

Neuroprothetik Exercise 6

Electric Stimulation

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1 Calculate the Potential Field

The potential at a distance r from a current point-source can be calculated by:

$$\Phi = \frac{\rho}{4\pi} \cdot \frac{I}{r}$$

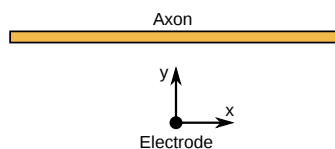
1.1 Potential Field

Using the following parameters, plot the potential field for a $50 \mu m$ by $50 \mu m$ slice in a distance of $10 \mu m$ from the point source.

Parameters
$\rho_{medium} = 300 \Omega cm$ $I = 1 mA$

1.2 Activation Function

Calculate and plot a) the external potential, b) the electric field and c) the activation function along a $50 \mu m$ piece of axon positioned $10 \mu m$ from a current point source. Plot the three graphs for a electrode current of $1 mA$ and for $-1 mA$



2 Create a Neuron Model

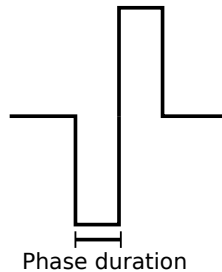
Enhance the model from the last exercise to consider the influence of an external potential. Change the parameters given in the table below.

Parameters		
$\rho_{axon} = 0.01 \text{ k}\Omega\text{cm}$	$r_{axon} = 1.5 \cdot 10^{-4} \text{ cm}$	$l_{comp} = 0.5 \cdot 10^{-4} \text{ cm}$

2.1 Stimulate the Axon

Create the following stimulation sequences and run a simulation with your axon positioned as in section 1.2. Run the simulation for about 30 ms and position your pulse at $t=5 \text{ ms}$

1. Stimulation by a mono-phasic current pulse, phase duration = 1 ms, current = -0.25 mA
2. Stimulation by a mono-phasic current pulse, phase duration = 1 ms, current = -1 mA
3. Stimulation by a bi-phasic current pulse (negative phase first), phase duration = 1 ms, amplitude = 0.5 mA
4. Stimulation by a bi-phasic current pulse (negative phase first), phase duration = 1 ms, amplitude = 2 mA
5. Stimulation by a mono-phasic current pulse, phase duration = 1 ms, current = 0.25 mA
6. Stimulation by a mono-phasic current pulse, phase duration = 1 ms, current = 5 mA



Plot the results and give a short interpretation.