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Dr. Grill

BME 515 – Neural Prosthetic Systems

30 October 2014

Homework Assignment 3

I have adhered to the Duke Community Standard in completing this assignment.

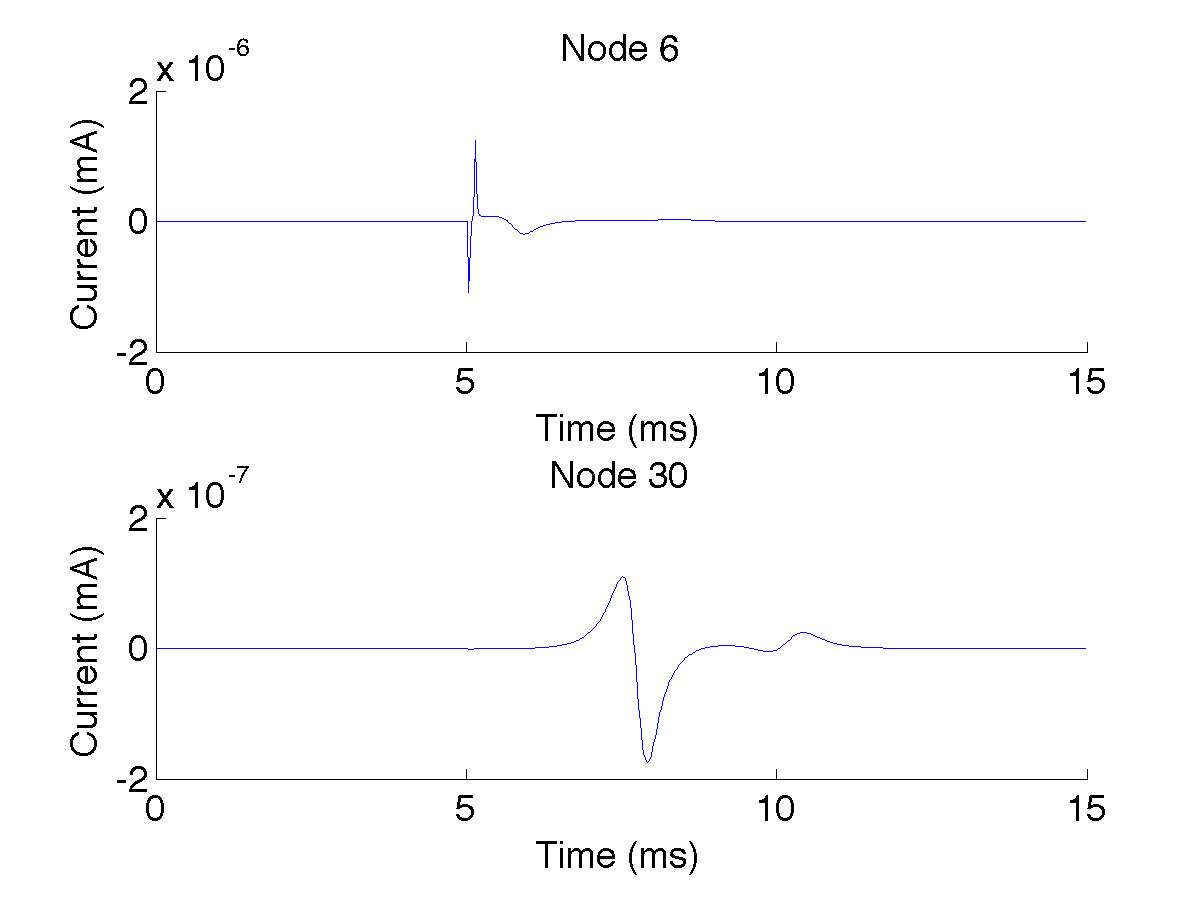
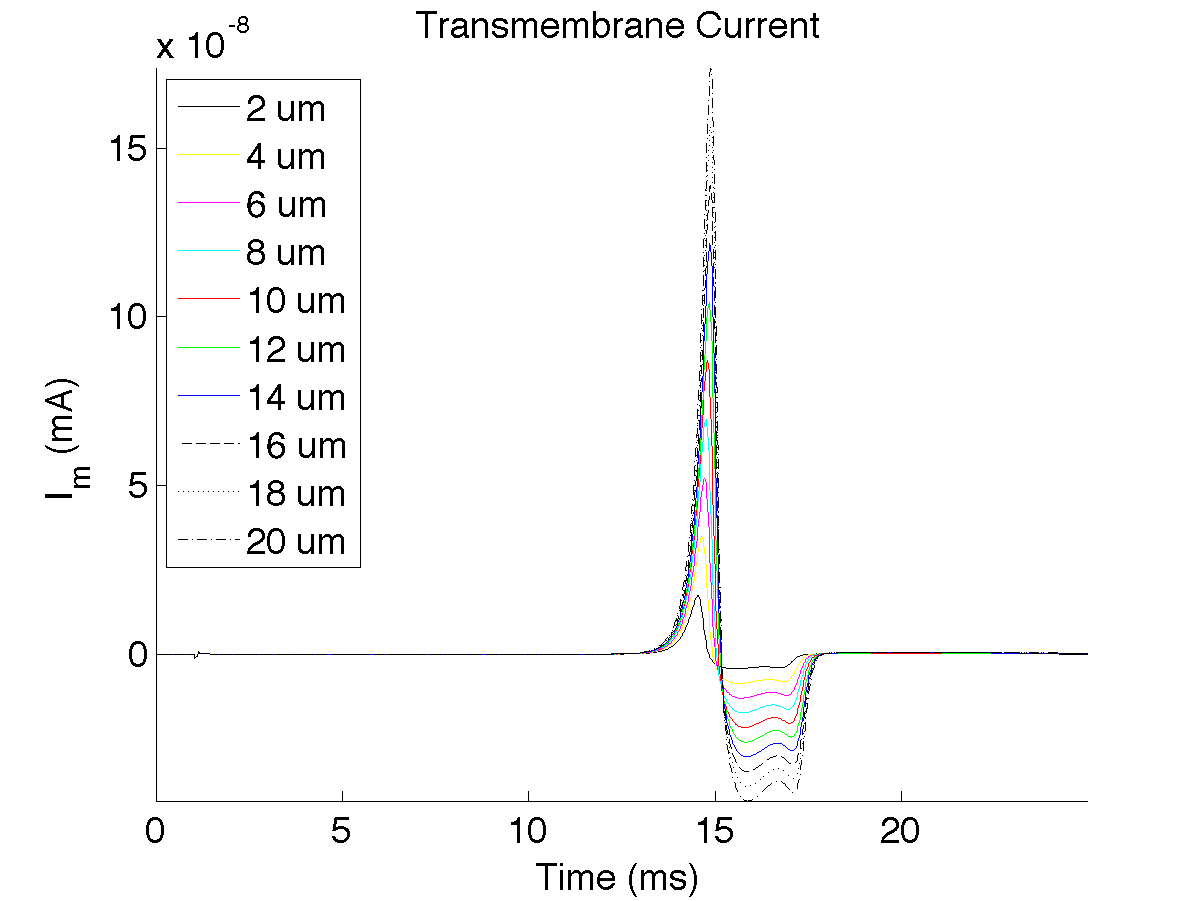
1. The Source: Transmembrane Current during an Action Potential
   1. By recording at a node far away from the point source, the stimulus artifact will likely have decayed due to the distance. 
   2. The total membrane current can be calculated as and was recorded in NEURON using i\_membrane.
   3. 

