

Extracellular potentials of coherently stimulated populations of parallel axons

Thomas McColgan, Hermann Wagner, Richard Kempter

January 30, 2015

Introduction

- EFPs have recently been shown to be not only of synaptic origin
- The aim of this study is to understand how the EFP is influenced by the anatomical structure of the axons which are the source of the potential.

Methods

- Experimental Methods
- Multicompartment Model
- Analytical Model

Results

- General results for axonal projections:
 - We can identify two main frequency components which show distinct behaviour
 - The low-frequency component is governed by the local density of bifurcations and terminations
 - The high-frequency is governed by the local fiber density
 - The low-frequency component exceeds the high-frequency component in reach
- Results specific to projections with distinct bifurcation and termination zones (like NL):
 - Low-frequency component is dipole-like, cancels out in the middle.
 - The high-frequency component shows a steady increase in latency with depth, while the low-frequency is stationary

Discussion

- Relevance of Findings
 - Interpretation of CSD
 - Dipole has far field, ABR response?
- Compare to other auditory systems (Chicken NL, MSO)
 - Speculate on functional relevance of polarity shift (a la Rinzel & Goldwyn)
- compare to other fiber bundle systems

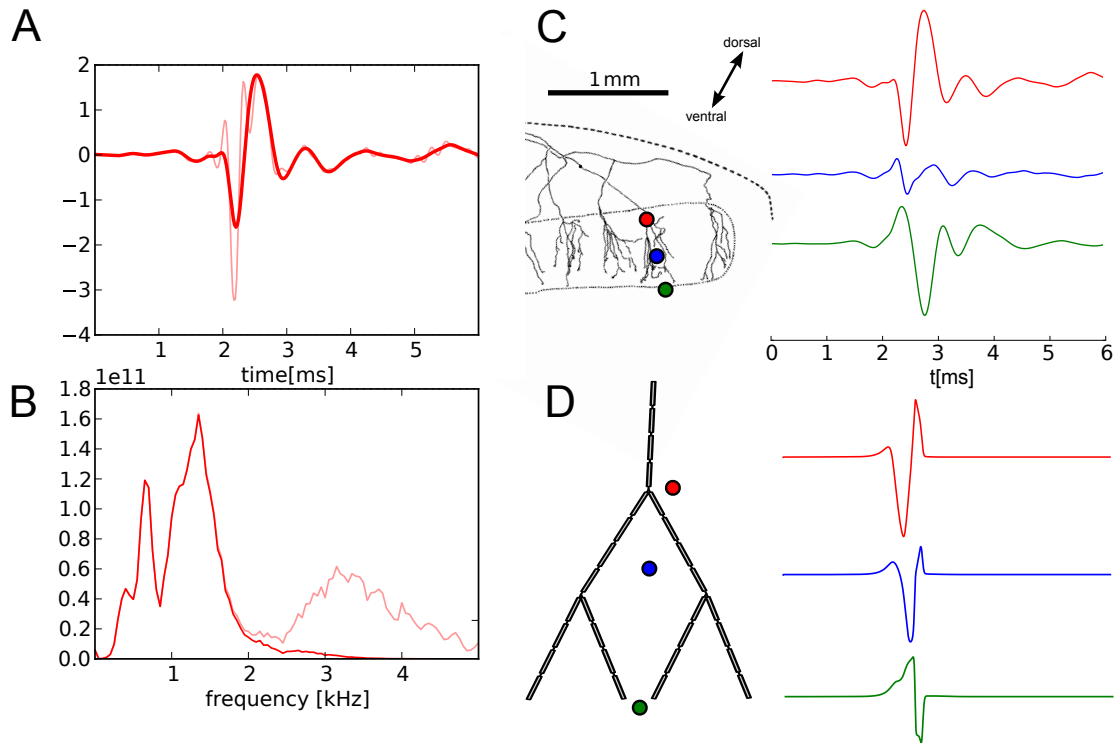


Figure 1: Introduction Figure

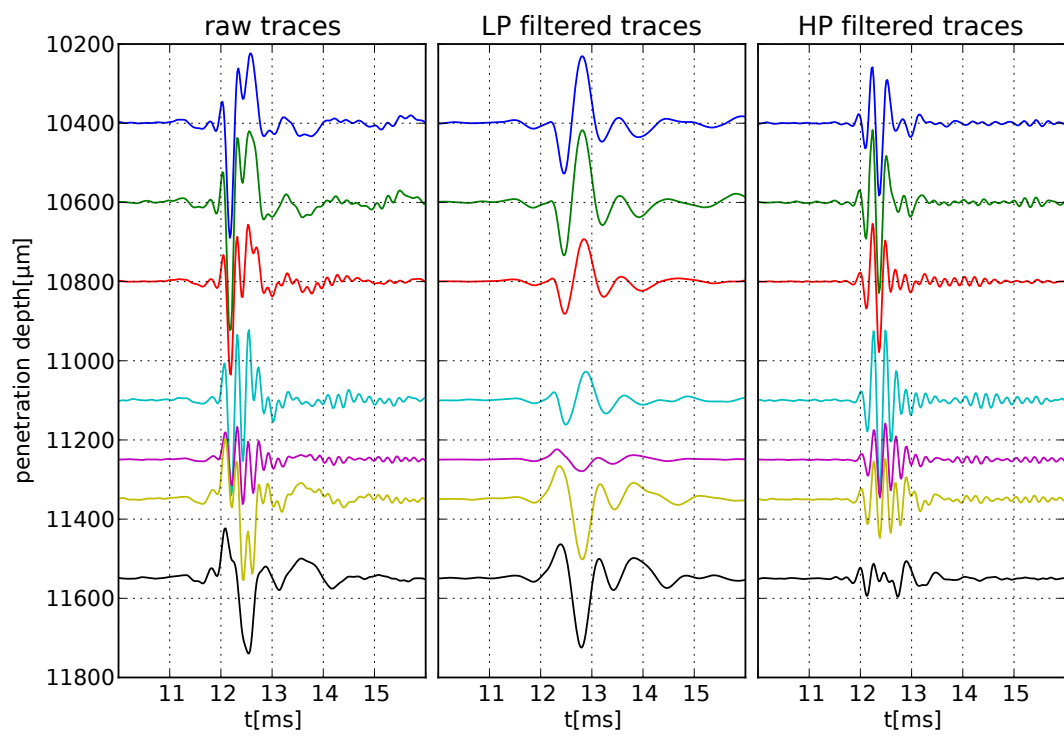


Figure 2:

