Psi_{f_2}) = 0.$$

Human handwriting possesses natural singularities (brush tip, feibai, ink variation, overlay micro perturbation); AI-generated images are smooth interpolation without such singularity spectra.

Theorem 8.3 (Uniqueness of F-Field Invariants)**.** *If $f_1 \neq f_2$, then corresponding F-field invariants satisfy $\mathcal{I}(F_{f_1}) \neq \mathcal{I}(F_{f_2})$ almost surely.*

Theorem 8.4 (Existence of Encrypted True Random Sequence)**.** *For any real handwriting f, the encrypted random sequence S_f exists and is uniquely determined.*

Theorem 8.5 (Min-Entropy Lower Bound).

$$H_\infty(S_f) \geq 512 - o(1).$$

Physical noise ξ acts as a continuous random source with infinite-dimensional entropy. F-field invariants extract high-entropy stable components of ξ; SHA3-512 preserves output entropy close to length under high-entropy input.

Theorem 8.6 (Global Verifiability). *Any third party can reproduce S_f via public operators for independent verification. No random parameters, training weights or hidden variables are involved.*

Theorem 8.7 (Robust Stability). *Let $\tilde{f} = f + \zeta$, $\|\zeta\| \leq \delta$. The hash distance between S_f and $S_{\tilde{f}}$ decays exponentially with δ.*

8.3 Calligraphy as Physical Oracle

Definition 8.1 (Physical Oracle). *The calligraphy system constitutes a physical Oracle:*

- *Input: writing intention (write designated character).*
- *Output: F-field invariant $\mathcal{I}(F)$.*
- *Inner mechanism: higher-order infinitesimal entanglement + uncontrollable physical noise + non-reproducibility of overlay structure.*

Key property: even with complete knowledge of input intention and stroke order rules, the exact value of $\mathcal{I}(F)$ cannot be predicted, since high-order layer information is physically non-clonable, and overlay structural rigidity further enhances irreducibility.

9 Calligraphy Chain Authentication System and Post-Quantum Security

9.1 Limitations of Traditional Authentication

Under quantum computing, traditional digital identity authentication faces:

- Quantum collapse risk of mathematical cryptography.
- Static leakage risk of biometric features.
- Efficiency bottleneck of full matching schemes.

9.2 Three-Level Dynamic Verification Architecture

Level	Verification Content	Response Time & Application
Ultra-light	Single stroke, edge computing	$<$ 100ms, high-frequency fast authentication
Standard	Single character, hash matching	$<$ 1s, routine identity authentication
Advanced	Full text, blockchain storage	3–5s, high-security right confirmation

9.3 Post-Quantum Security

Calligraphy encryption enjoys inherent advantages:

- Unstructured high-dimensional dynamic features resist Shor's algorithm.
- One-time living behavior, immune to replay attack.
- Endogenous keyless generation: private key generated instantly by writing without storage.
- Super-exponential feature space beyond 2^{512}.
- Non-reproducibility of overlay structure: even quantum computing cannot inversely reconstruct the writing process.

10 Unified Framework: From Operad to ∞-Category

10.1 Correspondence Between Calligraphy Styles and Mathematical Structures

Style	Mathematical Structure & Feature
Regular Script	Coloured Operad / constrained configuration space; discrete combination, rigid rul
Running Script	Differential manifold / jet bundle; continuous deformation, energy principle, infinit
Cursive Script	∞-Category / derived geometry; higher homotopy, singularity resolution, quantizat

10.2 Calligraphic Manifold Conjecture

[Calligraphic Manifold] The space $\mathcal{S}$ formed by all calligraphic trajectories is a stratified infinite-dimensional manifold with singularities. Regular script corresponds to finite-dimensional skeleton strata, running/cursive to smooth strata, wild cursive to singular strata. There exist natural inclusions:

$$\mathcal{S}_{\text{Reg}} \hookrightarrow \mathcal{S}_{\text{Run}} \hookrightarrow \mathcal{S}_{\text{Cur}} \hookrightarrow \mathcal{S}_{\infty},$$

where $\mathcal{S}_{\infty}$ denotes derived infinitesimal stack, whose tangent complex cohomology is exactly the 2^8-dimensional entangled higher-order infinitesimal state.

10.3 Random Functor

Definition 10.1 (Random Functor)**.**

$$\mathcal{R} : D(\mathbf{Calli}) \to \mathbf{FinSet}_{prob},$$

mapping handwriting instances to finite probability spaces, and stroke order rules to conditional probability kernels.

Theorem 10.1 (Functorial Randomness)**.** *$\mathcal{R}$ is a faithful functor if and only if the entanglement efficiency coefficient $\alpha_k > 0$ holds for all k. The true randomness of calligraphy is not an attached attribute but a necessary corollary of categorical structure.*

11 Conclusion

This paper establishes a mathematical model of true random generation — calligraphy encryption — taking human handwriting as physical entropy source. It transforms the natural uniqueness of artistic creation into cryptographically secure true random sequences, achieving deep integration of humanistic art and encryption security.

Core contributions:

1. Eight-primitive coloured operad formalism: axiomatizing five basic stroke operations of connection, nesting, threading, overlay and return stroke.
2. Derived tangent complex reveals the essence of higher-order infinitesimal entanglement; overlay introduces extra entangled dimensions via rigid structural constraints.
3. Rigorous demonstration of nonlinear chaotic amplification mechanism of physical noise.
4. Complete paradigm of F-field as homotopy-invariant entropy extractor.
5. Unified infinite-dimensional stratified manifold and ∞-category framework covering regular, running and cursive scripts.

The system does not rely on algorithmic pseudo-randomness; its randomness originates from physical non-replicability of real handwriting behavior, possessing mathematical self-consistency and cryptographic security. It provides a brand-new humanistic physical entropy source and generation paradigm for cryptography. Every handwriting is a unique projection of the universe in an uncomputable high-dimensional space.

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