Figure : Transmembrane Current at Node 150 of 151

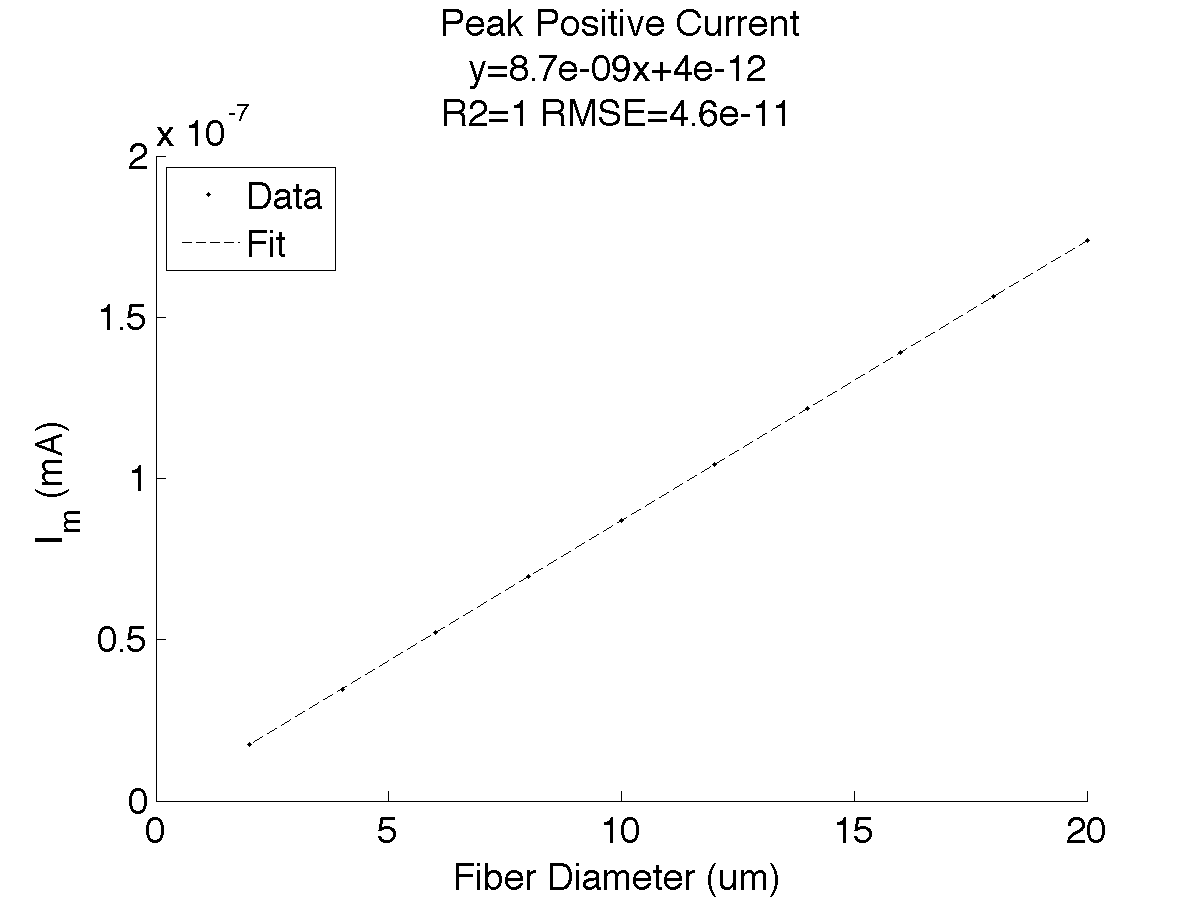
* 1. 