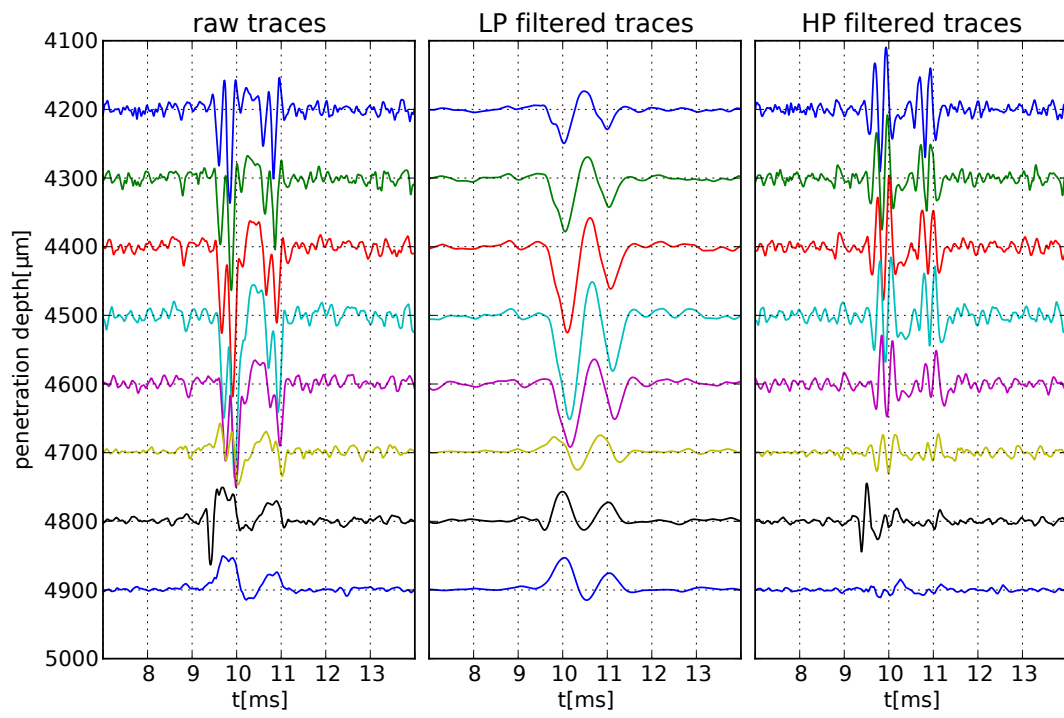


Figure 3:

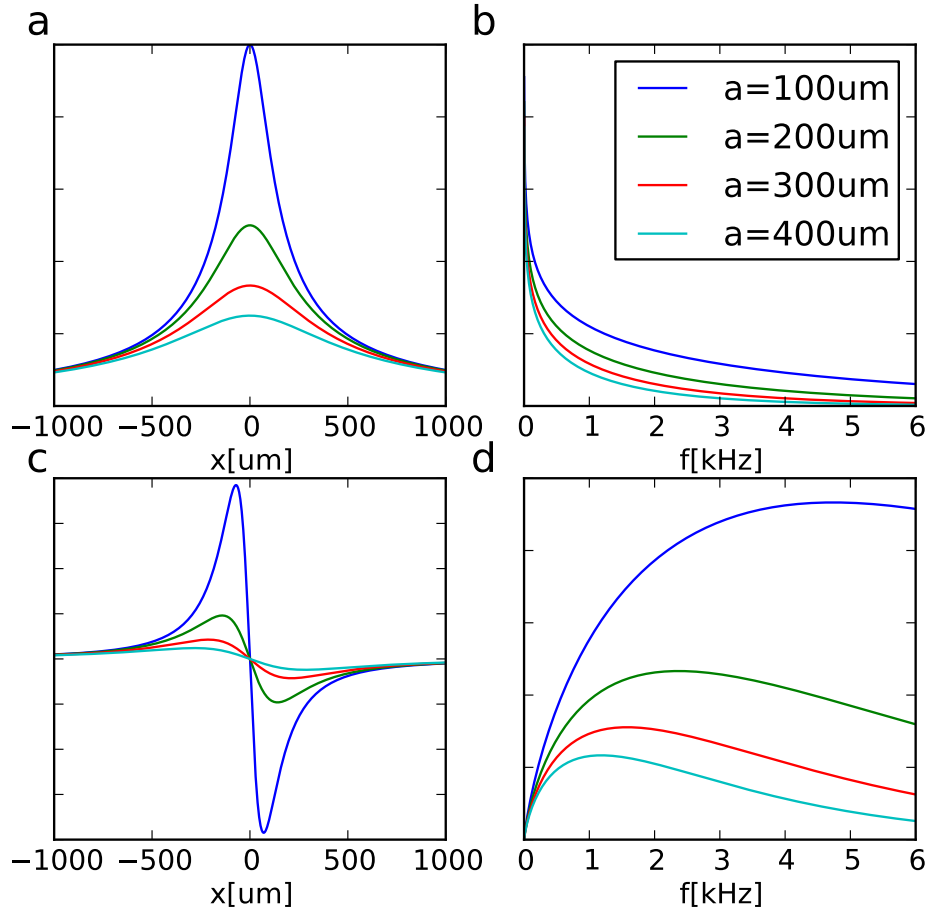


Figure 4: Impulse responses (left column) and frequency responses (right column) of the regular weighting functions w (a-b) and the derivative w' (c-d).

