

## Propagation Sign-State Theory (Summary)

A propagation state is defined by:

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

Where:

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

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

$E_k$  is energy

$\varepsilon_k$  is perturbation

Propagation score:

$$P_k = c_1 \varepsilon_k - c_2 |v_k|$$

Energy update:

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

Perturbation update:

$$\varepsilon_{\{k+1\}} = c_3 \varepsilon_k + c_4 P_k$$

Direction:

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

Magnitude class:

0 if E small,  $\Sigma$  if bounded,  $\infty$  if large

Nine propagation states:

$$\leftarrow 0, 0, \rightarrow 0$$

$$\leftarrow \Sigma, \Sigma, \rightarrow \Sigma$$

$$\leftarrow \infty, \infty, \rightarrow \infty$$

Interpretation:

- Negative  $P_k \rightarrow$  backward (decay)
- Near zero  $\rightarrow$  balance (loop/stability)
- Positive  $P_k \rightarrow$  forward (growth)

Zero and infinity are not points but directional regimes.

This defines a minimal propagation system combining energy, perturbation, and direction.