How Internodal Spacing Modulates Saltatory Ephaptic Information Flow

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Abstract

In this note, the authors simulate action potential propagation in a tract of two ephaptically coupled axons under different conditions of identical internodal spacing and find that this plays a critical role in information propagation.

We modify the model in [1] so that the internodal spacing on both axons in the tract is not fixed. In any biological system the internodal spacing will show slight variations from nodal pair to nodal pair. In this note we exaggerate these differences and study a few different types of internodal spacing profiles. These include: linear growth, exponential growth, exponential decay and so on. The figures below are self explanatory. Each shows the voltage on the vertical axis and time on the horizontal axis in both subplots. Each subplot shows one or more nodal voltage profiles for that axon's corresponding internodal spacing profile.

References

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

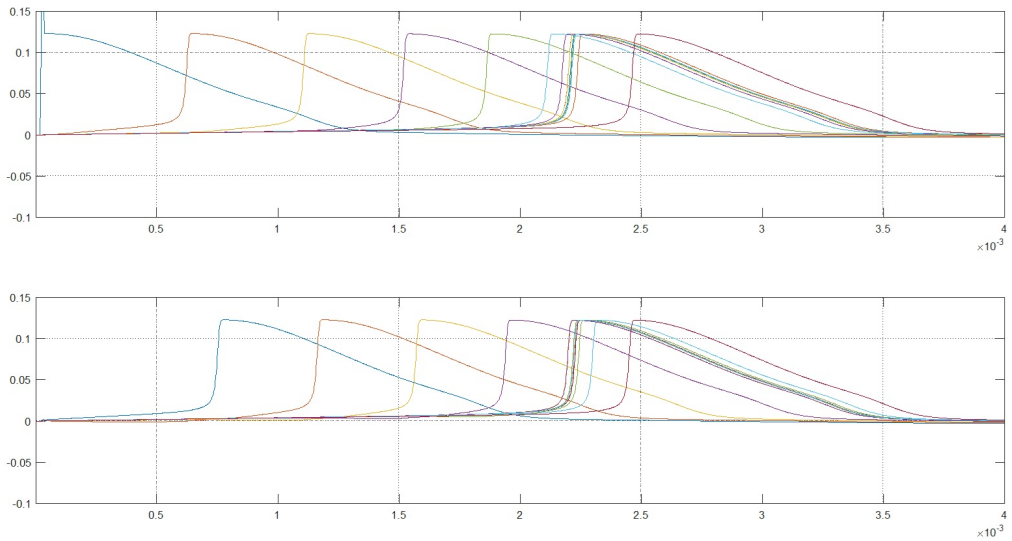

Figure 1: Baseline ephaptic information flow in equidistant nodes of two coupled axons.

