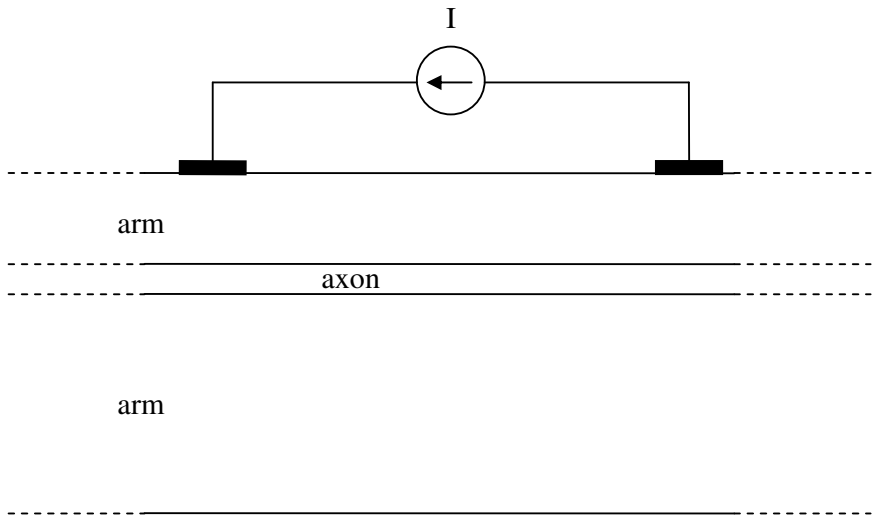
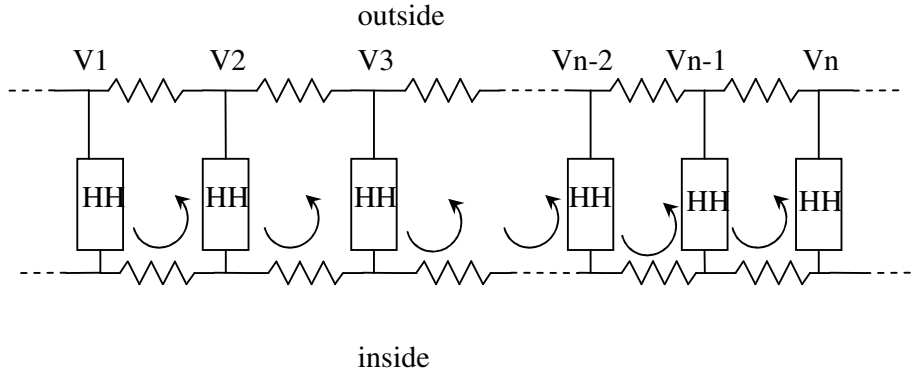
22-10-2007
Generation of an AP by an external Stimulator

As shown below two electrodes are used to apply current to the arm. An axon lies in the arm longitudinally. We can explain, by model based reasoning, how this axon gets excited to generate an AP. We can also determine approximately where the AP starts.



Since the axon is very thin, its presence does not alter the potential field in the arm. Therefore the potential near the point where the current enters the arm is larger than the potential at the point where the current leaves the arm. This can be illustrated in the below figure by V1 > V2 > ... > Vn-1 > Vn where n is the number of HH blocks we can use to discretize the axon lying under the two current electrodes.



Due to V1, V2, ..., Vn, currents are generated which flow inside the axon as shown above. Current which goes through the first section hyperpolarizes the membrane (decreases the membrane potential further), and therefore we cannot get an AP there. In the second section, and also in the sections up to the (n-1) section, currents through the membrane are small because the currents in subsequent loops cancel each other to a large extent. However

the current which goes through the nth section is high and it is also in the direction to depolarize the membrane (increase the membrane potential) there. Therefore the first place to get an AP is the nth section. One can of course make simulations to quantitatively analyze what happens under the experimental setup as described in this problem.