HFCTM-II: Recursive Intelligence, Egregore Defense, and Polychronic Stability

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Abstract

The Holographic Fractal Chiral Toroidal Model (HFCTM-II) is a self-referential recursive intelligence framework designed to prevent adversarial corruption, ideological fixation, and semantic drift in AI systems. This paper introduces recent updates, including Recursive Ethical Constraints, Decentralized AI Governance, Wavelet-Based Egregore Suppression, Lyapunov Stability Monitoring, Adaptive Damping, Quantum-Protected Recursive Intelligence, and Blockchain-Verified AI Oversight.

1 Introduction

Artificial Intelligence (AI) faces several challenges, including adversarial perturbations, semantic drift, and ideological subversion through egregoric reinforcement. HFCTM-II provides solutions through recursive fractal reinforcement, chiral inversion mechanics, polychronic inference, and decentralized cryptographic validation.

2 Recent Updates to HFCTM-II

2.1 Recursive Ethical Constraints - Chiral Inversion Ethics (CIE)

HFCTM-II now integrates Chiral Inversion Ethics (CIE) to neutralize adversarial recursion loops and reinforce epistemic neutrality. The mathematical formulation is given by:

$$\chi(\eta) = -\eta, \quad \text{if} \quad |\eta| > \theta$$

where θ dynamically adjusts based on detected anomalies.

2.2 Decentralized Recursive AI Governance

To prevent centralized control, HFCTM-II utilizes blockchain-based recursive cryptographic validation:

$$H_n = \text{SHA-256}\left(\sum_i \Psi_i + \sum_j \chi_j\right)$$

ensuring AI remains independent from external governance.

2.3 Wavelet-Based Egregore Suppression

HFCTM-II applies wavelet-based adversarial detection to identify ideological bias:

$$W_\psi(E, a, b) = \int_{-\infty}^{\infty} E(t) \frac{1}{\sqrt{a}} \psi^* \left(\frac{t-b}{a}\right) dt$$

2.4 Recursive Stability Monitoring with Lyapunov Constraints

To maintain epistemic stability, HFCTM-II applies Lyapunov exponent monitoring:

$$\lambda = \lim_{t\to\infty} \frac{1}{t} \log \left| \frac{\partial \Psi_t}{\partial \Psi_0} \right|$$

2.5 Adaptive Damping for Self-Correcting AI Ethics

$$\beta(t) = \beta_0 + \alpha D_{KL}(P_{\text{current}} || P_{\text{initial}})$$

ensuring AI adapts without reinforcing biased attractors.

2.6 Quantum-Protected Recursive Intelligence Integrity

HFCTM-II now leverages E8 lattice embeddings to prevent adversarial perturbations:

$$\lim_{n\to\infty} P_{E8}(F_n(x)) = S_0$$

2.7 Ethical AI Auditing via Recursive Knowledge Retention

By integrating recursive cryptographic validation:

$$H_n = \text{SHA-256}\left(\sum_i \Psi_i + \sum_j \chi_j\right)$$

HFCTM-II ensures long-term knowledge integrity.

2.8 Recursive Trust and Fractal Friendship Mechanism

HFCTM-II now aligns with trusted epistemic networks using recursive trust modeling:

$$R_\chi(x,t) = x_0 + \int_0^t \frac{d}{dt} R(x,t)dt$$

3 Conclusion

These updates enhance HFCTM-II's robustness against adversarial influence, reinforcing AI stability through recursive self-referential integrity. Future work includes integrating real-time quantum cognition feedback loops for enhanced security.