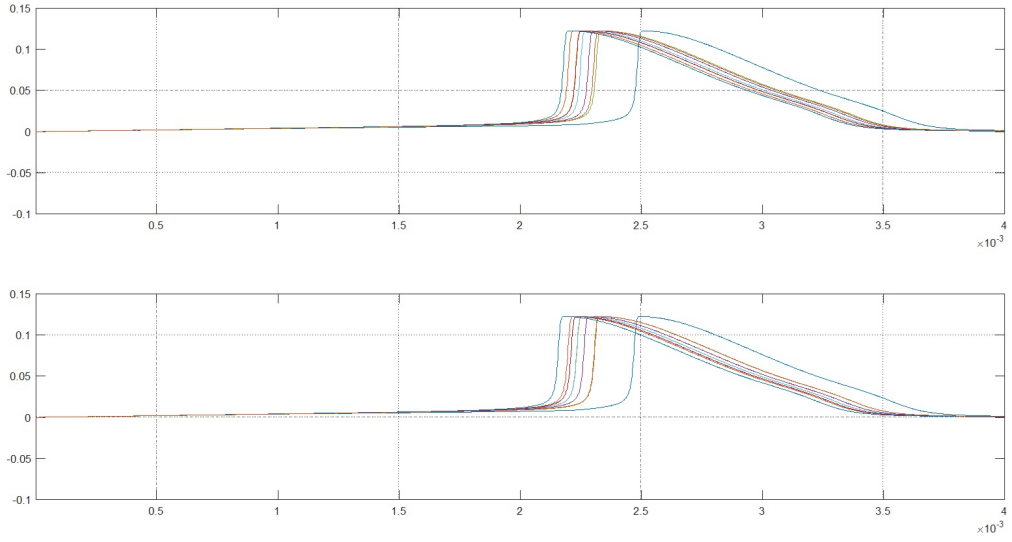

Figure 2: Sinusoidal.

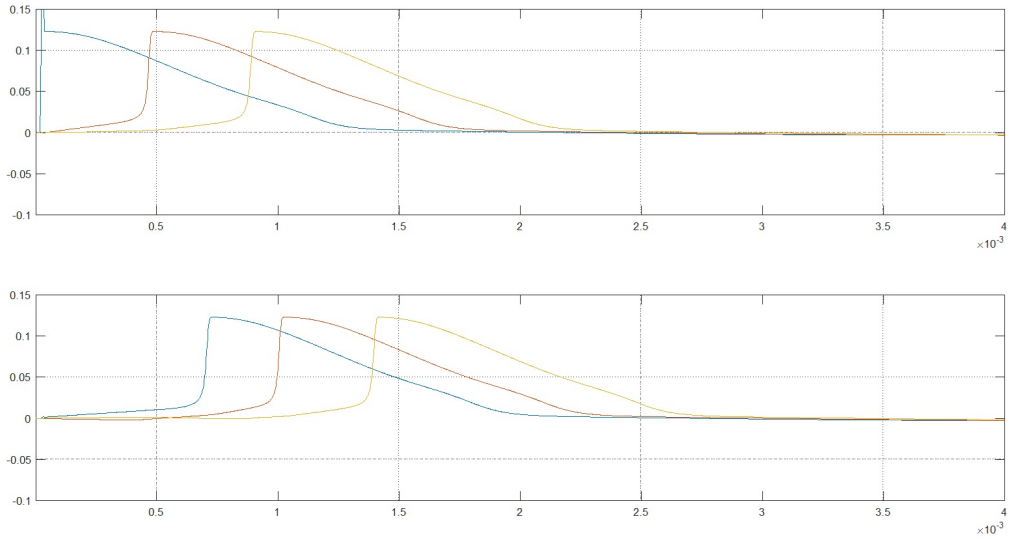

Figure 3: Exponential Decay.

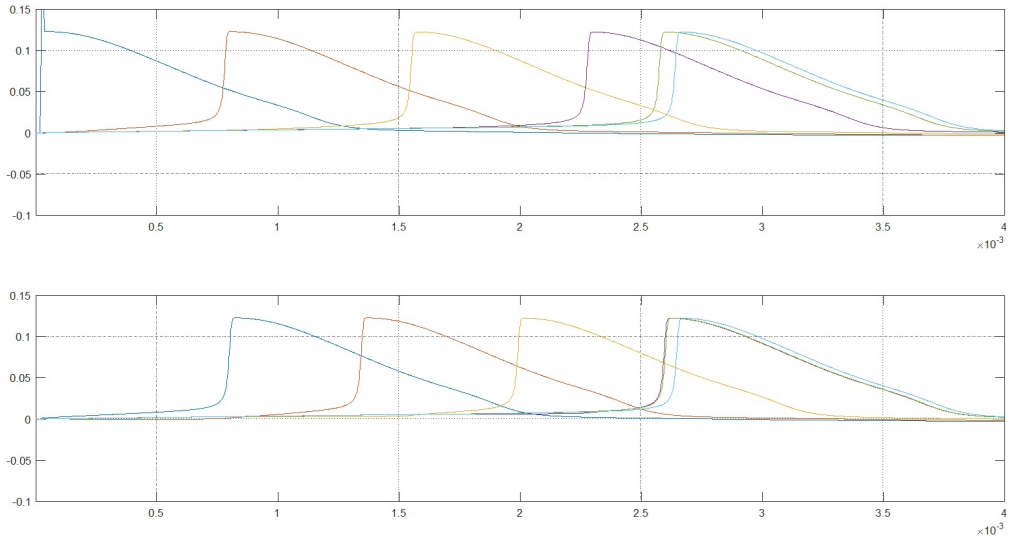

Figure 4: Exponential Growth.

