

Towards a MIMO Analysis of Ephaptic Communications

Aman Chawla

May 5, 2025

Abstract

In this note, the authors introduce a view of ephaptic communications which is analogous to the multiple-input multiple-output or MIMO setting studied in classical information theory.

Consider two axons placed next to one another. The nodes may be misaligned. Treat each node on each axon as a transmitter and receiver. This constitutes the MIMO system, with axon 1 as the input and the axon 2 as the output. We take a few first steps in reconstructing the transmission lengths geometrically, in Figure 1.

This is essential if we are to construct the MIMO channel matrix and apply research results from information theory to the ephaptic coupling channel. This work has implications for finding the fundamental limits of biological communication systems. Considering our rich repository of prior work on ephaptic coupling, it should be feasible to study the MIMO aspect in various settings, both theoretically and via simulations.

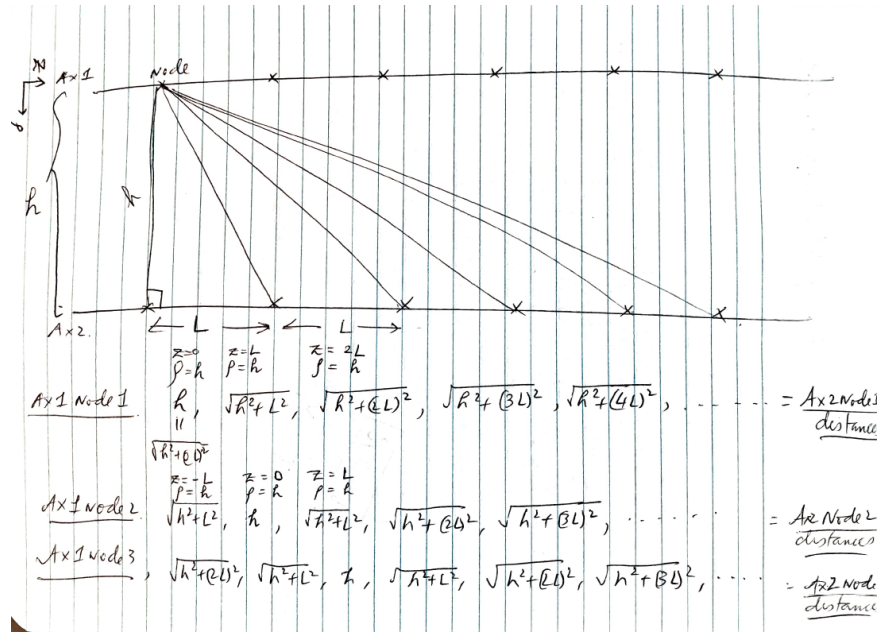


Figure 1: Two axons mimicking a MIMO setup.