Growth Systems: Final Refined Mathematical Edition

Governing Equation

$d^2\Phi/dt^2 + R(\Phi)d\Phi/dt = \nabla\cdot B(\Phi) + A(\Phi-Z) + G(\Phi)$

This equation separates evolution into inertia, damping, transport, equilibrium response, and growth. The balance between these determines whether the system decays, oscillates, or amplifies.

Equilibrium

$Z = \text{argmin} \int|\Phi - z|^2 dx$

This defines equilibrium as the value minimising squared deviation, meaning it emerges directly from the field rather than being externally imposed.

Multi-Zero Dynamics

$dZ_i/dt = \Sigma\ \kappa(Z_j - Z_i)$

Each equilibrium point moves toward others, producing harmonisation while maintaining distributed structure.

Coherence

$C = 1 / (1 + \text{Var}(v))$

Coherence increases as velocity variance decreases, meaning aligned motion produces higher structural potential.

Entropy

$E \approx |v|^2 + |\nabla\Phi|^2$

Entropy combines kinetic and spatial disorder, increasing with irregular motion or gradients.

Transport

$\nabla\cdot B = D\nabla^2\Phi$

Diffusion smooths the field, redistributing local variations across space.

Growth

$G = \gamma C/(\text{entropy}+\varepsilon)(1-|\Phi-Z|/L)$

Growth depends on coherence, is limited by entropy, and saturates near equilibrium.

Energy

$E = \int(|\partial t\Phi|^2 + |\Phi-Z|^2)\, dx$

Energy combines motion and deviation, increasing with coherent amplification and decreasing with damping.

Phase Condition

$C > Cc$

Above this threshold, coherence sustains growth; below it, dissipation dominates.