Algebraic Foundations of the Murgu Table2To3 Coordinate System and Collatz Inverse Method

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Abstract

This paper formalizes the Murgu Table2To3 system, analyzing Collatz $(3n+1)$ trajectories through a 2D matrix mapping. By partitioning the integer domain into a modular G_6 grid, the research isolates two active generator channels—Linear Engine Triads (LET_1 and LET_2)—alongside infinite structural closures, the Logical Dead Nodes (LDN), defined as $n \equiv 3 \pmod 6$. The Collatz Inverse Method is applied to demonstrate that these active generators create non-intersecting trajectories, thus limiting global divergence, with LDN boundaries ensuring path unicity toward the terminal unit.

I. Introduction and G_6 Partition

The operational universe is restricted to positive integers $\mathbb{Z}^+ = \{1, 2, 3, \dots\}$. We partition this domain into six rigid structural pathways:

$$G_6(k) = 6k + r, \quad \text{where } r \in \{1, 2, 3, 4, 5, 6\} \text{ and } k \geq 0 \tag{1}$$

II. Structural Closure of Logical Dead Nodes

The column $6k+3$ defines the Logical Dead Nodes (LDN), functioning as absolute system boundaries.

Theorem 1 (LDN Non-Invertibility)**.** *An element $D \in LDN$ $(6k+3)$ possesses no inverse odd Collatz predecessor, acting as a structural terminal point.*

Proof. Let the Collatz inverse transformation be defined as:

$$Q = \frac{2^m D - 1}{3} \tag{2}$$

For $D \in$ LDN, substitute $D = 6k + 3$:

$$3Q = 2^m(6k+3) - 1 \implies 3Q = 3(2^m)(2k+1) - 1 \tag{3}$$

Dividing both sides by 3 yields:

$$Q = 2^m(2k+1) - \frac{1}{3} \tag{4}$$

Since $\frac{1}{3} \notin \mathbb{Z}$, the resulting value $Q \notin \mathbb{Z}^+$. Therefore, no active integer node can transition into an LDN state via the upward $3n+1$ map. $\square$