Figure : Peak Positive Current as a function of Fiber Diameter

1. Conduction Speed
   1. Using the network connection object in NEURON, the target is set to nil or a NULLObject that inactivates the NetCon object. However, this is useful for recording the spike train from an output cell. The conduction speed can be calculated by dividing the difference in spike times at two different nodes by the distance between the two nodes.

|  |  |
| --- | --- |
| **Fiber Diameter (um)** | **Conduction Velocity (m/s)** |
| 20 | 23.3650 |
| 18 | 21.1563 |
| 16 | 18.8069 |
| 14 | 16.4575 |
| 12 | 14.1081 |
| 10 | 11.7587 |
| 8 | 9.3530 |
| 6 | 7.0599 |
| 4 | 4.6823 |
| 2 | 2.3330 |

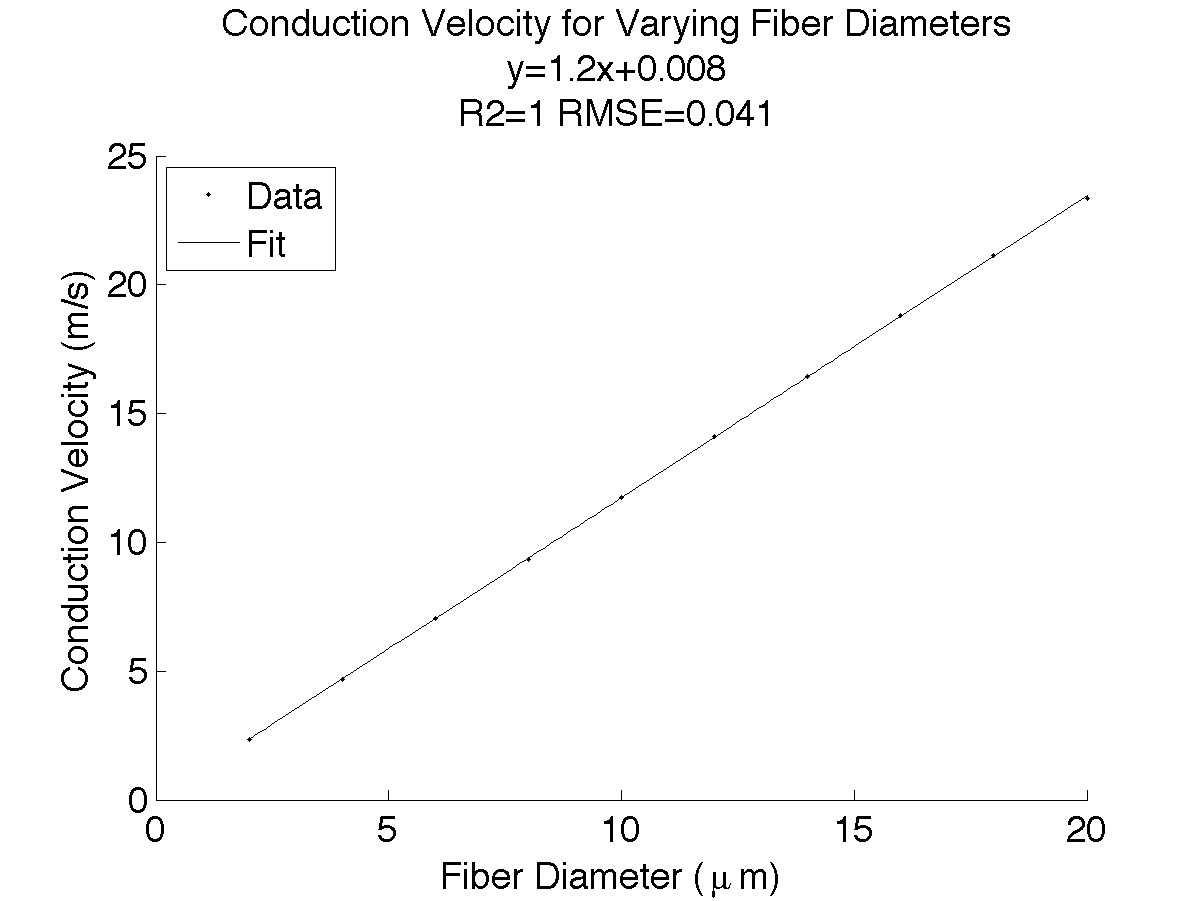
* 1. 

