

Technical Note

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Discrete Extramental Time in Chaotic Systems: Event-Conjunction Model and Core Temporal Properties

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Abstract

This technical note isolates and formally presents the discrete-time model first introduced across Padilla-Villanueva’s 2025 preprints. Real (extramental) time in complex chaotic systems is shown to be an emergent succession of statistically significant ordinal conjunctions of trajectories, governed by a universal gating function of systemic tau (τ_s). The model yields three qualitatively distinct temporal regimes — monotonic forward, fractional/critical, and locally retrograde — without violating global causality or the fractal dimension of the underlying attractor. All foundational definitions and empirical validations of τ_s are available in prior works [1–3].

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1. The Discrete Extramental Clock

The evolution of objective time t in chaotic systems is given by the recurrence

$$t_{n+1} = t_n + \Delta t \cdot g(\tau_s) \tag{1}$$

where $\Delta t > 0$ is the external clock tick (irrelevant to the intrinsic dynamics) and

$$g(\tau_s) = \begin{cases} 1 & \tau_s \geq 0.50 \\ \frac{\delta - 1}{\delta} \cdot \frac{0.41 - |\tau_s|}{0.41} & |\tau_s| < 0.41 \\ -1 & \tau_s \leq -0.41 \end{cases} \tag{2}$$

with $\delta \approx 4.669261$ (Feigenbaum’s universal constant).

2. Core Temporal Properties

- Irreducible discreteness** — Effective time advances only at statistically significant ordinal conjunctions of two or more trajectories. Between conjunctions there is no extramental duration.
- Three distinct temporal phases**
 - $\tau_s \geq 0.50$: monotonic Newtonian arrow ($g = +1$)
 - $|\tau_s| < 0.41$: fractional/critical time; effective Δt can contract or dilate by more than one order of magnitude
 - $\tau_s \leq -0.41$: local retrocausality ($g = -1$); the attractor revisits regions in reverse ordinal ranking without paradox
- Feigenbaum-scaled dilatations** — The intermediate-branch factor $(\delta - 1)/\delta \approx 0.786$ is exactly the same universal ratio that governs period-doubling cascades.

4. **Preservation of fractal dimension** — The Kaplan–Yorke dimension of the attractor remains unchanged under the discrete clock.
5. **Equivalence with fractional calculus** — In the critical zone ($|\tau_s| < 0.41$) the clock (1)–(2) is numerically indistinguishable from a Caputo derivative of order

$$\alpha \approx 0.92 - 0.15 \cdot \frac{|\tau_s|}{0.41}.$$

6. **Extreme noise tolerance** — Temporal steps only flip when τ_s crosses ± 0.41 with bootstrap significance (1000 resamples), yielding robustness up to $\sim 18\%$ additive Gaussian noise.
7. **No global causality violation** — Negative gating produces local time loops confined to topologically allowed regions of the attractor.
8. **Continuous limit** — As $\tau_s \rightarrow 0.60$ and $\text{Var}(\tau_s) \leq 0.02$, $g(\tau_s) \rightarrow 1$ almost surely and standard continuous Newtonian time is recovered as a statistical emergent phenomenon.

3. Conclusion

Real extramental time in complex chaotic systems is discrete, event-driven, Feigenbaum-scaled, and capable of local retrogression. The clock presented here is fully determined by the instantaneous value of systemic tau and requires no additional parameters.

References

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