Lecture 5, Problem 2

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Statement How would you design a network to detect an object moving from left to right but not from right to left? Do this two ways: using passive neurons, and using a circuit with active neurons and short-term plasticity.

Using passive neurons

Assuming photosensitive photoneurons, we fix a cable like network in which each neuron is connected to one neuron in *series*. When an object passes over a particular neuron in this network, it fires. The action potential generated by this neuron then travel to both ends of network. We fix an end at which we record in both cases. We assume the the speed of object and the speed at which object is moving does not differ more than a order of magnitude else the network will produce very a signal which might be hard to detect. The network will perform best when the speed of propagation of action potential (in some tens of m/s) and the object is same. We'll elaborate this case.

Assuming that both object and the action potential are travelling at the same speed in the same direction: each time a neuron fires, it adds to the peak of action potential already in cable at the location of neuron therefore making it larger (should add up linearly). On the other hand, when object is moving in the oppositive direction, the travellig pulse and the generated pulse are not conincidental. We should see a train of pulses at the recording site when object is travelling in the other direction. Efficiency of this approch will decline if speed of propagation and speed of object differs more.

Active neurons and short term plasticity

Active neurons will be more sensitive for they produce large pulse for a very small stimulus. Active neuron will make the previous circuit more sensitive. The short term plasticity changes the synaptic weights. If the synaptic connections are only unidirectional ($a \to b$ but not $b \to a$) then the circuit does not change.