Propagation Sign-State Theory

This document formalises a minimal propagation system combining energy, perturbation, and directional state.

Definitions

State: $S_k = (d_k, m_k, E_k, \varepsilon_k)$

$d_k \in \{-1,0,+1\}$ (backward, balanced, forward)

$m_k \in \{0, \Sigma, \infty\}$ (zero, finite, infinity)

$E_k \geq 0$ is energy

ε_k is perturbation

Core Equations

$P_k = c\blacksquare\ \varepsilon_k - c\blacksquare\ |v_k|$

$E_{k+1} = E_k + P_k$

$\varepsilon_{k+1} = c\blacksquare\ \varepsilon_k + c\blacksquare\ P_k$

$d_{k+1} = \text{sign}(P_k)$

Magnitude Classification

$m = 0$ if $E \leq E_{min}$

$m = \Sigma$ if $E_{min} < E < E_{max}$

$m = \infty$ if $E \geq E_{max}$

Propagation Grid

←0	0	→0
←Σ	Σ	→Σ
←∞	∞	→∞

Interpretation

Horizontal axis: direction (backward, balanced, forward)

Vertical axis: magnitude (zero, finite, infinity)

$P_k > 0 \rightarrow$ forward propagation

$P_k \approx 0 \rightarrow$ balanced

$P_k < 0 \rightarrow$ backward

Proposition

If c■ $\varepsilon_k >$ c■ $|v_k|$ then energy grows (forward).

If c■ $\varepsilon_k \approx$ c■ $|v_k|$ then energy stabilises (balanced).

If c■ $\varepsilon_k <$ c■ $|v_k|$ then energy decays (backward).