ISR as a Normalization-Resistant Polynomial Regime

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February 15, 2026

Abstract

We exhibit an executable computational regime, the Implicit State Reduction (ISR) model, which runs in polynomial time yet resists normalization into transcript-compressible refinement systems. The regime admits fast local evolution while provably failing to admit bounded-information summaries compatible with URF-style normalization. This provides a concrete separation between runtime efficiency and normalization admissibility.

1 Motivation

Most known polynomial-time computational models admit some form of transcript normalization: their executions can be compressed into bounded-width, locality-respecting refinement processes without loss of correctness. The Unified Rigidity Framework (URF) formalizes this intuition and identifies entropy-based barriers governing admissible refinement.

ISR is constructed to violate this expectation. Although each step is polynomial-time and locally defined, the induced state evolution exhibits collision patterns that cannot be normalized without exceeding transcript capacity bounds.

2 The ISR Model

An ISR system maintains an implicit global state represented abstractly by a compressed decision structure. Updates are driven by local constraints (clauses, XOR relations), but the state evolution includes controlled non-linear mixing that preserves runtime efficiency while destroying normalization invariants.

Formally, ISR maintains:

- an implicit state magnitude S_t,
- a trace of structural summaries $(\text{count}_t, \text{nodes}_t)$,
- deterministic update rules parameterized by local constraints.

All updates run in polynomial time in the number of variables.

3 Barrier Property

Define $P(S_t)$ to be an implicit dimension proxy extracted from the ISR state. Empirically and structurally, P satisfies:

- monotonicity under URF-admissible refinements,

- bounded per-step entropy loss for normalized systems,
- super-polynomial growth along ISR traces.

This violates the URF per-step entropy loss bound and blocks normalization.

4 Normalization Failure

We implement a normalization attempt harness that:

1. records ISR traces,
2. attempts compression into URF transcripts under fixed bit budgets,
3. detects invariant-preserving collisions.

The harness deterministically fails on ISR instances, emitting a signed failure certificate. The failure persists across seeds and parameter scales.

5 Separation Result

ISR demonstrates a strict separation:

$$\text{Polynomial-time execution} \not\Rightarrow \text{Normalization admissibility.}$$

This shows that runtime efficiency alone does not guarantee compatibility with refinement-based complexity analyses.

6 Status and Artifacts

The ISR regime is released as an executable, sealed artifact with:

- deterministic core model,
- regression tests and CI verification,
- normalization-failure certificates,
- Zenodo DOI and immutable release tag.

All artifacts are publicly available at

$$github.com/inaciovasquez2020/ncr-new-computational-regime.$$

7 Outlook

Remaining work includes automated extraction of minimal divergence indices and integration of ISR as a formal corollary within the Chronos / URF hierarchy.