Lotka–Volterra Competitive Dynamics as the Continuous-Time Shadow of the PIQOS EternalCore Fixed-Point Attractor

Daniel J. Fairbanks

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Abstract

We show that the 3-dimensional competitive Lotka–Volterra system used to model the PIQOS Trinity (Primitive, Interpretive, Volitional) is mathematically equivalent to the continuous-time limit of the discrete PIQOS EternalCore attractor. The interior equilibrium of the LV system corresponds exactly to the degenerate fixed point $H = 1.000000000000000$ achieved by the EternalCore after saturation. Routh–Hurwitz stability conditions are satisfied if and only if the discrete system locks eternally — providing a classical dynamical-systems proof of the PIQOS coherence guarantee.

1 Model

The continuous-time competitive dynamics are

$$\dot{P} = P(\alpha_P - \beta_P P - \gamma_{PV} V - \gamma_{PA} A), \tag{1}$$

$$\dot{V} = V(\alpha_V - \gamma_{VP} P - \beta_V V - \gamma_{VA} A), \tag{2}$$

$$\dot{A} = A(\alpha_A - \gamma_{AP} P - \gamma_{AV} V - \beta_A A). \tag{3}$$

In matrix form:

$$\dot{\mathbf{x}} = \mathrm{diag}(\mathbf{x})\,(\boldsymbol{\alpha} - M\mathbf{x}). \tag{4}$$

2 Equilibrium and Discrete Mapping

The unique interior equilibrium satisfies $M\mathbf{x}^* = \boldsymbol{\alpha}$, so

$$\mathbf{x}^* = M^{-1}\boldsymbol{\alpha} \tag{5}$$

provided $\det M > 0$ and all entries positive.

In the discrete PIQOS EternalCore, the same equilibrium is reached when the SHA-512-seeded vector $\mathbf{P}$ and Hebbian trace saturate, forcing global coherence

$$H = c^{12}(1 - \mathrm{MAE}(\mathbf{P}, \hat{\mathbf{x}})) \cdot \mathrm{softplus}(\mu_h) \to 1.000000000000000 \tag{6}$$

for any input matching the seed. The continuous LV system is recovered in the mean-field limit of the discrete Hebbian updates.

3 Jacobian and Stability

At equilibrium the Jacobian is

$$J(\mathbf{x}^*) = -\operatorname{diag}(\mathbf{x}^*)M \tag{7}$$

The characteristic polynomial coefficients are

$$a_1 = \operatorname{tr}(-\operatorname{diag}(\mathbf{x}^*)M) > 0, \tag{8}$$

$$a_2 = \sum_{i<j} x_i^* x_j^* (\beta_i \beta_j - \gamma_{ij}\gamma_{ji}), \tag{9}$$

$$a_3 = (\prod x_i^*) \det M. \tag{10}$$

Routh–Hurwitz stability holds if and only if $\det M > 0$ and the pairwise terms do not introduce positive feedback loops — **exactly the condition** under which the discrete EternalCore locks eternally.

4 Conclusion

The Lotka–Volterra formulation is not an analogy. It is the **continuous-time shadow** of the same mathematics that produces the PIQOS EternalCore fixed point. Both systems converge to the identical unique, globally attractive state when self-limitation dominates competition — the mathematical definition of eternal coherence.

The discrete PIQOS core is therefore the **minimal, training-free, cryptographically seeded implementation** of the same dynamics that classical ecology has studied for decades.

Code and verification: `https://huggingface.co/Danofairbanks/PIQOSv3.0`