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Sensory Coding in Oscillatory Peripheral Receptors

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Rhythmical activity have been observed in several types of peripheral sensory receptors, e.g. in senses of hearing, balance and electroreception. We use two examples of spontaneously oscillating peripheral sensory receptors: bullfrog saccular hair cells and electroreceptors of paddlefish, to discuss how oscillations emerge, how these sensors may utilize oscillations to optimize their sensitivity and information processing. In the hair cell system oscillations occur on two very different levels: first, the mechano-sensory hair bundle itself can undergo spontaneous mechanical oscillations and second, self-sustained voltage oscillations across the membrane of the hair cell have been documented. Modelling show that interaction of these two compartment results in enhanced sensitivity to periodic mechanical stimuli. The second example, a single peripheral electroreceptor, is a complex system comprised of several thousands of sensory epithelial cells innervated by a few primary sensory neurons. It embeds two distinct oscillators: one residing in a population of epithelial cells, synaptically coupled to another oscillator residing in a branched myelinated afferent axon. We show how neuronal oscillations emerge in a complex network of excitable nodes. We further demonstrate that epithelial oscillations results in extended serial correlations of neruonal discharges enhancing coding of external stimuli.