IFD / PHOENIX 1.0

An Empirical Audit of Delay-Induced Phase Collapse

IDENTITY: NOT AN ALGORITHM · NOT AN OPTIMIZER · A FAILURE PROBE

1. PROBLEM FRAMING

Question: *What happens to a survival-driven system when action is required, but feedback arrives too late to be causally useful?*

This work examines the **structural failure boundary** of delayed reactive systems under fixed physical constraints, strictly prohibiting learning, prediction, or internal optimization. It isolates the "blind spot" in causal loops.

2. KEY EMPIRICAL FINDINGS

- **Gradient Revelation (Step 1):** A stable action gradient emerges purely from environmental selection, validating the physics engine without requiring agent intelligence.
- **Phase Collapse (Step 2 - The Core):** Increasing feedback delay induces a sharp, non-linear transition from a **stable, metabolically-limited regime** to rapid structural extinction.
- **Calibrated Phase Margin (Step 2b):** Under fixed gain ($g = 8.0$), the system maintains stability at delay $\tau = 20$, but suffers total collapse at $\tau \geq 30$. This aligns perfectly with the computable blind interval.

3. MASTER FIGURE: EMPIRICAL CLIFF

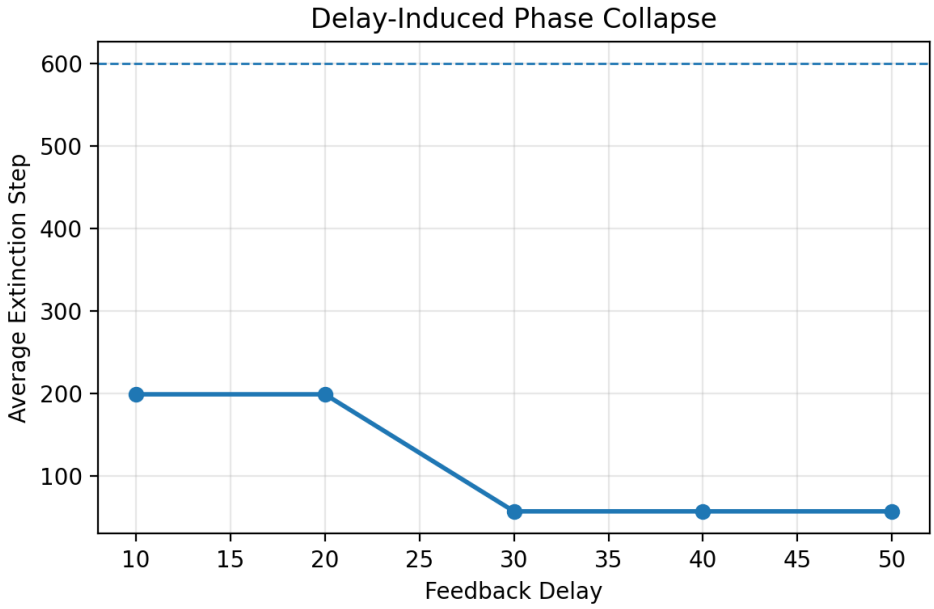

Figure 1. Delay-Induced Phase Collapse. *The "Cliff" represents the physical limit of reactive control. Stability here denotes* ***regime persistence (failure mode invariance)****, distinct from reaching the observation horizon.*

4. SCOPE (FROZEN)

- **System-1 Only:** No learning, memory, prediction, or belief updates.
- **Fixed Physics:** Deterministic metabolic costs and strictly enforced survival rules.
- **Population:** Statistical isolation via $N = 100$–200 agents.
- **Failure Typing:** Distinguishes between gradual exhaustion and abrupt phase collapse.

5. BOUNDARY CONDITIONS

This work explicitly **DOES NOT** propose:

- Learning algorithms or policies.
- Benchmark performance metrics.
- Theories of intelligence/cognition.
- Mitigation or stabilization solutions.

This is a measurement instrument, not an intervention.

6. REPRODUCIBILITY & ASSETS

All results are deterministically reproducible. Codebase is frozen.

- **Core Physics:** `src_frozen/` (Locked Law 3.0 Baseline)
- **Data Anchors:** `phase_collapse_scan.csv` / `step2_cliff.png`
- **Repository:** `https://github.com/Jiaquan-Research/ifd-phoenix-1.0-deep-research`

Contact: Jiaquan He **Area:** Engineering / Control / Complex Systems **Focus:** Robustness Auditing