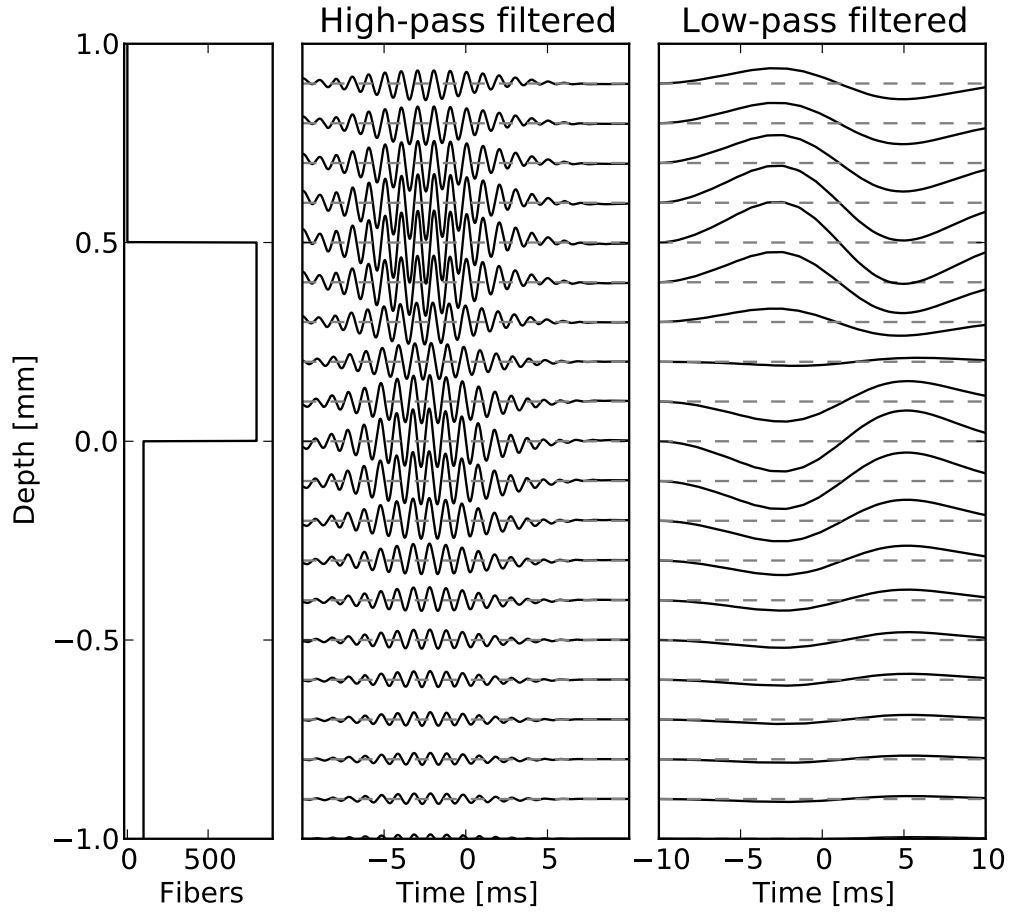


Figure 5: Minimal model of a bifurcating axon bundle. The number of fibers is a piecewise constant function of recording depth, shown on the left hand side. The center and right column show the field potential responses at various depths. The low-frequency component of the response, shown in the right column, shows a characteristic dipole-like behavior. The distance from the bundle was $\rho = 200\mu\text{m}$, and the velocity $v = 5\text{m/s}$.