

# MODEL PROBLEMS IN EPHAPTIC INTERACTION

AMAN CHAWLA

**ABSTRACT.** In this brief paper, the authors present a handful of model problems in axon-axon interaction.

Axons can interact with one another. This is being currently studied in the neuroscience community. In [1, 2], the authors proposed current-mediated coupling between axons which led to synchronization in their rhythms. Further, three-dimensional geometry was introduced to better model realistic tracts in [2, 3]. In the present paper, we take the model so developed, and based on it, present a few problems or examples which one should be able to tackle based on the understanding gained from the aforementioned references.

**Problem 1.** If three axons are inclined at  $\theta_1$ ,  $\theta_2$  and  $\theta_3$  degrees with an inter-axonal configuration matrix  $W'$ , it is proposed to find the law of inward electric field at any given node of any axon.

**Exercise 2.** Hence (ibid.) the induced inward current at any given node of any axon.

**Problem 3.** By combination of the relevant nodally induced inward currents, it is proposed to find the new current balance law for the insulated tract.

**Exercise 4.** Hence (ibid.) for a semi-insulated tract.

**Problem 5.** Using the new current balance law it is proposed to rederive the ephaptic propagation equation for the tract.

**Exercise 6.** And, to perform relevant simulations.

**Problem 7.** It is proposed to use mathematical induction or a direct derivation to find the current balance law for a general  $N$  number of axons.

## REFERENCES

- [1] Aman Chawla. *On Axon-Axon Interaction via Currents and Fields*. PhD thesis, University of South Florida, 2017.
- [2] 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.
- [3] Aman Chawla, Salvatore D. Morgera, and Arthur D. Snider. Fields, geometry, and their impact on axon interaction. *Journal of Applied Mathematics and Physics*, 9(4):751–778, 2021.