# On the Possible Influence of Metric Perturbations on Neural Tract Timing

Aman Chawla

13 February, 2026

**Abstract**

This note explores, at a preliminary and computational level, whether weak gravitational metric perturbations could in principle induce measurable changes in neural tract timing. Using a previously developed geometric model of interacting axons, we examine how variation in radial distance from a pulsating gravitational source affects action potential initiation times. The results indicate small but systematic timing shifts as a function of distance. While the physical magnitudes involved are extremely small and no biological claim is made, the analysis suggests a conceptual possibility: that spacetime geometry, under certain modeled conditions, could act as a modulator of neural timing.

## 1 Introduction

Neural computation is highly sensitive to timing. Millisecond-scale variations in action potential initiation and propagation can significantly alter network-level behavior. Traditionally, such timing variability is attributed to synaptic, ionic, or structural factors intrinsic to the nervous system. In this work, we consider a more speculative external factor: weak metric perturbations arising from gravitational radiation.

The present analysis does not claim biological relevance under terrestrial conditions. Instead, it investigates whether, within a computational model, distance-dependent metric perturbations could systematically influence axon tract timing.

## 2 Model Background

In earlier work [1, 2], we developed a geometric framework for simulating interacting axons embedded in a field-influenced environment. The present study modifies that framework to incorporate distance-dependent perturbations derived from standard treatments of gravitational radiation [3].

Specifically, we examine a tract consisting of $N = 4$ axons and compute action potential initiation times as a function of radial distance $r$ from a modeled pulsating source. The gravitational wave frequency is fixed at $2 \times 10^{-3}$ Hz for simulation purposes. The source mass parameter is scaled to maintain numerical stability.

## 3 Results

The simulations indicate that action potential initiation times vary systematically with radial distance from the source. Over a change in distance of approximately $2 \times 10^{10}$ meters (20 million kilometers), one axon exhibited a timing difference on the order of 0.2 milliseconds.

This magnitude is small but nonzero within the computational framework. The variation appears as a smooth function of radial displacement rather than numerical noise.

It is important to emphasize that these values arise under idealized and scaled parameters. The model does not attempt to represent a specific biological organism or astrophysical environment.

## 4 Interpretive Considerations

For context, Earth's orbital distance from the Sun varies by approximately $5 \times 10^9$ meters between perihelion and aphelion. Under realistic solar gravitational wave emission, the predicted effects would be orders of magnitude smaller than those modeled here. Consequently, no claim is made that human neural systems are measurably influenced by such effects.

However, as a conceptual exercise, the model raises a general question: if neural timing is sensitive to geometric perturbations, could extreme astrophysical configurations yield detectable modulation? For example, in environments with stronger gravitational radiation or larger orbital variations, would distance-dependent metric fluctuations become a non-negligible component of neural timing variability?

These questions remain speculative. The present work merely demonstrates that within a geometric simulation, timing shifts can arise from distance-dependent metric perturbations.

## 5 Limitations

Several limitations must be noted:

- The gravitational parameters are scaled for numerical tractability.
- Biological noise sources are not modeled.
- The tract model is simplified and does not represent full neural network complexity.
- No empirical measurements are provided.

Therefore, the results should be interpreted as exploratory rather than predictive.

## 6 Conclusion

The computational results suggest that, in principle, weak metric perturbations can induce small but structured changes in neural tract timing within a geometric axon model. While the physical plausibility under known biological and astrophysical conditions is extremely limited, the analysis highlights a broader conceptual point: neural timing models embedded in curved spacetime may exhibit distance-dependent modulation.

Future work would require more realistic astrophysical parameters, robust numerical treatment, and careful assessment of signal-to-noise constraints before any biological interpretation could be considered.

## References


[1] A. Chawla, S. Morgera, and A. Snider, "On axon interaction and its role in neurological networks," *IEEE/ACM Transactions on Computational Biology and Bioinformatics*, 2019.

[2] A. Chawla, S. D. Morgera, and A. D. Snider, "Fields, geometry, and their impact on axon interaction," *Journal of Applied Mathematics and Physics*, 9(4):751–778, 2021.

[3] W. L. Burke and K. S. Thorne, "Gravitational radiation damping," in *Relativity: Proceedings of the Relativity Conference in the Midwest*, Springer, 1970.