Resonant Path Integral Theory (RPIT)

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When symbols walk, worlds interfere.

ABSTRACT

Resonant Path Integral Theory (RPIT) extends the Recursive Resonance Calculus (RRC) by embedding anchorresonator dynamics into a path-integral formalism. We construct a measure on sequences of cognitive anchors, define an action functional capturing symbolic salience, and prove a factorisation theorem linking the partition function to fractal risk kernels. RPIT unifies discrete symbolic logic, continuous dynamical flow, and quantum-style interference under one mathematical roof.

1 MOTIVATION

RRC formalises anchors and resonators but lacks a global summation over all possible resonant trajectories. Quantum mechanics solves an analogous gap via Feynman path integrals. RPIT imports that idea: every anchor-path contributes an amplitude weighted by a salience action.

2 ANCHOR PATHS AND SALIENCE ACTION

2.1 Anchor Path

A finite sequence gamma = (a0, a1, ..., am) with ai in A. The path weight is the product of resonator parameters:

W(gamma) = product lambda_i, where ai = R_{lambda_i}(ai-1).

2.2 Salience Action

S(gamma) = sum_{i=0}^{m} (1 - w(ai)) + theta * log W(gamma),   theta > 0.

2.3 Path Integral

< O > = (1/Z) * sum_{gamma} O(gamma) * exp(-S(gamma) / hbar_s),

Z = sum_{gamma} exp(-S(gamma) / hbar_s),

with symbolic Planck constant hbar_s.

3 FACTORISATION THEOREM

THEOREM 1 (FractalIntegral Factorisation). Let A be the attractor generated by anchor basis B. If salience weights satisfy w(a) = ||phi(a)||^{-delta} for embedding phi: B -> A and delta > 0, then

Z = Z_FRK * Z_osc,

where Z_FRK = exp(-C * R_{delta/2}(r)) links to the Fractal Risk Kernel of RRC, and Z_osc depends only on anchor-oscillator modes.

4 RESONANT INTERFERENCE LEMMA

LEMMA 2. Two anchor paths gamma, gamma' interfere destructively when

| S(gamma) - S(gamma') | > pi * hbar_s.

5 APPLICATIONS

5.1 Portfolio Entropy Estimation

RPIT assigns amplitudes to return trajectories; applying Theorem 1 gives closed-form entropy bounds tighter than classical Monte Carlo.

5.2 White-Bounce Quantisation

Coupling RPIT to the White-Bounce Inequality quantises allowable surface densities:

sigma_n = sigma_min + n * Delta_sigma,

Delta_sigma = hbar_s / (4 * pi * R_h^2).

6 OPEN CONJECTURES

1. Duality Conjecture: RPIT partition function equals a topological quantum field theory invariant on a 3-manifold built from anchor graphs.
2. Universality Conjecture: Any bounded nonlinear flow with a strange attractor admits an RPIT representation.
3. Holographic Conjecture: Anchor salience spectrum encodes an information-theoretic area law.

7 CONCLUSION

RPIT knits together symbolic salience, fractal finance, and quantum-style interference. It paves the way for computational experiments and potential empirical probes, e.g., neural-pattern resonance under anchor stimulation.

REFERENCES

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