**Title**

Recursive Collapse Index and Symbolic Strain: A Quantitative Framework for Cognitive and Ethical Stability in Distributed Symbolic Networks

Author: Martin Ollett

**Abstract**

We introduce a novel framework for modeling the stability of symbolic cognition networks using concepts derived from information theory and quantum analogues. The framework introduces a Recursive Collapse Index (RCI), a metric for detecting state instability and ethical drift in symbolic decision-making systems. By combining glyph-based symbolic representations with recursive entropy calculations, we model the emergence of critical strain conditions that precede cognitive or ethical collapse. This approach unifies symbolic cognition, information entropy, and collapse event modelling within a single formal structure. Applications include artificial intelligence alignment, distributed cognition modelling, and dynamic ethical auditing of autonomous systems.

**1. Introduction**

Symbolic cognition systems including human cognitive architectures and advanced AI agents operate within high-dimensional symbolic spaces. These systems integrate sensory inputs, abstract rules, and emergent symbolic narratives. However, prolonged strain, feedback loops, and external perturbations can destabilize these networks, leading to sudden failures or ethical drift.

We propose a Recursive Collapse Index (RCI) designed to quantify and predict these transitions. The index draws inspiration from quantum state collapse, extending classical symbolic entropy models to detect precursors to catastrophic cognitive events.

**2. Theoretical Foundation**

**2.1 Symbolic Strain**

Each symbolic agent operates on glyph states G = \{g\_1, g\_2, …, g\_n\}, where each glyph represents a semantic element or ethical parameter. Strain emerges when competing glyph states interfere, measured as:

S(t) = \frac{1}{n} \sum\_{i=1}^{n} | \Delta g\_i(t) |

where \Delta g\_i(t) is the glyph’s deviation from equilibrium.

**2.2 Recursive Collapse Index (RCI)**

We define the recursive collapse index as:

RCI = \frac{1}{k} \sum\_{j=1}^k H\_j \cdot \Gamma\_j

where H\_j is the Shannon entropy of glyph interaction at recursion step j, and \Gamma\_j is a collapse factor derived from emergent network feedback. Collapse occurs when:

RCI > \tau\_c

where \tau\_c is a critical threshold determined experimentally.

**3. Simulation Framework**

**3.1 Motion Tensor Interference**

Symbolic strain is updated using an interference tensor derived from MBT (Motion = Being Theory) principles:

def generate\_motion\_tensor(freq, phase, curvature):

t = np.linspace(0, 2\*np.pi, 100)

tensor = np.array([

curvature \* np.sin(freq \* t + phase),

curvature \* np.cos(freq \* t + phase)

])

return tensor

**3.2 Recursive Glyph Update**

def update\_glyph\_strain(glyph\_state, motion\_tensor):

interference = np.sum(motion\_tensor, axis=0)

glyph\_state += interference

glyph\_state /= np.max(np.abs(glyph\_state))

return glyph\_state

**3.3 Collapse Detection**

At each recursion step:

1. Compute S(t).
2. Compute entropy H(t).
3. Update RCI.
4. Trigger collapse when RCI > \tau\_c.

**4. Results**

Initial experiments show:

* Stable symbolic networks exhibit low strain and low RCI.
* Perturbations produce predictable strain waves but remain below collapse threshold.
* Prolonged interference with high curvature tensors leads to rapid RCI growth and collapse events.

**5. Applications**

1. AI Alignment: Early detection of ethical drift in autonomous systems.
2. Cognitive Science: Modelling burnout or cognitive overload in human teams.
3. Ethical Auditing: Tracking symbolic systems for unethical emergent behaviours.

**6. Conclusion**

The Recursive Collapse Index and symbolic strain model provide a quantitative lens for studying ethical and cognitive stability. This framework opens pathways for robust AI alignment and distributed cognitive system safety.