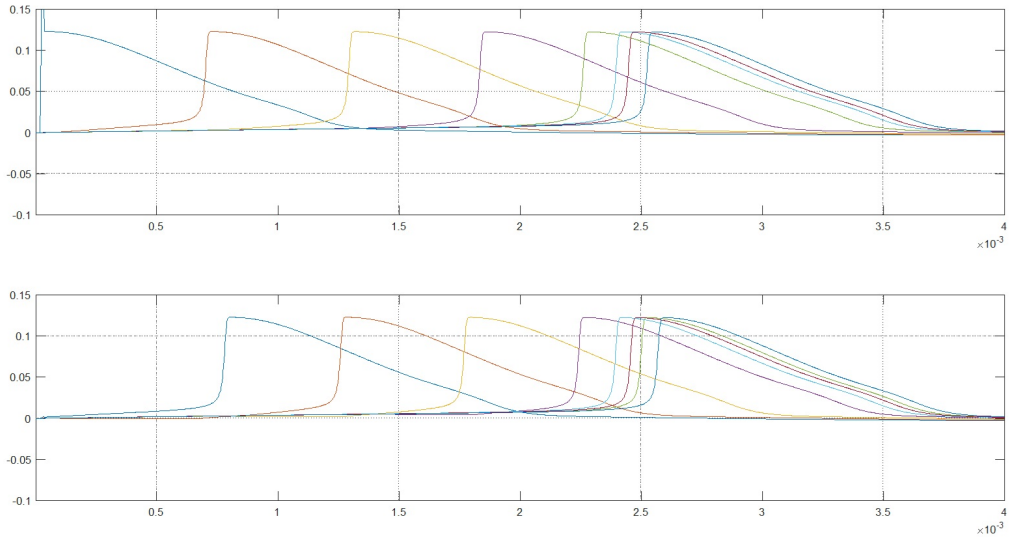

Figure 5: Linear growth.

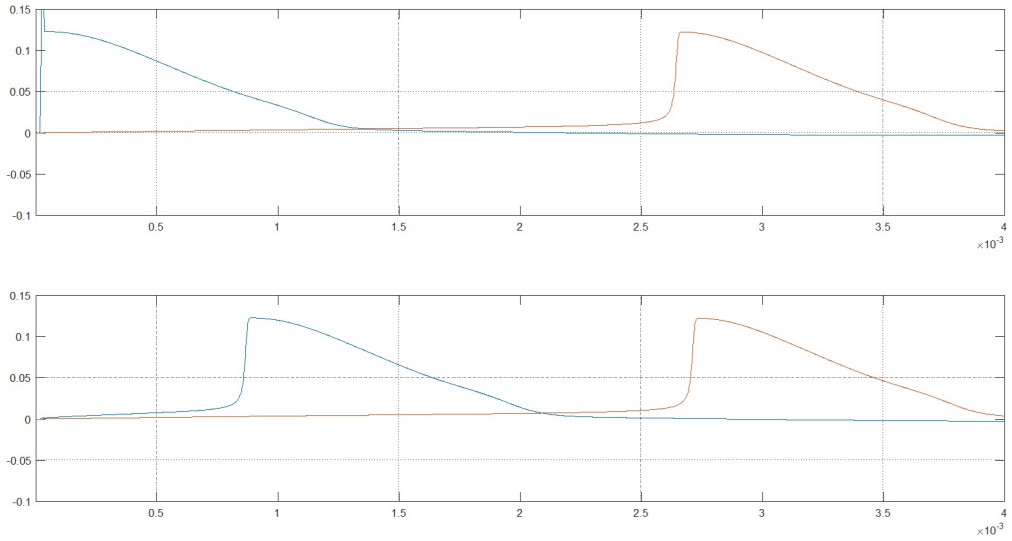

Figure 6: Quadratic Growth.

