**Coincidence Detection Summary**

Dawei Wu

**Coincidence detection underlies integration in CNS neurons**

1. The relative timing, or coincidence, of inputs is critical for neuronal firing.
2. Coincidence detection: Process by which a neuron or a neural circuit can encode information by detecting the simultaneous and distinct input signals.
3. Coincidence detection reduces temporal jitter, reduces spontaneous activity and is critical in forming associations between separate neural events.

**Goal: How can a narrow coincidence detection window be achieved?**

Auditory system neurons are coincidence detection models. These neurons have narrow "coincidence detection windows" (CDWs).

**Find the duration of the CDW for a soma with two subthreshold excitatory inputs.**

CDW = 591.5μsec

**Before moving on, why does the impulse initiate in the soma?**

No dendrites are present to draw current from the soma.

Without a dendritic arbor to provide a capacitive load for the synaptic currents to charge, most of the current crosses the somatic membrane.

Although the axon has far less capacitance to charge than the soma, only a small amount of the synaptic current flows into the axon from the soma because of its small diameter.

Thus the currents can depolarize the soma rapidly enough to cause it to give an impulse before the axon does.

**Simulate an auditory neuron by adding specialized channels to the soma.**

Add Ih and Klva channels; these channels lower the input resistance. The time constant is lowered. The shorter time constant leads to a narrower CDW.

CDW = 341μsec

**Before moving on, observe that the impulse initiates in the axon now.**

The impulse begins in the axon first.  The spike in the soma occus when the EPSP's depolarization has returned almost to baseline. Why is this?

It is now more difficult for the synaptic current to depolarize the soma.}The soma is now "leakier." With the Ih and Klva channels added, the synaptic current flowing into the soma is not able to depolarize the somatic membrane by as much or quickly.

The axonal membrane is easier to charge up than the somatic membrane.

The axon's membrane do not have the new channels; its resistance remains higher than that of the soma. Remember, V = IR so if the resistance of the axon membrane is very high, only a small amount of current is needed to depolarize the axon membrane.

Thus the current flowing into the axon can depolarize the small amount of axonal membrane faster than it can depolarize the large amount of leaky somatic membrane. The axon fires first and the action potential is then back-propagated into the soma.

**Would increasing the temperature narrow the CDW appreciably?**

CDW = 156.3µsec

**Can you further narrow the CDW by decreasing the time to peak of the synaptic conductance?**

CDW is reduced to 11.5µsec.

**Can the CDW be decreased further by decreasing the subthreshold gmax amplitudes? By how much can you narrow the CDW if you reduce the percent by which each gmax is above half-threshold?**

If each gmax is only 5% above half threshold, CDW is lowered to 8µsec.