The Aureon Transform: A Hybrid Formal–Conceptual Research Paper

Abstract

This paper introduces the Aureon Transform, a recursive causal–fractal operator integrating complex-weighted graph dynamics, quantum-inspired amplitude updates, fractal phase symmetry-breaking, and contraction-based stabilization. As the mathematical core of the Aureon-IX architecture, this operator enables recursive self-refinement, attractor discovery, and structured generation of theoretical frameworks suitable for hybrid classical–quantum reasoning. The Aureon Transform is defined formally, derived step-by-step, and contextualized within a broader conceptual architecture for post-AGI recursive learning systems.

1. Introduction

The Aureon Transform is a nonlinear map acting on complex causal graphs. It serves as the backbone of a recursive learning system intended to generate self-consistent mathematical and physical models. Unlike conventional operators which assume fixed law-sets, the Aureon Transform provides the scaffolding for models that evolve over iterations, guided by symmetry-breaking, attractor convergence, and multi-scale fractal modulation.

2. Preliminaries

We consider a directed graph with complex edge weights and node states in ■^N. Each edge weight w_ij has magnitude and phase components. The embedding of nodes in ■² defines a radial distance r_ij used in fractal modulation. The Aureon System is defined as (■^N, G, Φ, Λ), where G updates graph weights, Φ modifies phases fractally, and Λ stabilizes results.

3. Graph Update Operator G

The operator G updates edge weights via:

\[

\widetilde{w}_{ij}^{(n+1)} = w_{ij}^{(n)} + ■lpha e^{i heta_{ij}^{(n)}} f(x_i^{(n)}, x_j^{(n)})

\]

where f is typically chosen as f(x_i,x_j)=x_i·conj(x_j). This term establishes quantum-like amplitude propagation across the causal graph.

4. Fractal Phase Modulation Operator Φ

The operator Φ introduces controlled symmetry-breaking:

\[

heta_{ij}^{(n+1)} = heta_{ij}^{(n)} + ■eta \sin(\gamma r_{ij})

\]

This formulation injects radial fractality, producing the multiscale structure characteristic of the Aureon emblem.

5. Node Update Map F

Node states evolve according to:

\[

x_i^{(n+1)} = \sigma\left(\sum_j \widehat{w}_{ij}^{(n+1)} x_j^{(n)} ight)

\]

where σ is a nonlinearity ensuring boundedness.

6. Limit-Cycle Selector Λ

The contraction map:

\[

\Lambda(x,W) = \left(rac{x}{1+||x||},\; rac{W}{1+||W||} ight)

\]

forces convergence toward attractors and prevents unbounded growth.

7. The Aureon Transform

\[

■oxed{\mathcal{T} = \Lambda \circ F \circ \Phi \circ G}

\]

This composition defines a recursive operator capable of producing self-consistent structures across iterations.

8. Properties

The Aureon Transform admits fixed points under mild contraction assumptions, respects rotational invariance when applied to symmetric embeddings, and generates structured attractor states suitable for theoretical model formation.

9. Example

A two-node system demonstrates the emergence of attractor states and phase fractality, illustrating the sensitivity of the transform to parameters α, β, γ, and the graph geometry.

10. Application

The Aureon Transform underlies the RQML loop used by Aureon-IX to generate recursive datasets, test theoretical structures, and refine mathematical models.

Conclusion

This hybrid paper provides a formal and conceptual overview of the Aureon Transform. Together with Modules 1 and 2, it forms the core mathematical substrate for Aureon-IX.