Figure : Conduction Velocity as a function of Fiber Diameter

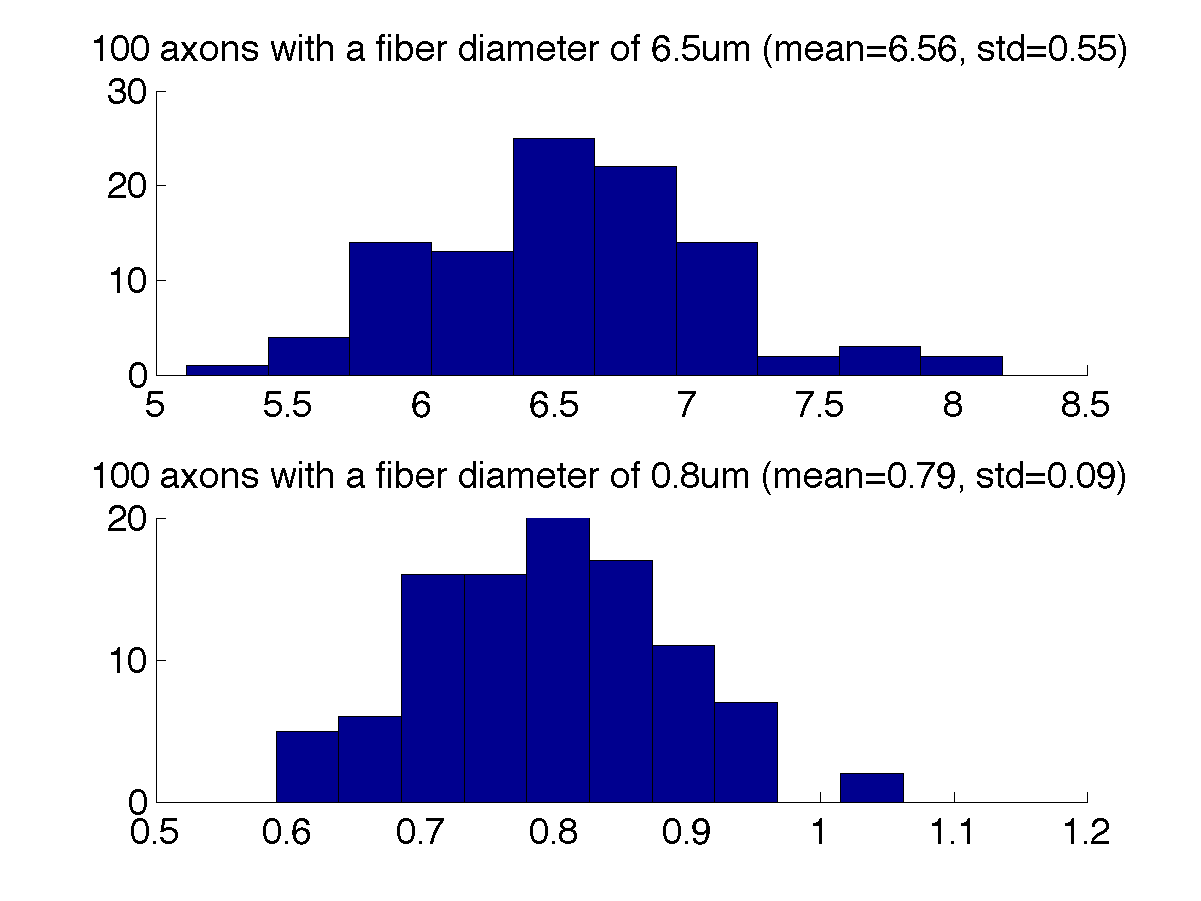
1. Compound Nerve Action Potential (CNAP)
   1. 

Figure : Histogram of Axon Diameters

Population 1 was generated at and . Population 2 was generated at and .

