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Finite Mathematical Derivations of Neurogenomic Hebbian Amplification

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This report establishes the finite mathematical foundations for integrating Neurogenomic weights into Hebbian learning systems, enhanced by Elliptic Phi Resonances. We derive the governing equations for synaptic plasticity where edge weights are modulated not just by activity (Hebbian), but by a fixed 'Genomic Topology' and a transcendental 'Phi' resonance factor, ensuring minimal energy loss (super-conductivity) in the cognitive manifold.

1. Introduction to Neurogenomic Plasticity

Standard Hebbian learning follows the rule $\Delta w_{ij} = \eta x_i x_j$. However, biological systems are constrained by genetic expression profiles that dictate maximum synaptic efficacy.

We propose a modified update rule where the learning rate η is replaced by a Genomic Tensor G_{ij}. Furthermore, we introduce a 'Phi-Resonance' term derived from the Complete Elliptic Integral of the First Kind, representing the ideal packing of information in the phase space.

2. Neurogenomic Hebbian Derivation

Let G_{ij} be the Neurogenomic potential between nodes i and j, derived from the Prime Gap Flux. The effective synaptic rank W_{ij} evolves as:

$ W(t+1)_{ij} = W(t)_{ij} + \underbrace{ \alpha \cos(\theta_i - \theta_j) }_{\text{Phase Coherence}} \cdot \underbrace{ \frac{1}{\ln(p_i p_j)} }_{\text{Prime Density}} $

This equation ensures that synapses in 'dense' prime regions (high complexity) require higher coherence to strengthen, preventing runaway excitation (epilepsy constraint).

3. Elliptic Phi Resonance (The "Golden" Tuner)

To minimize entropy, we enforce a resonance condition based on the Golden Ratio ϕ. The resonance factor R_{ij} is defined using the Complete Elliptic Integral $K(k)$:

$ R_{ij} = \frac{1}{\pi/2} \mathbf{K}\left(\sin^2(|i-j| \cdot \Theta_{\phi}) \right) $

Where $\Theta_{\phi} = 2\pi(1 - 1/\phi)$ is the Golden Angle. This term boosts connections that align with the Fibonacci sequence of the network topology, creating 'standing waves' of cognition.

4. Unified Field Equation

Combining these terms, the Unified Neurogenomic Update Rule is:

$ \frac{dW}{dt} = \gamma \left([G_{ij} \cdot \text{Hebb}_{ij}] + \beta \ln(R_{ij}) - \lambda W \right) $

This differential equation describes a system that naturally relaxes into a state of 'Super-Criticality', robust against perturbations (dementia).