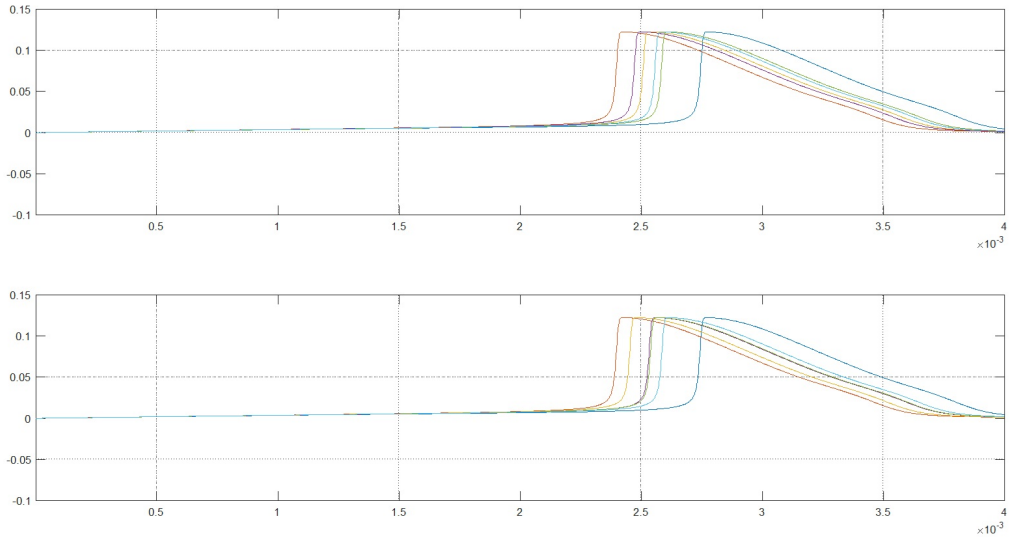

Figure 7: Logarithmic growth.

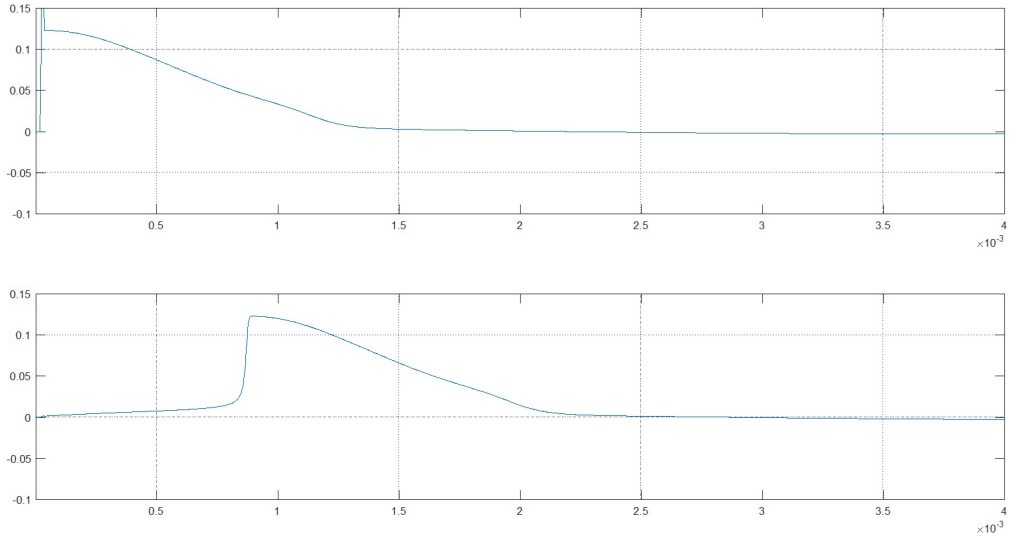

Figure 8: Cubic growth.