* 1. 1. A larger diameter fiber has a greater peak positive current and a faster conduction velocity.
     2. The potential at a recording electrode can be calculated as for potential , membrane current , extracellular resistivity , and distance from recording electrode to node N.
     3. The net recorded voltage in response to from a given node N and potentials V1, V2, and V3 is .

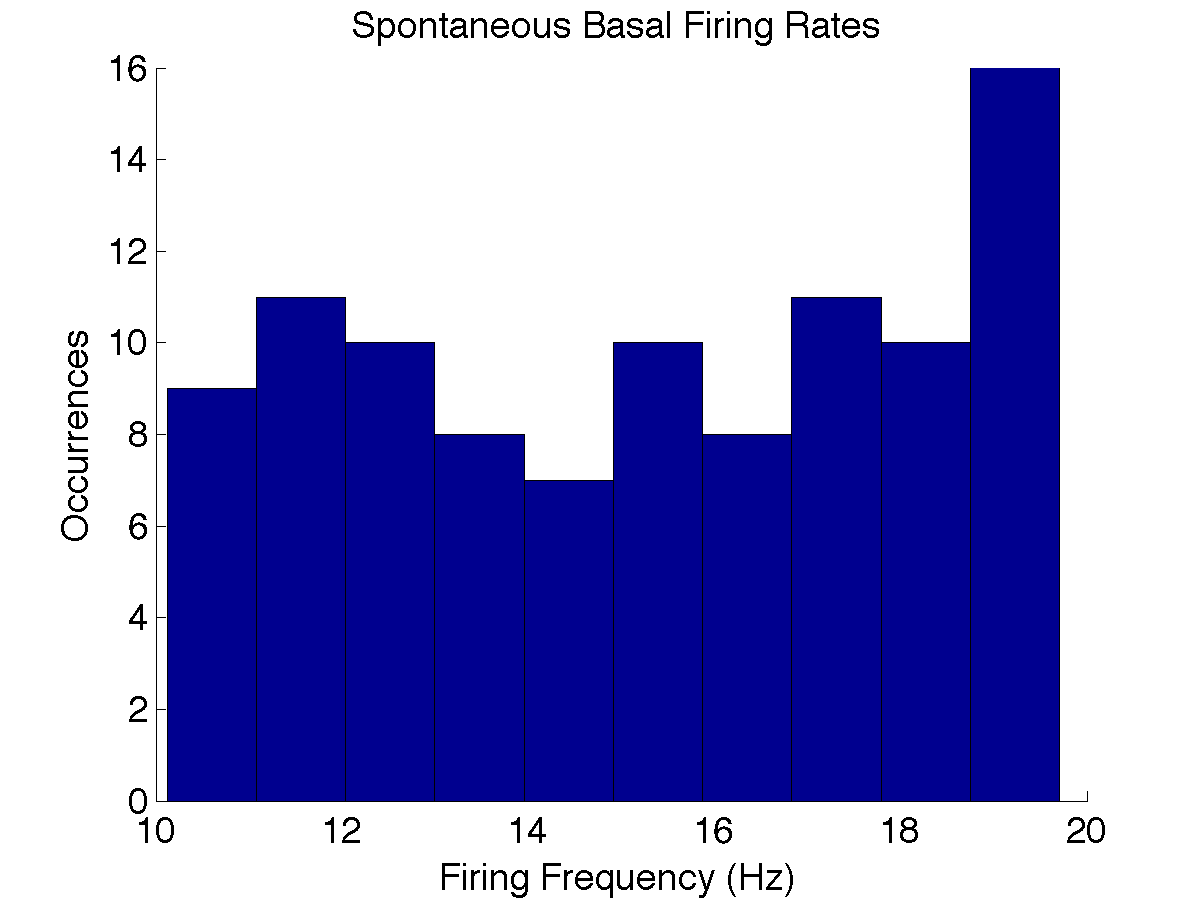
1. Electroneurogram (ENG)
   1. 

Figure : Histogram of Firing Frequencies