UMMIC–WSIG Unified Theory: Universal Minimal Model of Introspective Computation

Version 1.3

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Abstract

Establish Universal Minimal Model of Introspective Computation (UMMIC) integrated with Windowed Scattering & Information Geometry (WSIG). Core results: (i) Introspection encoded as append-only log with Zeckendorf canonical form; (ii) Minimal recording entropy monotonically increasing unless halted; (iii) Trinity scale identity $\varphi'/\pi = \rho_{\mathrm{rel}} = (2\pi)^{-1} \operatorname{tr} Q$ unifying phase, density, delay; (iv) NPE three-term error decomposition for windowed readout; (v) Halting equivalence: no entropy increase $\Leftrightarrow$ I-projection fixed point $\Leftrightarrow$ computational halt.

1 Introduction

UMMIC provides minimal axioms for introspective computation. Combined with WSIG measurement framework, establishes operational theory of halting and information growth.

2 Core Definitions

Definition 2.1 (Introspective System)**.** *Tuple* (Z, R, U, Enc) *where* Z *external state,* R *internal record,* U *reversible update,* Enc *prefix encoder.*

Definition 2.2 (Recording Entropy)**.** $S(R_t) := H(R_t)$ *where* H *Shannon entropy of record distribution.*

3 Main Theorems

Theorem 3.1 (Entropy Monotonicity)**.** *For append-only updates* $R_{t+1} = R_t \circ C_t$*, have* $S(R_{t+1}) \geq S(R_t)$ *with equality iff halted.*

Theorem 3.2 (Trinity Scale Identity)**.**

$$\frac{\varphi'(E)}{\pi} = \rho_{\mathrm{rel}}(E) = \frac{1}{2\pi} \operatorname{tr} Q(E)$$

holds a.e. on absolutely continuous spectrum.

Theorem 3.3 (Halting Equivalence)**.** *Following equivalent:*

1. *No entropy increase:* $S(R_{t+1}) = S(R_t)$
2. *I-projection fixed point:* $\min_{p \in \mathcal{C}} D_{\mathrm{KL}}(p \| q)$ *attained*
3. *Computational halt: no further state updates*

4 Applications

UMMIC–WSIG framework applies to:

- Quantum measurement halting criteria
- Reversible computing with introspection
- Minimal recording strategies
- Information-theoretic complexity bounds