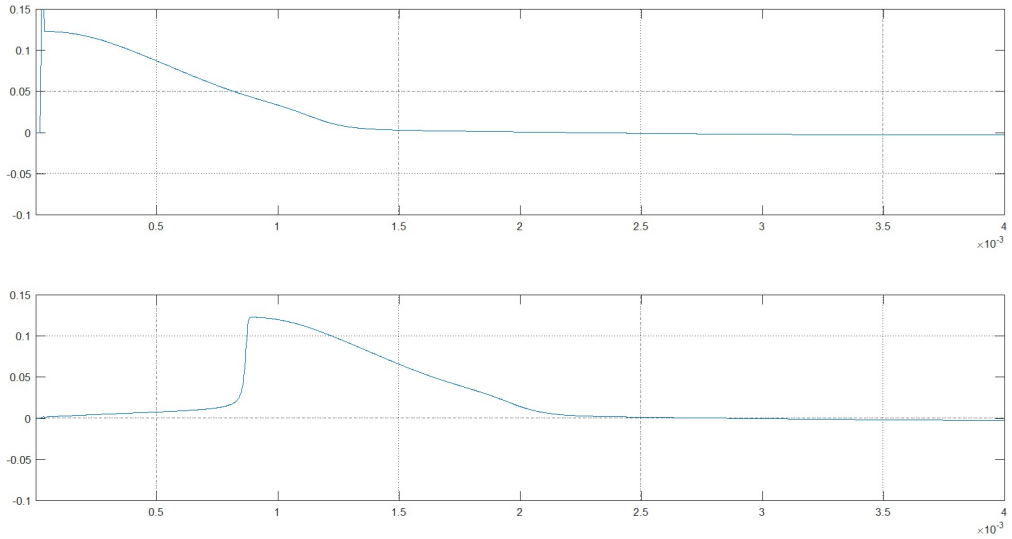

Figure 9: Harmonic growth.

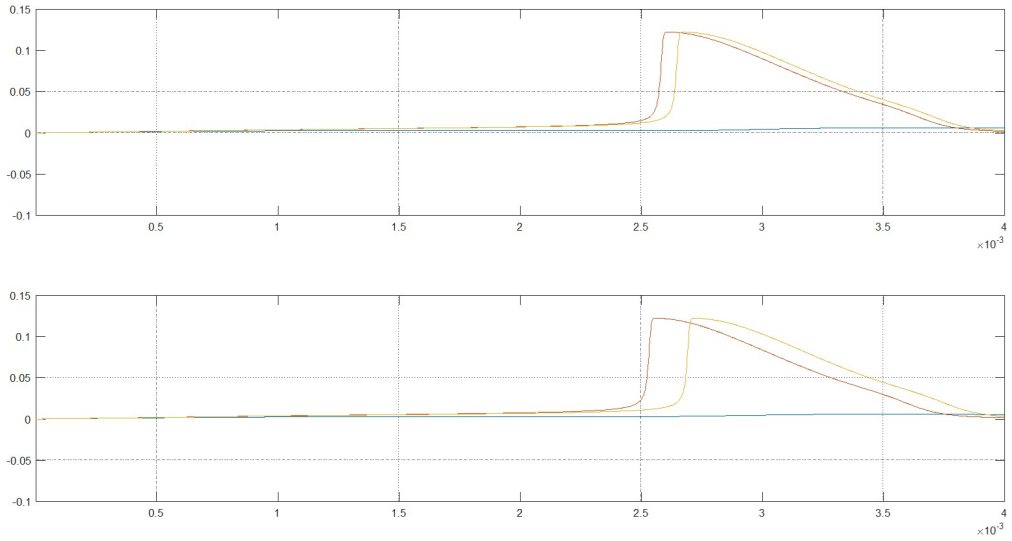

Figure 10: Custom polynomial growth.